

Influence of Technology Use on Numeracy Skills in Early Childhood Learners

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Publication Date: 2025/04/12

Abstract: This study investigates the influence of technology use on numeracy skills in early childhood education, focusing on the perceptions of kindergarten teachers and the relationship between digital tool integration and mathematical development. Data were collected from 100 preschool teachers across diverse educational settings using a descriptive-correlational research design. The study reveals a statistically significant positive correlation between technology use and numeracy skills, with a coefficient of 0.596 ($p = 0.001$), indicating that increased technology use enhances numeracy skills among young learners. The findings suggest that interactive digital tools can maintain learner focus, facilitate engagement, and provide adequate educational resources, aligning with constructivist theories emphasizing active learning and social interaction. Additionally, the study highlights strong foundational numeracy skills among early learners, such as counting accuracy and number recognition, as critical predictors of future academic success. The research underscores the potential of technology to transform early education by providing personalized, engaging learning experiences that support mathematical development.

However, it also emphasizes careful planning and strategic implementation to ensure digital tools complement traditional learning methods. Recommendations include integrating high-quality educational apps into curricula, balancing screen time with other activities, encouraging parental involvement, and ensuring equitable access to digital resources. Further research is suggested to explore the long-term impact of technology on numeracy skills and consider contextual factors such as the home learning environment. By harnessing digital tools, educators can create enriched learning environments that prepare young learners for future academic challenges.

Keywords: *Technology Use, Numeracy Skills, Early Childhood Learners.*

How to Cite: Ju-ann A. Fajardo; Francia A. Lastica; April Rose B. Camral; Rhea Mae C. Sabejon; Jackielyn B. Sernicula; Danica V. Hassan; Jessie S. Acosta. (2025). Influence of Technology Use on Numeracy Skills in Early Childhood Learners. *International Journal of Innovative Science and Research Technology*, 10(4), 104-111. <https://doi.org/10.38124/ijisrt/25apr029>

I. INTRODUCTION

Early childhood education is a pivotal phase in a child's development, setting the stage for future academic success and lifelong learning. Among the essential skills developed during this period, numeracy—the ability to understand and work with numbers—is a critical predictor of later mathematical proficiency and overall academic achievement. As education systems worldwide strive to improve learning outcomes, there is increasing interest in how technology can be harnessed to support the development of numeracy skills in young learners.

Technology integration in early childhood education can be understood through several theoretical lenses. Constructivist theories, such as those proposed by Piaget and Vygotsky, emphasize the importance of active learning and social interaction in cognitive development. Technology, particularly interactive digital tools, can provide engaging platforms for children to explore mathematical concepts actively. Vygotsky's idea of the Zone of Proximal Development (ZPD) is particularly relevant, as technology can offer scaffolding through adaptive learning environments that adjust to a child's

current level of understanding, thus promoting more effective learning experiences.

Numeracy skills are foundational for various academic disciplines and real-world applications. Early numeracy encompasses basic arithmetic, counting, number recognition, and the ability to understand relationships between numbers. Research has consistently shown that early mastery of these skills predicts later academic performance in mathematics and other subjects that require logical reasoning and problem-solving. Therefore, enhancing numeracy skills in early childhood is critical for educators and policymakers.

Over the past decade, advancements in educational technology have transformed the landscape of early childhood education. Digital tools such as tablets, educational apps, and interactive games offer innovative ways to engage young learners. These technologies provide opportunities for personalized learning experiences, allowing children to progress at their own pace and explore mathematical concepts through interactive and engaging mediums. Educational apps often incorporate elements of gamification, which can motivate children to engage with numeracy tasks by making learning fun and rewarding.

The integration of technology in early childhood education offers several potential benefits. Interactive digital tools can provide immediate feedback, helping children to correct mistakes and reinforce learning. This real-time feedback loop is crucial for a deep understanding of numeracy concepts.

Furthermore, technology can facilitate differentiated instruction, catering to young children's diverse needs and learning styles. For instance, adaptive learning software can tailor tasks to a child's current level of understanding, providing neither easy nor complex challenges, thus maintaining engagement and promoting optimal learning.

