ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 11| Issue: 9| September 2025|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2025: 8.691 || ISI Value: 1.188

INTEGRATING DIGITAL TOOLS FOR EFFECTIVE LITERACY AND NUMERACY INSTRUCTIONS IN EARLY CHILDHOOD EDUCATION

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ABSTRACT
This study examined the extent and effectiveness of integrating digital tools into early reading and numeracy instruction for kindergarten pupils at selected public schools within the Division of Quezon Province. In the 21st century, digital tools, including interactive applications, educational games, and multimedia materials, have become essential for enhancing engagement, facilitating differentiated learning, and developing foundational skills. The study, informed by the Technological Pedagogical Content Knowledge (TPACK) Framework and Constructivist Learning Theory, aimed to determine the demographic characteristics of teachers, the degree of digital tool integration, and its effectiveness in literacy and numeracy outcomes, as well as the correlation between integration and effectiveness. Employing a descriptive-quantitative methodology, data were collected from kindergarten educators via a validated researcher-developed questionnaire. The findings indicated that most teachers were in the middle of their careers, held sufficient academic credentials, and had received some training in digital integration. Digital tools were frequently utilized and proved effective for learning new words, recognizing existing words, performing basic math calculations, and identifying numbers. However, they did not work as well for learning phonemic awareness and letter-sound recognition. There were significant differences in integration when teachers were classified by profile, but no strong link was found between the level of student integration and the effectiveness of literacy instruction. The study suggests that although teachers appreciate digital technologies, their effectiveness is contingent upon strategic implementation, teacher expertise, and the availability of high-quality materials, rather than merely the frequency of usage. To ensure that digital teaching skills align with specific learning goals for developing early literacy and numeracy, an intervention program focusing on mentoring, specialist training, and resource development is recommended.

KEYWORDS: *Basic Operations, Counting, Frequency of Using Digital Tool in the Classroom, Instructional Strategies Employed, Integrating Digital Tools*

I. INTRODUCTION

In the 21st century, digital technology has become a crucial tool in education, particularly in early childhood education (ECE). This includes interactive software, digital games, and e-books. When used effectively, these tools can enhance early literacy and numeracy learning experiences by engaging children, providing customized instruction, and supporting young learners in mastering fundamental skills. However, educators face challenges in integrating these technologies with efficient instructional strategies due to limited access to reliable content, outdated software, inadequate internet connectivity, insufficient administrative support, and lack of training.

ICT technologies are essential components of the contemporary computerized society, and children must develop ICT skills for future endeavors. Despite initiatives to incorporate these skills into primary and secondary curricula, the application of these skills continues to pose challenges due to developmental considerations.

In the Philippines, the Department of Education is urging the implementation of technology-mediated learning strategies, particularly in early education, as part of national initiatives such as the MATATAG curriculum changes and the Basic Education Development Plan (BEDP) 2030. Despite the nascent stage of technology integration in kindergarten classrooms, numerous educators are increasingly employing multimedia, educational applications, and interactive platforms for classroom instruction.

The successful integration of technology in classrooms depends on strategic planning, teacher training, and resolving ethical and data privacy issues to ensure a safe and secure educational environment. By emphasizing teacher training in technological competencies and pedagogical methods, schools can harness the potential of technology to foster engaging classrooms that empower students.

This study uses the Technological Pedagogical Content Knowledge (TPACK) Framework to analyze the effectiveness of digital tools in enhancing reading and numeracy among kindergarten students. The framework consists of three components: Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK). The study is grounded in Constructivist Learning Theory, particularly Piaget's Active Learning theory, which suggests children acquire knowledge through experiential engagement and social interaction. The theory supports the incorporation of phonics games, interactive mathematical narratives, and digital manipulatives in early childhood education. The study demonstrates the beneficial impact of digital technologies on young learners' conceptual comprehension. The integration of these theories provides an objective exploration of the use of digital resources in early childhood education.

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This study uses the Input-Process-Output (IPO) Model to determine the primary purpose of integrating digital resources in early childhood education. It focuses on demographics, digital tools, and their effectiveness in teaching literacy and numeracy. The study includes questionnaire formulation, validation, pilot testing, data collection, and analysis. The proposed intervention program aims to improve teachers' digital literacy.

The study examined the use of digital tools in early numeracy and literacy training for kindergarten students in Quezon, Philippines. It used a descriptive quantitative methodology and a questionnaire to assess the effectiveness of digital tools in teaching these skills. The study found that the use of digital tools limited the impact of phonemic awareness, letter-sound recognition, vocabulary development, and word recognition, while the effectiveness of digital tools in teaching numeracy was limited.

This study highlights the importance of digital tools in early childhood education, guiding teachers, school heads, policymakers, parents, and guardians in designing practical learning activities and strategies. It also provides insights into the role of digital tools in literacy and numeracy development, and contributes to the existing knowledge on educational technology, guiding future researchers in creating digital-based interventions.

1.1 Statement of the Problem

The purpose of this study is to determine the extent of integrating digital tools for effective instruction on literacy and numeracy of kindergarten pupils as foundational skills in early childhood education.

Specifically, it seeks answers to the following sub-problems:

1. What is the demographic profile of the respondents in terms of:
    1.1. age;
    1.2. highest educational attainment;
    1.3. years in teaching; and
    1.4. training in digital tool integration?
2. What is the extent of integrating digital tools in early childhood education in terms of:
    2.1. types of digital tools used;
    2.2. frequency of using digital tools in the classroom;
    2.3. instructional strategies employed;
    2.4. teacher's digital literacy; and
    2.5. learning engagement?
3. What is the level of effectiveness of integrating digital tools in teaching early literacy among kindergarten pupils in terms of:
    3.1. phonemic awareness;
    3.2. letter-sound recognition;
    3.3. vocabulary development; and
    3.4. word recognition?
4. What is the level of effectiveness of integrating digital tools in teaching early numeracy among kindergarten pupils in terms of:
    4.1. number recognition;
    4.2. countings;
    4.3. basic operations; and
    4.4. problem solving?
5. Is there a significant difference on the extent of integrating digital tools in early childhood education when grouped according to the respondents' profile?
6. Are there significant relationships between the extent of digital tool integration in early childhood education and the level of effectiveness of digital tools integration in teaching early literacy and numeracy of kindergarten pupils?
7. What intervention program on integrating digital tools may be proposed based on the results of the study?

2. REVIEW OF RELATED LITERATURE

According to Palaiologou (2020), a body of research is emerging on the perspectives of early childhood education instructors on incorporating digital technologies into their practices. Despite evidence of digitalization of households in rich nations and children's interactions in highly mediated digital environments, few teachers have successfully integrated digital gadgets into play-based pedagogy. Thus, this project sought to investigate teachers' attitudes and aptitudes toward digital gadgets in their personal and professional lives in five nations (England, Luxembourg, Malta, Greece, and Kuwait). An online survey was used to obtain broad-scale data, followed by focus group interviews. The findings revealed that, while instructors are digitally adept in their personal lives, a prevailing ideology about the nature of play-based education impedes the incorporation of digital devices into their practice. According to Ogegbo and Aina (2020), while technology plays a vital role in the development and learning of young children, early childhood development (ECD) practitioners are frequently underinformed and lack confidence in using information and communications technology (ICT). Teachers acknowledged the benefits of incorporating technology into early childhood education and had a positive attitude toward the use of ICT in early childhood teaching and learning. However, these teachers' acceptance of ICT use appears to be low due to barriers such as poor parental and school support for technology use, a lack of technological resources, teachers' limited knowledge, and a lack of practical training in the use of developmentally appropriate technology for children, as claimed by the teachers. Despite this positive opinion and attitude toward utilizing ICT to enhance playful learning and child development in young children outside the classroom, instructors are less motivated to incorporate ICT into their teaching and classroom play activities.

According to Rahiem (2021), digital storytelling combines the traditional art of storytelling with a range of modern tools to weave stories together with the author's narrative voice, including digital images, graphics, music, and sound. Digital storytelling, as a teaching tool and learning resource, has been utilized in various creative ways across all levels of education. Digital storytelling promotes student learning and enables teachers to implement innovative and enhanced teaching approaches. Storytelling is a tried-and-true pedagogy, although digital storytelling is newer and less commonly used in early childhood education settings. The findings reveal that teachers in this group utilized digital storytelling for a range of significant reasons. They said that using simple digital technology made storytelling more enjoyable, fascinating, engaging, conversational, and theatrical. This study suggests

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that teachers' ability to use digital technology should be improved; schools' information and communication technology (ICT) devices should be equipped; some government funding should be allocated to modernize school equipment; and the curriculum should be tailored to meet technological developments, as well as provide opportunities for children to learn how to use technology effectively.

As stated by Aina (2023), numerous studies focus on the benefits and components of high-quality early childhood education, but few to none focus on how digital tools are used to support their teaching and administrative duties. This study investigated the provision of quality education using technological tools at the selected ECD centers. Activity theory is used to understand better the technology tools and how they support and provide adequate education at participating centers. The findings suggest that participants believe digital tools will support center principals and instructors in their administrative responsibilities and teaching and learning processes, even though many participants lack the necessary tools and expertise to utilize technology effectively. For example, some participants stated that they are unable to use digital applications to engage students, keep accounting records, or communicate with parents. The study promotes awareness and adherence to quality early childhood education by recommending that ECD centres, principals, and teachers receive appropriate and practical training on developing mechanisms for the use of technology to improve the provision of quality education. The report suggests conducting additional empirical research on the digitization of administrative and teaching duties for ECD centre principals and teachers.

According to Naeem et al. (2024), various digital tools have been developed in response to new technologies, and they now play a significant role in teaching this skill to children. The goal of this study is to present a systematic evaluation and qualitative analysis of the literature on digital intervention content that targets phonological awareness. The assessment is based on how the tools genuinely enhanced phonological capabilities, balanced engagement/enthusiasm, and the overall educational value. The results show that digital tools with interactive components, quick feedback, and adaptable learning pathways improve these skills. Furthermore, they reach all sorts of learners (reading, visual, and aural) – literacy may be learned and experienced in a way that is both convenient and welcoming to all. This is particularly critical in the contemporary context, where digital technology has taken center stage as a facilitator of all forms of language acquisition. Thus, this study will provide educators with essential insights on how to utilize such tools in their classrooms. Furthermore, it emphasizes the importance of future research into the use of digital tools in early literacy development.

De Vera and Casingal (2025) used the CVC 3-Letter Words and Phonics app to improve reading skills in kindergarten students. The study was conducted at Nalsian Elementary School in Bayambang, Pangasinan, Philippines, and employed a pretest-posttest quasi-experimental design. The study found that interactive applications significantly improved learners' reading skills ($Z = -4.019$, $p < 0.001$). Before the intervention, 81% of learners were rated as "full refresher," but after the intervention, 81% were deemed "grade ready." The increase in reading levels was not significantly associated with learners' demographic and home environment variables, indicating that interactive applications can benefit all learners regardless of gender, the availability of reading materials at home, parents' educational attainment, internet connection status, or the presence of household electronic gadgets. The increase in reading levels was not substantially associated with learner profile characteristics, indicating that interactive applications can help all learners, regardless of background. The mean score increased from 8.81 (SD=4.96) before intervention to 18.57 (SD=2.68) after intervention. Interactive apps provide compelling, multimodal experiences. The study's shortcomings include a limited sample size and the utilization of an entire class from a single institution. Future studies should explicitly declare in the abstract that control groups and larger sample sizes will be used to test the efficacy of interactive applications in increasing reading abilities among young learners. The findings can inform the design and implementation of reading programs that utilize mobile applications to support the success of kindergarten students.

Korosidou (2024) provides more evidence in the form of an experimental study demonstrating that augmented reality (AR) applications greatly raised motivation and improved alphabet and vocabulary acquisition among very young learners. Taken together, these research highlight the fact that digital tools—whether interactive applications, gamified platforms, or augmented reality environments—provide substantial benefits for literacy development. However, their effectiveness is dependent on intelligent integration into pedagogy, teacher training, and fair access to technical infrastructure to guarantee that these gains are sustainable and inclusive.

Butler et al. (2022) seeks to determine whether and how the use of digital technologies can promote numeracy development in early childhood, primary, and post-primary mathematics education. This question is, of course, heavily reliant on how numeracy is defined and how its progress may be assessed or accessed. There is also the complex issue of whether mathematical achievement/attainment should be viewed solely as evidence of the practical and appropriate use of digital tools (which raises the question of what constitutes mathematical achievement) or as an integral component of the development of mathematical thinking, knowledge, skills, and dispositions.

According to Perini et al. (2023), early numeracy (covering basic skills such as counting, order processing, and so on) has consistently been shown to predict later academic as well as vocational prospects. As a result, it appears prudent to encourage it early on in development. In this paper, we explain the creation and first evaluation of Number Express, a digital game meant to improve numerical skills in pre- and primary school, using the most recent findings from order processing research. The game consists of a train with six carriages that the player must fill in with numbers in the correct sequence. The game's difficulty increases over several levels, progressing from minor to larger numbers and sequences in increments of 2, 5, and 10. Informative feedback assists players in case they react incorrectly. Associating numbers with carriages in the correct order awards the player points, which may be used to purchase products in a virtual shop, giving them more experience calculating with money. During the design phase,

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we solicited feedback from researchers, teachers, and an education consultant who specializes in elementary math learning and instruction. Piloting will entail testing the game with a small group of preschool children to assess its playability and ease of use, as well as to address any outstanding technical difficulties. In addition, we will solicit input from youngsters to identify any aspects of the game that could be enhanced or made more engaging. The game will then be tested in an intervention trial to see how effective it is in improving children's early numeracy skills. If the game is successful in enhancing children's early numeracy skills, it has the potential to be a valuable tool for educators and parents in promoting their children's numerical development.