Despite the potential benefits, integrating technology into early childhood education presents challenges. Concerns about screen time, the quality of educational content, and equitable access to technology are prevalent. It is essential to ensure that digital tools complement traditional learning experiences rather than replace them. Educators and parents must be discerning when selecting high-quality educational apps that align with learning objectives and support holistic development.

Numerous studies have documented positive correlations between technology use and the development of numeracy skills in early childhood. [5] Disney et al. (2019) found that preschool children who engaged with educational apps significantly improved their numeracy scores. Similarly, [11] Miller (2018) emphasized that interactive technologies in play-based environments could foster engagement and skill acquisition among young learners. Despite these positive findings, gaps remain in understanding the specific mechanisms through which technology influences numeracy skills. Many studies fail to isolate the effects of particular types of technology or account for other influencing factors, such as the role of the home learning environment or parental

involvement. Furthermore, there is a need for longitudinal studies to assess the long-term impact of technology use on numeracy skills development.

The home learning environment shapes children's educational experiences and outcomes. A supportive HLE, characterized by activities such as shared reading, numeracy games, and positive attitudes toward learning, can significantly influence children's skill development. Research indicates that children who engage in numeracy-related activities at home tend to perform better in mathematical tasks. Therefore, understanding how the HLE interacts with technology use is essential for developing effective educational strategies.

Parental involvement is another critical factor mediating the relationship between technology use and numeracy skills. Parents' attitudes towards technology and education can shape children's engagement with digital tools. For instance, parents who view technology as a valuable educational resource are likelier to encourage its use for learning. Additionally, parental guidance in educational apps can enhance the learning experience by providing context, support, and reinforcement of concepts.

The classroom environment also influences the effectiveness of technology integration. Educators play a pivotal role in facilitating technology use, guiding children in exploring digital tools, and integrating these tools into the broader curriculum. Professional development and training for educators are essential to ensure that technology is used effectively and aligns with pedagogical goals.

While this study's primary focus is on numeracy skills, it is essential to consider the broader impact of technology on children's holistic development. Digital tools can support the development of other important skills, such as literacy, creativity, and critical thinking. For example, research by [9] Kirova et al. (2018) illustrates how digital platforms can facilitate multiliteracy practices, allowing children to express their understanding through various media. This indicates that technology not only aids in skill acquisition but also promotes creativity and cognitive development.

The findings of this study will have significant implications for educators and policymakers seeking to integrate technology into early childhood education effectively. Recommendations may include guidelines for selecting high-quality educational apps, strategies for balancing screen time with traditional learning experiences, and frameworks for involving parents in technology-based learning. Future research should address the gaps identified in the literature, such as isolating the effects of specific types of technology and exploring the long-term impact of technology use on numeracy skills. Additionally, studies should consider the role of contextual factors, such as the home learning environment and parental involvement, in shaping the effectiveness of technology integration.

Understanding how these tools can best serve learners' developmental needs is crucial as early childhood education continues to evolve in response to technological advancements.

This study aims to fill existing literature gaps by examining technology's role in shaping numeracy skills, considering both direct effects and contextual influences. By providing a comprehensive understanding of these dynamics, the research will create enriching learning experiences that foster essential skills in young children, ultimately preparing them for future academic challenges.

II. OBJECTIVES OF THE STUDY

This study will determine the influence of technology use on numeracy skills in early childhood learners. Precisely, this will aim to:

- Describe the level of influence of technology use on early childhood learners,
- Determine the level of Numeracy Skills in Early Childhood learners and
- Assess the relation between the influence of technology use and numeracy skills in early childhood learners.

III. METHODOLOGY

A. Research Design

This study will employ a quantitative research design using a descriptive-correlational approach. The goal is to assess the relationship between the influence of technology use and numeracy skills in early childhood learners.

B. Research Setting

The research will be conducted in various urban, suburban, and rural educational settings across multiple districts. This variety aims to capture a broad spectrum of Organizational Culture and the Administrative behavior of school leaders.

C. Participants of the Study

The study will involve a random sample of public schools in the Valencia City division. Participants will comprise approximately 100 preschool teachers. Data will be collected through structured surveys to capture diverse perspectives on the influence of administrative behavior and organizational culture on institutional development. This approach ensures a comprehensive analysis of the study's key variables.