According to Inafazri and Formen (2024), children's numerical skills can be challenged at times; thus, strategies for improving early childhood numeracy learning outcomes are required. The purpose of this study is to assess the influence of digital educational games on numeracy development in children aged 4-5 years at one of the Global Kindergartens (pseudonyms) in Semarang City. The method employed is a pre-experimental research design, utilizing a One-Group Pretest-Posttest design. This participant comprised 31 Kindergarten A students. Data were collected using a pretest and posttest of numeracy skills designed in accordance with the Minister of Education and Culture of the Republic of Indonesia's Regulation Number 137 of 2014 (National Standard for Early Childhood Education). The results revealed that the average pretest score was 28.00, and the posttest score climbed to 46.16 after using digital educational games. The normality test usually reveals normally distributed data; however, the N-Gain Score test yields an average score of 0.91, indicating a high category. The hypothesis test utilizing the Paired Sample T-Test yielded a Sig. (2-tailed) value of 0.000, indicating that the use of digital educational games had a substantial influence on children's numeracy abilities. This rise demonstrates that the appropriate use of digital games in education can considerably improve early childhood numeracy skills. This study demonstrates that incorporating digital educational games into the early childhood education curriculum is an effective way to enhance numeracy skills.

II. RESEARCH METHODOLOGY

Research Design

The study utilized a descriptive correlational research design, which described the existing conditions and provided conclusive results. This approach was used to evaluate hypotheses, characterize traits, define groups, assess perceptions, and predict behaviors. Quantitative research methods, such as questionnaires, observations, and experiments, were used to observe occurrences affecting a specific sample population. The descriptive design allowed the researcher to gather essential data on the impact of digital technologies on numeracy and literacy instruction for kindergarten students in early childhood education, and to determine their integration with other variables.

Population and Sampling

800 kindergarten teachers in Quezon Province were randomly selected from four congressional districts using stratified sampling techniques.

Respondents of the Study

The respondents of the study consist of one hundred five (105) kindergarten teachers in the selected public elementary schools in the Division of Quezon who will provide the data needed in determining how effective integrating digital tools is in early literacy and numeracy instruction of kindergarten pupils in early childhood education.

Research Instrument

The study used a questionnaire to assess the effectiveness of digital tool integration in early childhood education. The questionnaire covered demographic information, the extent of digital tool integration, instructional strategies, teachers' digital literacy, and learning engagement. It also assessed the effectiveness of integrating digital tools in teaching early literacy, phonemic awareness, letter-sound recognition, vocabulary development, and word recognition. The study used a Likert scale to rate the indicators and interpretation of data.

Validity and Reliability of the Instrument

The research instrument's validity and reliability were crucial for the study. A panel of experts confirmed the questionnaire's content, revised it, and approved it. The questionnaire was then pilot tested, and the Cronbach alpha coefficient was used for reliability testing. The final questionnaire was prepared for distribution and use by participants.

Data Gathering Procedure

The study was approved by the Division Office of Quezon Province and selected public elementary school heads. Data was collected from the questionnaires, which were analyzed using SPSS. The results influenced the development of an intervention program to improve literacy and numeracy instruction for kindergarten teachers by integrating digital tools into early childhood education.

Statistical Treatment

The study used frequency and percentage distributions to analyze data on demographics, digital tool integration, and effectiveness in teaching early literacy and numeracy in kindergarten students. Weighted mean was used to determine the types of tools used, instructional strategies, teachers' digital literacy, and learning engagement. A paired t-test was used to determine significant differences in digital tool integration based on respondents' profiles. Pearson's r was used to determine a significant relationship between digital tool integration and teaching effectiveness.

Ethical Consideration

The study was approved by the Superintendent of Quezon Province and public elementary school principals, with approval obtained through an endorsement letter. The researcher ensured clarity of information, anonymity of respondents, and confidentiality of data. They monitored participant safety, ensuring no harm was done to kindergarten students, and conducted the study in accordance with research ethics norms.

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III. RESULTS AND DISCUSSION

Problem number 1. What is the demographic profile of the respondents in terms of Age, Highest Educational Attainment, Years in Teaching, and Training in digital tool integration?

Table 1 shows that the majority of teacher respondents are aged 31-40, followed by 21-30, with a smaller proportion in older categories. The largest educational qualification is a bachelor's degree, followed by master's and doctorate degrees. The leading teachers have 6-10 years of experience, followed by those with 1-5 years. Most respondents have received partial or complete training on digital tool integration.

Table 1

Demographic profile of the teacher-respondents

		f	%	Rank
Age	21 - 30	27	26	2
	31 - 40	58	55	1
	41 - 50	16	15	3
	51 and above	4	4	4
	Total	**105**	**100**	
Highest Educational Attainment	Bachelor's Degree	77	73	1
	Master's Degree Graduate	23	22	2
	Doctorate Degree Graduate	5	5	3
	Total	**105**	**100**	
Years of Teaching	1 - 5	29	28	2
	6 -10	55	52	1
	11 - 15	13	12	3
	16 - 20	8	8	4
	21 and above	0	0	5
	Total	**105**	**100**	
Training Attended on Integration of Digital Tools in Teaching	No Training	20	19	3
	Incomplete Training	64	61	1
	Full Training	21	20	2
	Total	**105**	**100**	

The study indicates that mid-career teachers with a bachelor's degree have limited classroom experience and lack comprehensive training in digital tool integration, suggesting a need for focused professional development to enhance confidence and consistent technology application in early literacy and numeracy instruction.

The findings are supported by the research of Leoste et al. (2022), who found that well-structured online professional development formats can considerably improve early childhood teachers' digital competencies, supporting the integration of digital resources in the classroom. Similarly, Paul et al. (2023) did a comprehensive evaluation and discovered that instructional technologies in preschool settings have a variety of outcomes but can have a beneficial academic impact when used with careful pedagogical design. Furthermore, UNICEF's 2020 scoping report emphasizes that children's digital literacy depends not only on access, but also on teacher capacity, curriculum alignment, and supportive policy and familial environments. Overall, these findings indicate that improving teacher competence through focused, accessible training is an important strategy for effective digital integration in early literacy and numeracy instruction.

Problem number 2. What is the extent of integrating digital tools in early childhood education in terms of types of digital tools used, frequency of using digital tools in the classroom, instructional strategies employed, teachers' digital literacy, and learning engagement?

Table 2.1 shows the integration of digital tools in early childhood education, with interactive whiteboards, smart TVs, educational websites, and audio-visual materials being the most commonly used. Numeracy play applications were the least frequently used. Overall, educators generally agree on the regular use of digital technologies in literacy and numeracy training.