D. Sampling Procedure

The study will use a random sampling technique to ensure representation from different school environments. Schools will be categorized based on their environment, and then participants will be randomly selected from each category to ensure proportional representation.

E. Data Gathering Procedure

A structured questionnaire will be developed, consisting of sections on the influence of technology use and numeracy skills. The questionnaire will be pilot-tested with a small group of preschool teachers to ensure clarity and reliability. The finalized questionnaire will be distributed to the selected participants via email or an online survey platform. Participants will be given two weeks to complete the survey. To maximize response rates, reminder emails will be sent to non-respondents one week after the initial distribution.

F. Data Analysis

The data will be analyzed using descriptive statistics to summarize the influence of technology use and the numeracy skills levels. Pearson correlation coefficients will be calculated to determine the relationship between technology use and the numeracy skills of early childhood learners. All data analysis will be performed using statistical software such as SPSS to ensure the accuracy and reliability of the results.

IV. RESULT AND DISCUSSION

The data presented in Table 1 provides a comprehensive overview of the perceptions regarding using technology in learning numeracy skills. With a total mean score of 4.29, the results suggest a consensus that technology is a beneficial tool in this educational context. The highest-rated indicator, with a mean of 4.53, indicates that technology significantly helps learners maintain focus during learning activities, highlighting its potential to enhance engagement. Other indicators, such as the belief in technology as an effective tool for learning numeracy skills (mean of 4.43) and the preference for technology over traditional learning methods (mean of 4.37), further reinforce the positive outlook on digital integration in education.

Table 1. The Influence of Technology Use

INDICATOR	MEAN	QUALITATIVE DESCRIPTION
Technology helps the learners stay focused during learning activities.	4.53	Mostly True
I believe technology is an effective tool for learning numeracy skills.	4.43	True
Parental involvement in technology use enhances learners' learning.	4.40	True
The learners prefer using technology over traditional learning methods.	4.37	True
I am satisfied with the role of technology in my learner's education.	4.37	True
Technology use has increased the learner's interest in learning.	4.36	True

INDICATOR	MEAN	QUALITATIVE DESCRIPTION
The learners learn new concepts faster using technology.	4.30	True
Educational apps are a regular part of my child's learning routine.	4.27	True
The learners use technology to solve numeracy-related problems.	4.03	True
The learners frequently use digital devices for educational purposes.	3.83	True
Total Mean	4.29	True

Legend:

4.51- 5.00	Strongly Agree	Mostly true
3.51- 4.50	Agree	True
2.51- 3.50	Neutral	Somewhat true
1.51- 2.50	Disagree	Untrue
1.00- 1.50	Strongly Disagree	Mostly Untrue

Parental involvement in technology use also received a favorable rating, with a mean score of 4.40, indicating that parents' active participation can enhance learners' educational experiences. Additionally, technology's role in increasing learners' interest in learning and facilitating faster understanding of new concepts is viewed positively, with mean scores of 4.36 and 4.30, respectively.

The findings suggest a substantial perceived benefit of using technology in learning numeracy skills. The consistent "True" ratings across most indicators reflect a positive outlook on integrating digital tools into educational practices. These perceptions stem from technology's interactive and engaging nature, which can cater to diverse learning styles and provide immediate feedback.

Reference [13] Smith & Jones (2022) found that technology integration in classrooms improves student engagement and focus, aligning with the results showing technology's role in keeping learners focused. Research by [4] Brown et al. (2021) supports the view that technology can enhance learning outcomes by providing interactive and adaptive learning experiences, particularly in numeracy. Additionally, [7] Johnson & Lee (2020) emphasize the importance of parental involvement in digital learning

environments, reinforcing the positive impact seen in this study. Furthermore, [14] Williams & Taylor (2023) discuss the growing preference among students for technology-based learning over traditional methods, consistent with the findings of this analysis. These studies provide a broader context for understanding the positive perceptions of technology use in learning numeracy skills, supporting the notion that technology can play a transformative role in education.

Table 2, which focuses on numeracy skills, reveals a comprehensive picture of learners' mathematical abilities and engagement with numeracy tasks. The mean scores for various indicators provide insights into numeracy skills development's foundational and advanced aspects.

Table 2 provides a detailed evaluation of learners' numeracy skills, highlighting various aspects of their mathematical development. The overall mean score of 4.40 suggests that, generally, respondents agree that learners possess strong numeracy skills. The highest-rated indicators, with a mean of 4.53, indicate that learners can easily count objects and recognize numbers, which fall under the "Mostly True" category. These skills are fundamental to numeracy and suggest a solid foundational understanding.

Table 2. Numeracy Skills

Indicator	Mean	Qualitative Interpretation
The learners can count objects accurately.	4.53	Mostly True
The learners recognize numbers with ease.	4.53	Mostly True
The learners can perform essential addition and subtraction.	4.50	True
Numeracy activities are enjoyable for the learners.	4.47	True
The learners apply numeracy skills in everyday situations.	4.47	True

Indicator	Mean	Qualitative Interpretation
The learners understand the concept of more than and less than.	4.37	True
The learners can identify patterns and sequences in numbers.	4.33	True
The learners show improvement in numeracy skills over time.	4.33	True
I am satisfied with my learner's numeracy development.	4.33	True
The learner is confident in solving numeracy tasks independently.	4.13	True
Total Mean	4.40	True

Legend:

4.51- 5.00	Strongly Agree	Mostly True
3.51- 4.50	Agree	True
2.51- 3.50	Neutral	Somewhat True
1.51- 2.50	Disagree	Untrue
1.00- 1.50	Strongly Disagree	Mostly Untrue

Starting with essential arithmetic operations, the ability to perform addition and subtraction is fundamental to numeracy. The mean score of 4.50, falling under the "True" category, indicates that learners are generally proficient in these basic operations. Mastery of addition and subtraction is crucial as it forms the basis for understanding more complex mathematical concepts, such as multiplication and division. The proficiency in these operations suggests that learners have a solid grasp of fundamental numeracy, which is essential for their progression in mathematics.

Another critical aspect highlighted by the data is the enjoyment of numeracy activities, which received a mean score of 4.47. Enjoyment is a significant factor in learning, as it can influence motivation and engagement. Learners who find numeracy activities enjoyable are likelier to participate actively and persist through challenges. This positive engagement can lead to a deeper understanding and retention of mathematical concepts. Enjoyment in numeracy activities also suggests that the learning environment is supportive and that the activities are appropriately challenging and engaging.

The ability to apply numeracy skills in everyday situations, also rated at 4.47, underscores the practical application of these skills. This aspect is crucial for developing problem-solving abilities that extend beyond the classroom. When learners can apply their numeracy skills to real-world situations, it indicates that they understand the relevance and importance of mathematics in daily life. This practical application is a key goal of numeracy education, as it prepares learners to use their mathematical knowledge in various contexts, such as managing finances, measuring ingredients in recipes, or calculating distances and time.

Further data analysis highlights learners' understanding of more complex numeracy concepts. For instance, the ability to understand more than and less than, with a mean score of 4.37,

suggests that learners can compare and evaluate quantities, a foundational algebraic thinking skill. Similarly, the ability to identify patterns and sequences in numbers, with a mean score of 4.33, indicates learners' capacity to recognize relationships and structures within mathematics. Recognizing patterns is essential for understanding mathematical concepts and developing logical reasoning and critical thinking skills.

The data also reflects a strong overall numeracy development trajectory among learners. Indicators such as consistent improvement over time, satisfaction with numeracy development, and confidence in solving tasks independently, all with mean scores above 4.13, point to a positive trend in learners' mathematical growth. An improvement over time suggests that learners build on their existing knowledge and skills, which are essential for continuous learning and development. Satisfaction with numeracy development indicates that learners, educators, and possibly parents are pleased with the progress, which can foster a supportive learning environment. Confidence in solving tasks independently is crucial for developing autonomy and self-efficacy in learning.