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Table 2.1
The extent of integrating digital tools in early childhood education in terms of the types of digital tools used

	Mean	Std. Deviation	Verbal Interpretation
1. Mobile devices or tablets help my instructional delivery in my class among kindergarten pupils.	2.91	0.52	Agree
2. I use literacy apps like phonics or story apps in my class among kindergarten pupils.	2.87	0.52	Agree
3. I utilize numeracy play apps such as counting games or number puzzles for kindergarten pupils.	2.86	0.61	Agree
4. I use digital storybooks or e-books as part of literacy instruction in my class among kindergarten pupils.	2.98	0.55	Agree
5. I use digital tools as part of classroom activities, used with interactive whiteboards or smart TVs for my kindergarten pupils.	3.06	0.50	Agree
6. I visit websites that support content for early literacy or numeracy learning with interactive activities for kindergarten pupils.	3.02	0.50	Agree
7. I use audio-visual materials (videos, songs) in the teaching of literacy or numeracy among kindergarten pupils.	3.01	0.49	Agree
TYPES OF DIGITAL TOOLS USED	**2.96**	**0.22**	**Agree**

Legend: *4 (3.50 - 4.00) - Strongly Agree 3 (2.50 - 3.49) - Agree. 2 (1.50 - 2.49) - Disagree 1 (1.00 - 1.49) - Strongly Disagree*

Teachers generally agree on using digital technologies in early childhood education, including interactive whiteboards, smart TVs, and instructional websites, to enhance reading and numeracy education, with some applications less frequently used due to content accessibility or curriculum compatibility. When used in conjunction with conscious pedagogy, tablets, interactive displays, and multimedia materials have been shown to improve engagement and skill development (Dong et al., 2024). Systematic reviews have also found that educational applications and instructional technology produce beneficial academic outcomes when teachers can effectively integrate them into learning activities (Paul et al., 2023). According to Çeken (2022), well-designed interactive tools that adhere to multimedia learning principles and are pedagogically scaffolded can improve academic achievement, creativity, and collaboration for young learners.

Table 2.2 study reveals a consensus among teachers about the frequent use of digital tools in early childhood education, with a mean of 2.95. The highest mean was for technology utilization in learning centers, followed by group and individual instruction, and consistent integration in numeracy lessons. The standard deviations ranged from 0.41 to 0.64.

Table 2.2
The extent of integrating digital tools in early childhood education in terms of the frequency of using digital tools in the classroom

	Mean	Std. Deviation	Verbal Interpretation
1. I routinely incorporate digital technologies into literacy instruction every day for kindergarten pupils.	2.81	0.59	Agree
2. I regularly employ digital technologies in the teaching of numeracy lessons for kindergarten pupils.	3.01	0.56	Agree
3. I incorporate digital resources in lesson planning on a weekly basis for kindergarten pupils.	2.94	0.52	Agree
4. I also encourage the use of technology within learning centers or stations among kindergarten pupils.	3.06	0.41	Agree
5. I use digital learning tools as part of both group learning and one-on-one teaching for kindergarten pupils.	3.03	0.56	Agree

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6. I contextualize the use of technology within daily instruction for kindergarten classes.	2.95	0.61	Agree
7. Digital tools are my main resource for early literacy and numeracy activities for kindergarten pupils.	2.87	0.64	Agree
FREQUENCY OF USING DIGITAL TOOLS IN THE CLASSROOM	**2.95**	**0.25**	**Agree**

Legend: *4 (3.50 - 4.00) - Strongly Agree 3 (2.50 - 3.49) - Agree. 2 (1.50 - 2.49) - Disagree 1 (1.00 - 1.49) - Strongly Disagree*

Teachers consistently use digital resources in literacy, numeracy, lesson planning, and diverse learning environments. Technology integration includes direct instruction and learning centers, but some practices, like integrating technology into daily literacy activities, are implemented less frequently.

The finding is supported by Dong et al. (2023), who discovered that instructors use digital tools more frequently when they believe they improve engagement and align with educational aims. According to Scherer et al. (2021), consistent use of technology in early education is associated with increased teacher digital self-efficacy and institutional backing. Furthermore, Neumann (2020) observed that adding technology into routine reading and numeracy tasks improves both skill development and motivation in young learners, provided the instruments are developmentally appropriate and accompanied by directed instruction.

Table 2.3 reveals that digital tools are being increasingly integrated into early childhood education, with the highest rating being aligned with learning objectives. Other strategies include technology-based collaboration, personalized instruction, and monitoring student progress. The results show moderate to high consistency in responses, indicating a consensus on their frequent use.

Table 2.3
The extent of integrating digital tools in early childhood education in terms of the instructional strategies employed

	Mean	Std. Deviation	Verbal Interpretation
1. I employ digital means of differentiated instruction that are dependent upon kindergarten pupils' needs.	2.98	0.44	Agree
2. I create blended face-to-face and digital learning activities appropriate for a kindergarten learning environment.	2.83	0.67	Agree
3. I employ technology in centers or small group instruction employing a child-centered approach.	2.95	0.63	Agree
4. I use technology for the skills literacy and numeracy skills development of kindergarten pupils.	2.96	0.71	Agree
5. I incorporate digital tools into my lessons according to learning goals suited for kindergarten pupils.	3.10	0.59	Agree
6. I applied collaboration and interaction among my kindergarten pupils using digital technologies.	3.03	0.47	Agree
7. I keep track of my kindergarten pupils' progress through online assessments or activities.	2.85	0.58	Agree
INSTRUCTIONAL STRATEGIES EMPLOYED	**2.96**	**0.25**	**Agree**

Legend: *4 (3.50 - 4.00) - Strongly Agree 3 (2.50 - 3.49) - Agree. 2 (1.50 - 2.49) - Disagree 1 (1.00 - 1.49) - Strongly Disagree*

Teachers in early childhood use digital resources to enhance education, connecting technology with learning objectives, fostering collaboration, and using child-centered methodologies. Progress monitoring is less prioritized than direct instruction and interactive experiences, with assessment serving a complementary yet subordinate function.

The finding is corroborated by the research conducted by Blackwell et al. (2021), which revealed that early childhood educators frequently emphasize digital tools for enhancing engagement and varied instruction rather than formal assessment roles. Likewise, Dong et al. (2023) indicated that

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the incorporation of technology aligned with learning objectives improves the acquisition of reading and numeracy skills in young learners. Lai et al. (2022) asserted that customized blended and interactive digital solutions foster collaboration and creativity, resulting in more significant learning experiences.

Table 2.4 study evaluates teachers' digital literacy in early childhood education, with a mean score of 2.93. The most highly scored capability is proficiency in basic troubleshooting for digital devices or software, followed by preparedness to teach safe and effective use of digital tools. The lowest rating is autonomously configuring and using digital resources.

Table 2.4
The extent of integrating digital tools in early childhood education in terms of the teachers' digital literacy

	Mean	Std. Deviation	Verbal Interpretation
1. I feel comfortable implementing technology in my teaching for my kindergarten pupils.	2.91	0.52	Agree
2. I am capable of independently configuring and using digital teaching tools in a kindergarten class.	2.83	0.51	Agree
3. I know how to assess and choose quality educational apps suited for early childhood education.	2.84	0.54	Agree
4. I have been trained on the use of technology in early childhood education.	2.95	0.63	Agree
5. I can do basic troubleshooting for digital devices or software.	3.05	0.63	Agree
6. I apply the use of technology carefully and appropriately for my kindergarten pupils.	2.88	0.62	Agree
7. I am prepared to guide my kindergarten pupils on how to use digital tools safely and productively.	3.04	0.63	Agree
TEACHER'S DIGITAL LITERACY	**2.93**	**0.25**	**Agree**

Legend: *4 (3.50 - 4.00) - Strongly Agree 3 (2.50 - 3.49) - Agree. 2 (1.50 - 2.49) - Disagree 1 (1.00 - 1.49) - Strongly Disagree*

Teachers generally have good digital literacy and confidence in incorporating technology into their courses. However, areas like autonomous tool configuration and high-quality educational applications need further specialized training and professional development.

The findings are supported by the research of Ghavifekr et al. (2023), who discovered that while early childhood educators often have fundamental digital capabilities, gaps persist in advanced technical abilities and application assessment. Scherer et al. (2021) discovered that enhanced teacher digital literacy is associated with greater confidence and frequency of technology integration in early learning settings. Dong et al. (2023) also stressed that early childhood education training programs can significantly increase teachers' ability to use technology efficiently and securely.

Table 2.5 study reveals that integrating digital tools in early childhood education enhances learning engagement. The highest-rated item suggests that digital tools encourage students to explore print and numerical concepts, increase engagement in lessons, and increase enthusiasm for technology. The lowest-rated item suggests greater engagement and enthusiasm when technology is incorporated into early reading and numeracy instruction.

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 11| Issue: 9| September 2025|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2025: 8.691 || ISI Value: 1.188

Table 2.5
The extent of integrating digital tools in early childhood education in terms of learning engagement

	Mean	Std. Deviation	Verbal Interpretation
1. Digital tools used for literacy and numeracy activities can foster more attention and focus among my kindergarten pupils.	2.92	0.57	Agree
2. My kindergarten pupils are more engaged in lessons in which digital apps or games are used.	2.97	0.70	Agree
3. Digital tools invite kindergarten pupils to discover the concept of print and the concepts of number for themselves.	3.02	0.62	Agree
4. My kindergarten pupils show more enthusiasm/more motivation to use technology in the classroom.	2.97	0.56	Agree
5. Computerized activities are more interactive, both with content and with kindergarten pupils.	2.93	0.71	Agree
6. Using digital tools captures and maintains my kindergarten pupils' interest for the length of the lesson.	2.83	0.63	Agree
7. My kindergarten pupils are much more active and captivated when integrating technology in learning experiences related to early literacy and numeracy.	2.81	0.54	Agree
LEARNING ENGAGEMENT	**2.92**	**0.28**	**Agree**

Legend: *4 (3.50 - 4.00) - Strongly Agree 3 (2.50 - 3.49) - Agree. 2 (1.50 - 2.49) - Disagree 1 (1.00 - 1.49) - Strongly Disagree*

Teachers believe digital resources enhance student involvement in early reading and numeracy training, promoting attention, discovery-based learning, and passion. However, sustained enthusiasm requires deliberate techniques to maintain attention.

The findings are supported by Hsiao et al. (2022), who discovered that interactive digital media can significantly boost young learners' motivation and concentration when aligned with age-appropriate educational goals. Kucirkova and Falloon (2020) argue that digital storytelling and gamified reading exercises increase engagement by allowing students to actively research themes. Furthermore, Dong et al. (2023) shows that the use of digital technology in early education promotes both active participation and increased conceptual comprehension when combined with guided instruction.

Table 2.6 study shows that digital tools are widely accepted in early childhood education, particularly for promoting literacy and numeracy skills. Educators recognize their importance in delivering engaging teaching strategies and fostering engagement, demonstrating a collective recognition of the need to incorporate technology into young learners' learning practices.

Table 2.6
Composite table on the extent of integrating digital tools in early childhood education

	Mean	Std. Deviation	Verbal Interpretation
Types of Digital Tools Used	2.96	0.22	Agree
Frequency of Using Digital Tools in the Classroom	2.95	0.25	Agree
Instructional Strategies Employed	2.96	0.25	Agree
Teacher's Digital Literacy	2.93	0.25	Agree
Learning Engagement	2.92	0.28	Agree
The Extent of Integrating Digital Tools for Effective Early Literacy and Numeracy Instruction Among Kindergarten Pupils	**2.94**	**0.11**	**Agree**

Legend: *4 (3.50 - 4.00) - Strongly Agree 3 (2.50 - 3.49) - Agree. 2 (1.50 - 2.49) - Disagree 1 (1.00 - 1.49) - Strongly Disagree*

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This finding is consistent with Chai and Kong's (2022) assertion that teacher preparedness and professional development are critical for effective technology integration in early childhood settings. Similarly, Paul et al. (2023) found that technology-enhanced instructional design increases learning results when combined with purposeful pedagogy. Finally, Korkmaz and Toraman (2023) found that instructors' digital literacy has a direct impact on the quality of technology integration, especially when combined with interactive and learner-centered approaches.

Problem number 3. What is the level of effectiveness of integrating digital tools in teaching early literacy among kindergarten pupils in terms of phonemic awareness, letter-sound recognition, vocabulary development, and word recognition?

Table 3.1 shows the extent of integrating digital tools in early childhood education, in terms of phonemic awareness.

Table 3.1
Level of effectiveness of integrating digital tools in teaching early literacy among kindergarten pupils in terms of phonemic awareness

	Mean	Std. Deviation	Verbal Interpretation
1. My kindergarten pupils can discern initial sounds of words when phonics applications are used.	2.96	0.63	Often Observed
2. Digital activities support my kindergarten pupils in recognizing that sounds vary from word to word.	2.98	0.64	Often Observed
3. My kindergarten pupils are engaged in sound segmentation and blending games.	2.90	0.61	Often Observed
4. My kindergarten pupils listen to support audio in the applications, associate sounds correctly with letters.	3.05	0.64	Often Observed
5. My kindergarten pupils recognize rhyming sounds in the context of digital story or song activities.	2.84	0.68	Often Observed
6. Phonics software engages my kindergarten pupils actively through sound-matching activities.	3.13	0.57	Often Observed
7. Digital learning tools allow my kindergarten pupils to segment sounds at the beginning, middle, or end of the word.	2.86	0.67	Often Observed
PHONEMIC AWARENESS	**2.96**	**0.24**	**Often Observed**

Legend: 4 3.50 - 4.00 Always Observed 3 2.50 - 3.49 Often Observed 2 1.50 - 2.49 Sometimes Observed 1 1.00 - 1.49 Rarely Observed

Kindergarten students frequently use digital technologies to enhance phonemic awareness in early reading. Teachers use interactive games, phonics software, and applications to help students recognize rhymes, segment words, and identify sounds. Although not fully utilized, these tools involve significant sound-based tasks, indicating a common understanding of how digital tools can improve phonemic awareness.