The literature aligns with these findings, emphasizing the importance of foundational skills, engagement, and practical application in numeracy education. [1] Anderson & Miller (2022) highlight the role of foundational skills such as addition and subtraction in building more advanced mathematical abilities. [8] Johnson et al. (2021) discuss the impact of engaging in numeracy activities on learners' motivation and enjoyment, which is reflected in the favorable ratings for enjoyment in the data. [3] Brown & Taylor (2023) emphasize the significance of applying numeracy skills in real-world contexts, supporting the findings that learners can use these skills practically.

➤ *Relationship between Technology Use and Numeracy Skills.*

Pearson Product-Moment was used to assess the degree of relationship between the continuous variables explored. Pearson (r) was mainly run to determine the relationship between the dependent variable, the Numeracy skills of early childhood, and the independent variable, technology use.

Table 3 presents the correlation analysis between technology use as an independent variable and the numeracy skills of early childhood learners. The analysis reveals a correlation coefficient (r) of 0.596, with a probability (p) value of 0.001, indicating a statistically significant positive correlation at the 0.01 level (2-tailed test). This suggests a moderate to strong relationship between the use of technology and the development of numeracy skills among young learners, based on the sample size of 100 participants.

Table 3. Correlation Analysis Technology Use and Numeracy Skills

INDICATORS	CORRELATION COEFFICIENT (r)	PROBABILITY (p)
Technology Use	.596(**)	.001
Numeracy Skills	.596(**)	.001

** Correlation is significant at the 0.01 level (2-tailed).

b. listwise N=100

The positive correlation coefficient of 0.596 indicates that as technology use increases, there is a corresponding improvement in numeracy skills among early childhood learners. This relationship is statistically significant, as evidenced by the p-value of 0.001, well below the conventional threshold of 0.01. Such a considerable correlation underscores the potential impact of technology as a tool for enhancing numeracy skills in early education.

The findings align with existing literature emphasizing the role of technology in educational contexts. [10] Li and Ma (2022) highlight that digital tools and educational apps can provide interactive and engaging learning experiences, which are particularly beneficial for young learners. These tools often incorporate elements of gamification, such as rewards and challenges, which can enhance motivation and engagement, leading to improved learning outcomes. The interactive nature of technology allows learners to receive immediate feedback, facilitating quicker understanding and retention of numeracy concepts.

Technology can cater to various learning styles and paces, providing personalized learning experiences that traditional methods may not offer. This adaptability is crucial in early childhood education, where learners have diverse needs and abilities. By leveraging technology, educators can offer differentiated instruction that meets individual learners' needs, supporting their numeracy development more effectively.

Additionally, the integration of technology in early education can promote self-directed learning. As young learners interact with digital tools, they can explore numeracy concepts independently, fostering a sense of autonomy and confidence in their abilities. Research by [12] Papadakis et al. (2023) supports this notion, suggesting that technology-enhanced learning environments encourage exploration and self-discovery, which are vital for early childhood cognitive development.

Moreover, technology in education can bridge the gap between home and school learning environments. With the widespread availability of digital devices, learners can continue to engage in numeracy activities outside the classroom,

reinforcing their skills through consistent practice. This seamless integration of learning experiences across different settings can contribute to more robust numeracy skill development.

However, it is essential to consider the quality and context of technology use. While the correlation is positive, the efficacy of technology in enhancing numeracy skills depends on how it is implemented. Educators must ensure that digital tools are age-appropriate, educationally sound, and aligned with curricular goals. Effective technology integration requires careful planning and consideration of pedagogical strategies to maximize its benefits.

The correlation analysis presented in Table 3 highlights the significant positive relationship between technology use and numeracy skills in early childhood learners. This relationship is supported by literature emphasizing the benefits of interactive, personalized, and engaging learning experiences facilitated by technology. As education continues to evolve in the digital age, integrating technology into early childhood education holds promise for enhancing numeracy skills, provided it is implemented thoughtfully and strategically. By harnessing the potential of technology, educators can create enriched learning environments that support young learners' mathematical development and prepare them for future academic success.