These findings are consistent with Hofmann et al. (2021), who discovered that app-based phonological awareness training dramatically improves word-reading comprehension, particularly among lower-achieving students. Similarly, Herodotou et al. (2022) found that when digital books include interactive aspects that enhance sound recognition, they increase early literacy outcomes.

Table 3.2 shows the extent of integrating digital tools in early childhood education, in terms of letter-sound recognition.

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EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
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Table 3.2
Level of effectiveness of integrating digital tools in teaching early literacy among kindergarten pupils in terms of letter-sound recognition

	Mean	Std. Deviation	Verbal Interpretation
1. Following practice on literacy apps, my kindergarten pupils can pronounce letter sounds correctly.	2.89	0.59	Often Observed
2. My kindergarten pupils match letters with pictures or sounds in digital games.	2.92	0.58	Often Observed
3. My kindergarten pupils can answer letter and sound prompts during the interactive whiteboard activities.	3.01	0.60	Often Observed
4. My kindergarten pupils use letter tracing activities found in the apps to support sound identification.	3.14	0.56	Often Observed
5. Experiencing letters multiple times in association with sounds in digital formats enables kindergarten pupils to remember more such associations.	3.10	0.55	Often Observed
6. As the kindergarten pupils are independent on the computer, they initiate letter-sound games on their own.	2.99	0.51	Often Observed
7. My kindergarten pupils can more readily recall letter sounds when lessons are digitally based.	2.84	0.65	Often Observed
LETTER-SOUND RECOGNITION	**2.99**	**0.29**	**Often Observed**

Legend: 4 3.50 - 4.00 Always Observed 3 2.50 - 3.49 Often Observed 2 1.50 - 2.49 Sometimes Observed 1 1.00 - 1.49 Rarely Observed

Kindergarten students consistently use digital resources for letter-sound recognition learning, with a mean score of 2.99 and a standard deviation of 0.29. This method, which includes digital letter tracing, sound matching, and interactive lesson-based sound recall, is effective in early literacy contexts. The consistent responses suggest that this integration method is a reliable and effective strategy.

Verhoeven (2020) reported that computer-supported early literacy interventions, including digital letter and sound activities, significantly improved preschoolers' phonological awareness and letter-sound recognition skills, while Almansoori et al. (2024) found that integrating digital applications such as Jolly Phonics Lessons into literacy instruction enhanced phonics skills and recall among preschool students.

Table 3.3 shows the extent of integrating digital tools in early childhood education, in terms of vocabulary development.

Table 3.3
Level of effectiveness of integrating digital tools in teaching early literacy among kindergarten pupils in terms of vocabulary development

	Mean	Std. Deviation	Verbal Interpretation
1. Digital stories and animations present kindergarten pupils with new words.	2.89	0.67	Often Observed
2. App users bring the new vocabulary into conversations or in-class activities among kindergarten pupils.	2.95	0.58	Often Observed
3. In a digital context, word meanings are learned by kindergarten pupils through visual or video prompts.	3.02	0.55	Often Observed
4. My kindergarten pupils show vocabulary knowledge via in-app games or quizzes on vocabulary.	2.99	0.53	Often Observed

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5. My kindergarten pupils then practice and use words contained within the audio-based learning apps.	2.90	0.48	Often Observed
6. Apps employ tools for vocabulary enrichment among kindergarten pupils.	3.10	0.60	Often Observed
7. Vocabulary from the digital lessons is recalled and practiced by kindergarten pupils in subsequent activities.	3.20	0.56	Often Observed
VOCABULARY DEVELOPMENT	**3.01**	**0.24**	**Often Observed**

Legend: 4 3.50 - 4.00 Always Observed 3 2.50 - 3.49 Often Observed 2 1.50 - 2.49 Sometimes Observed 1 1.00 - 1.49 Rarely Observed

The study found that digital tools like stories, animations, and vocabulary exercises are frequently used in classroom education, albeit not universally obvious. These tools are used for vocabulary enhancement through sustained participation in activities like language use and audio-visual stimuli, promoting interactive and multimodal experiences.

Surya and Aprilia (2024) discovered that digital storytelling helps preschoolers enhance their language acquisition, comprehension, and narrative skills. Similarly, Ilham (2025) found that multimedia technologies improve English vocabulary learning among preschoolers. Choiril Wiladyah and Novita Sari (2025) also noted that novel digital tools and gamified strategies improve participation and retention in vocabulary education.

Table 3.4 shows the extent of integrating digital tools in early childhood education, in terms of word recognition.

Table 3.4

Level of effectiveness of integrating digital tools in teaching early literacy among kindergarten pupils in terms of word recognition

	Mean	Std. Deviation	Verbal Interpretation
1. My kindergarten pupils are exposed to and can identify shared sight words presented in e-flashcard programs.	3.17	0.64	Often Observed
2. My kindergarten pupils sound out CVC words using applications.	3.08	0.55	Often Observed
3. Digital games help kindergarten pupils identify words by repeating them.	2.95	0.63	Often Observed
4. My kindergarten pupils practice independent reading on digital readers and e-books.	2.89	0.61	Often Observed
5. My kindergarten pupils decompose words they do not know into syllables with the help of the digital interface.	3.00	0.71	Often Observed
6. My kindergarten pupils learn easily when words are highlighted and listen to audio storybooks.	2.99	0.47	Often Observed
7. My kindergarten pupils accurately associate printed words with pictures in online reading activities.	2.98	0.64	Often Observed
WORD RECOGNITION	**3.01**	**0.24**	**Often Observed**

Legend: 4 3.50 - 4.00 Always Observed 3 2.50 - 3.49 Often Observed 2 1.50 - 2.49 Sometimes Observed 1 1.00 - 1.49 Rarely Observed

The study found that digital tools like flashcards, online reading activities, and in-app word exercises are frequently used in classroom education to improve early literacy skills. However, there is potential for improved independent reading engagement and interactive learning opportunities to optimize literacy outcomes.

Sari, Sormin, Purba, and Khairas (2023) demonstrated that flashcard media significantly improved early childhood English letter and vocabulary recognition. Longchin, Poopatwiboon, and Phusawisot (2024) reported that digital flashcards effectively enhanced word reading skills among primary students. Furthermore, Oakley (2024) emphasized that digital technologies, including interactive reading tools, support early literacy development and help build reading fluency, although opportunities for independent engagement remain underutilized.

Table 3.5 shows the composite mean on extent of integrating digital tools in early childhood education, in terms of phonemic

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
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awareness, letter-sound recognition, vocabulary development, and word recognition.

Table 3.5

Composite table on the level of effectiveness of integrating digital tools in teaching early literacy among kindergarten pupils

	Mean	Std. Deviation	Verbal Interpretation
Phonemic Awareness	2.96	0.24	Often Observed
Letter-Sound Recognition	2.99	0.29	Often Observed
Vocabulary Development	3.01	0.24	Often Observed
Word Recognition	3.01	0.24	Often Observed
Level of Effectiveness of Digital Tools Integration in Teaching Early Literacy of Kindergarten Pupils	**2.99**	**0.12**	**Often Observed**

Legend: 4 3.50 - 4.00 Always Observed 3 2.50 - 3.49 Often Observed 2 1.50 - 2.49 Sometimes Observed 1 1.00 - 1.49 Rarely Observed

The study shows that digital resources are frequently used in early literacy training to improve vocabulary and word recognition, with teachers showing a favorable response to technology integration as an educational aid for young learners.

Verhoeven (2020) discovered that computer-assisted early literacy therapies, such as phonemic awareness and letter-sound recognition programs, significantly improve early reading skills in preschool children. According to Fälth (2024), the majority of primary school instructors use digital technology to help students with phonological awareness, decoding, vocabulary, and writing, and they have good opinions regarding these tools. Similarly, Sari (2024) found that digital books significantly improved phonemic awareness and word recognition in children aged 5-6 years, while Samuelsson et al. (2024) found that teachers see digital literacy interventions as valuable resources for engaging students and improving literacy instruction.

Problem number 4. What is the level of effectiveness of integrating digital tools in teaching early numeracy among kindergarten pupils in terms of number recognition, countings, basic operations, and problem solving?

Table 4.1 shows the level of effectiveness of intergrating digital tools in teaching early numeracy among kindergarten pupils in terms of number recognition.
The study found that digital tools, such as digital number games and apps, significantly improve kindergarten students' number recognition skills. Teachers generally agree that these resources are effective, with a strong consensus on their effectiveness, indicating a unified viewpoint.

Table 4.1

Level of effectiveness of integrating digital tools in teaching early numeracy among kindergarten pupils in terms of number recognition

	Mean	Std. Deviation	Verbal Interpretation
1. Digital number games help kindergarten pupils to recognize numbers 1-10.	2.92	0.51	Agree
2. My kindergarten pupils pair numerals with quantities through tablet activities.	2.89	0.52	Agree
3. My kindergarten pupils always choose the correct number in the app-based quizzes.	2.93	0.51	Agree
4. Single and double-digit numbers are presented on the screen; thus, kindergarten pupils learn to distinguish between the two.	2.98	0.60	Agree
5. My kindergarten pupils play digital puzzles that require the identification of numbers.	3.10	0.47	Agree
6. My kindergarten pupils correctly trace numbers on number-tracing apps.	3.04	0.63	Agree

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
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7. My kindergarten pupils can identify numbers in different formats presented by digital tools such as numerals, dots on the dice, or fingers.	3.00	0.60	Agree
NUMBER RECOGNITION	**2.98**	**0.27**	**Agree**

Legend: *4 (3.50 - 4.00) - Strongly Agree 3 (2.50 - 3.49) - Agree. 2 (1.50 - 2.49) - Disagree 1 (1.00 - 1.49) - Strongly Disagree*

Teachers believe digital resources enhance early numeracy skills, particularly number recognition, through interactive applications, games, and number-tracing exercises. These visually appealing learning experiences improve children's knowledge and comfort with numbers.

Fitriani, Tabroni, Guilin, and Jiao (2023) found that interactive number recognition cards significantly improve number recognition skills among children aged 4–5 years. Lange (2021) highlighted that number games in preschool classrooms effectively support mathematical learning when integrated with digital tools, and Hosch (2022) emphasized that digital math games improve number sense and early numeracy skills.

Table 4.2 shows the level of effectiveness of intergrating digital tools in teaching early numeracy among kindergarten pupils in terms of counting.

The study found that kindergarten pupils generally perceive digital tools as effective in teaching early numeracy, particularly in counting. The highest rating was for app activities allowing pupils to identify numerals, while the lowest was for independent counting using number-focused apps.

Table 4.2

Level of effectiveness of integrating digital tools in teaching early numeracy among kindergarten pupils in terms of countings

	Mean	Std. Deviation	Verbal Interpretation
1. Digital games and simulations help kindergarten pupils count objects correctly.	2.84	0.62	Agree
2. During app activities, kindergarten pupils “drag-and-drop” the right number of items.	2.93	0.61	Agree
3. My kindergarten pupils practice one-to-one correspondence with onscreen manipulatives.	2.96	0.65	Agree
4. My kindergarten pupils count verbally in and with the animated sequences or songs that are part of the digital programs.	2.96	0.60	Agree
5. My kindergarten pupils show knowledge of counting order while playing with an interactive app.	2.93	0.52	Agree
6. My kindergarten pupils independently engage in counting when playing with number-centered apps.	2.80	0.64	Agree
7. During app activities, kindergarten pupils can find the numeral that corresponds to a specific quantity.	3.13	0.56	Agree
COUNTINGS	**2.94**	**0.28**	**Agree**

Legend: *4 (3.50 - 4.00) - Strongly Agree 3 (2.50 - 3.49) - Agree. 2 (1.50 - 2.49) - Disagree 1 (1.00 - 1.49) - Strongly Disagree*

Digital technologies in early childhood schools improve counting skills through interactive tasks, manipulatives, and animated melodies. Integrating self-directed, problem-solving tasks can enhance independent counting abilities.

Getuaban and Vertulfo (2025) found that digital play-based learning tools positively influenced early literacy and numeracy development, enhancing student engagement and counting skills. Fajardo et al. (2025) reported a statistically significant positive correlation between technology use and numeracy skills in early childhood education. Torres-Peña et al. (2025) highlighted that problem-solving activities combined with digital tools can strengthen counting and seriation skills in preschool children.

Table 4.3 shows the level of effectiveness of intergrating digital tools in teaching early numeracy among kindergarten pupils in terms of basic operations.

The study found that kindergarten pupils generally perceive digital tools as beneficial in teaching early numeracy, particularly in basic operations. The highest-rated indicator was "Learners like to solve easy problems when guided by digital animations or avatars," while the lowest-rated was "Math sentences are represented by kindergarten pupils using drag-and-drop counters."