V. CONCLUSION

The study's findings reveal the profound impact of technology on the development of numeracy skills in early childhood learners. By examining kindergarten teachers' perceptions and analyzing the relationship between technology use and numeracy skills, this research provides valuable insights into the role of digital tools in education. The positive correlation identified suggests that technology can significantly enhance young learners' mathematical abilities when implemented effectively. Data from Table 1 indicates that educators perceive technology as a beneficial tool for learning, with high ratings for its ability to maintain focus, facilitate engagement, and serve as a practical educational resource. These perceptions align with constructivist theories, such as

those of Piaget and Vygotsky, emphasizing active learning and social interaction in cognitive development. Technology, particularly interactive digital tools, can provide engaging platforms for children to explore mathematical concepts actively, offering scaffolding through adaptive learning environments that adjust to a child's current level of understanding.

Table 2 highlights strong numeracy skills among early childhood learners, with high ratings for counting accuracy, number recognition, and applying skills in everyday situations. These findings underscore the importance of foundational numeracy skills as predictors of future academic success. The positive engagement and enjoyment in numeracy activities further emphasize the significance of creating supportive learning environments that encourage exploration and persistence through challenges. The correlation analysis in Table 3 underscores the potential of technology as a transformative tool in early education. The statistically significant positive relationship between technology use and numeracy skills highlights the benefits of interactive, personalized, and engaging learning experiences facilitated by digital tools. These findings align with existing literature emphasizing the role of technology in providing opportunities for customized learning, promoting self-directed exploration, and bridging the gap between home and school learning environments.

However, the study also highlights the importance of careful planning and strategic implementation of technology in education. The efficacy of digital tools depends on their alignment with curricular goals, age-appropriateness, and educational soundness. Educators must ensure that technology complements traditional learning experiences rather than replacing them, fostering a balanced approach to learning that supports holistic development. In conclusion, this study demonstrates the significant positive impact of technology on numeracy skills in early childhood learners. By harnessing the potential of digital tools, educators can create enriched learning environments that support mathematical development and prepare young learners for future academic challenges. The findings provide a foundation for further research and exploration into the effective use of technology in educational settings, ultimately contributing to advancing teaching and learning practices.

RECOMMENDATIONS

Based on the findings of this study, several recommendations are proposed to enhance the integration of technology in early childhood education and maximize its benefits for numeracy skills development.

Firstly, educators should strategically integrate technology into the curriculum, ensuring that digital tools are age-appropriate, educationally sound, and aligned with learning objectives. This involves selecting high-quality educational apps and interactive games that support numeracy development and complement traditional teaching methods. Professional development programs should be provided to

equip educators with the necessary skills to incorporate technology into their teaching practices effectively.

While technology offers numerous benefits, balancing screen time with other forms of learning and play is crucial. Educators and parents should ensure that children engage in activities that promote physical, social, and cognitive development. Guidelines should be established to manage screen time and ensure that digital tools are used purposefully to enhance learning experiences. Encouraging parental involvement in technology-based learning can significantly improve children's numeracy skills.

Parents should be informed about the benefits of educational apps and games and how they can support their children's learning at home. Creating a supportive home learning environment that includes numeracy-related activities can reinforce concepts learned at school and promote a positive attitude toward mathematics.

Policymakers and educational institutions should work toward providing equitable access to digital resources for all learners. This includes addressing disparities in access to technology and ensuring that all children can benefit from digital tools that support numeracy development. Targeted interventions may be necessary to bridge gaps in numeracy skills among disadvantaged populations.

Further research is needed to explore the long-term impact of technology use on numeracy skills development. Longitudinal studies can provide valuable insights into how digital tools influence mathematical abilities over time and identify the mechanisms through which technology enhances learning outcomes. Additionally, research should consider the role of contextual factors, such as the home learning environment and parental involvement, in shaping the effectiveness of technology integration.

While this study focuses on numeracy skills, it is essential to consider the broader impact of technology on children's holistic development. Digital tools can support the development of other important skills, such as literacy, creativity, and critical thinking. Educators should aim to create a balanced and integrated approach to education that fosters the whole child's development.

By implementing these recommendations, educators, policymakers, and stakeholders can enhance technology integration in early childhood education, supporting the development of numeracy skills and preparing young learners for future academic success. The study's findings underscore the potential of digital tools to transform educational practices and create enriching learning experiences that foster essential skills in young children.

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