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Table 4.3
Level of effectiveness of integrating digital tools in teaching early numeracy among kindergarten pupils in terms of basic operations

	Mean	Std. Deviation	Verbal Interpretation
1. My kindergarten pupils solve simple addition problems using interactive games.	3.03	0.56	Agree
2. My kindergarten pupils solve subtraction problems using educational math apps.	2.98	0.59	Agree
3. My kindergarten pupils are presented with visuals accompanied by sound assistance to connect with fundamental operations.	2.98	0.59	Agree
4. My kindergarten pupils exhibit comprehension of digital comparisons for "more than" or "less than".	3.05	0.74	Agree
5. Math sentences are represented by kindergarten pupils using drag-and-drop counters.	2.90	0.66	Agree
6. Repetitive digital practice increases accuracy in fundamental operations among kindergarten pupils.	3.08	0.62	Agree
7. Learners like to solve easy problems when being guided by digital animations or avatars.	3.10	0.66	Agree
BASIC OPERATIONS	**3.02**	**0.32**	**Agree**

Legend: *4 (3.50 - 4.00) - Strongly Agree 3 (2.50 - 3.49) - Agree. 2 (1.50 - 2.49) - Disagree 1 (1.00 - 1.49) - Strongly Disagree*

Digital tools in early numeracy education enhance young learners' understanding of essential mathematical procedures through interactive activities, boosting motivation and engagement, and enhancing problem-solving skills.

Aguilar (2025) also highlighted that digital play-based learning tools enhance both early literacy and numeracy development among kindergarten learners. Lee and Chen (2025) reported that interactive digital activities, such as drag-and-drop and avatar-guided problem-solving, improve understanding of basic operations, while Lange (2021) found that number games in preschool classrooms, when combined with digital tools, significantly enhance young learners' comprehension of foundational math concepts.

Table 4.4 shows the level of effectiveness of intergrating digital tools in teaching early numeracy among kindergarten pupils in terms of problem solving.

Table 4.4
Level of effectiveness of integrating digital tools in teaching early numeracy among kindergarten pupils in terms of problem solving

	Mean	Std. Deviation	Verbal Interpretation
1. My kindergarten pupils solve puzzles of logic or sequence through a digital platform.	2.99	0.64	Agree
2. Math apps provide experiences for kindergarten pupils in the areas of shape, pattern, and measurement.	3.05	0.54	Agree
3. My kindergarten pupils can articulate their reasoning within app-based Problem-solving games.	2.90	0.64	Agree
4. My kindergarten pupils draw on experiences in the computer-based worlds to address mathematics questions.	2.94	0.66	Agree
5. My kindergarten pupils show persistence in working through multi-step problems within digital games of numeracy.	2.95	0.56	Agree

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6. Virtual tools are evidenced by kindergarten pupils' understandings of spatial relationships.	2.97	0.67	Agree
7. The use of digital supports helps kindergarten pupils select suitable problem-solving strategies.	3.02	0.48	Agree
PROBLEM SOLVING	**2.98**	**0.25**	**Agree**

Legend: *4 (3.50 - 4.00) - Strongly Agree 3 (2.50 - 3.49) - Agree. 2 (1.50 - 2.49) - Disagree 1 (1.00 - 1.49) - Strongly Disagree*

The study found that teachers generally believe digital tools are effective in improving students' problem-solving skills, particularly in logic puzzles, shapes, patterns, and measurements, with a generally uniform reaction across participation.

Clemente-Suárez (2024) emphasized that digital drawing and puzzle apps help youngsters discover patterns, forms, and spatial relationships, which improves their early mathematics skills. Kumaş (2024) observed that digital storytelling treatments can enhance problem-solving abilities in early numeracy.

Table 4.5 study indicates that teachers consistently evaluate digital resources as moderately to highly effective across numeracy domains, with a composite mean of 2.98, with minimal diversity in overall perceptions. Teachers view digital tools as essential for young children's numeracy development, enhancing number recognition, counting, and problem-solving skills. Technology is seen as an integral part of numeracy pedagogy, enhancing experiential learning and classroom instruction.

Table 4.5

Composite Mean on the level of effectiveness of integrating digital tools in teaching early numeracy among kindergarten pupils

	Mean	Std. Deviation	Verbal Interpretation
Number Recognition	2.98	0.27	Agree
Countings	2.94	0.28	Agree
Basic Operations	3.02	0.32	Agree
Problem Solving	2.98	0.25	Agree
Level Of Effectiveness of Digital Tools Integration in Teaching Early Numeracy of Kindergarten Pupils	**2.98**	**0.16**	**Agree**

Legend: 3.50 - 4.00 = Strongly Agree, 2.50 - 3.49 = Agree, 1.50 - 2.49 = Disagree, and 1.00 - 1.49 = Strongly Disagree

The findings are consistent with recent research demonstrating a key role for digital devices in early mathematics training. Juhaevah, Tahmir, and Talib (2025) did a meta-analysis of 83 studies and found that digital learning medium effectively improves early numeracy skills, notably number recognition and counting. Similarly, studies on interactive and play-based digital tools have shown that technology enhances problem-solving skills and promotes engagement in young learners (Kumaş, 2024).

Problem number 5. Is there a significant difference in the extent of integrating digital tools in early childhood education when grouped according to the respondents' profiles?

Table 5 study found significant differences in the integration of digital tools in early childhood education based on demographic factors such as age, educational attainment, years of teaching, and training. These factors significantly influence the use of digital resources in reading and numeracy instruction for kindergarten students, suggesting that professional preparedness and familiarity with contemporary teaching methods may influence this integration.

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EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 11| Issue: 9| September 2025|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2025: 8.691 || ISI Value: 1.188

Table 5
Significant difference in the extent of integrating digital tools in early childhood education when grouped according to the respondents' profiles

	t	df	Sig. (2-tailed)	Decision	Remarks
Age - The Extent of Integrating Digital Tools to Effective Early Literacy and Numeracy Instruction among Kindergarten Pupils	-12.943	104	0.000	Reject	Significant
Highest Educational Attainment - The Extent of Integrating Digital Tools to Effective Early Literacy and Numeracy Instruction among Kindergarten Pupils	-29.291	104	0.000	Reject	Significant
Years of Teaching - The Extent of Integrating Digital Tools to Effective Early Literacy and Numeracy Instruction among Kindergarten Pupils	-11.213	104	0.000	Reject	Significant
Training Attended on Integration of Digital Tools in Teaching - The Extent of Integrating Digital Tools to Effective Early Literacy and Numeracy Instruction among Kindergarten Pupils	-15.096	104	0.000	Reject	Significant

The findings are consistent with recent research demonstrating the impact of demographic and professional variables on digital tool integration. For example, Alotaibi (2023) discovered that younger teachers and those who had more recent experience to technology were more inclined to include digital resources into classroom instruction. Similarly, Yang (2024) found that teachers' digital skills and attitudes toward technology greatly predict their effective use of ICT in early childhood educational contexts. These findings imply that instructors' age and experience interact with their digital literacy skills, influencing the extent and method of technology integration.

Educational attainment was also found as an important influence. Teachers with higher levels of formal education indicated stronger integration of digital technologies, which is congruent with the findings of Guillén-Gámez et al. (2022), who discovered that educators' digital competence and ICT use were strongly predicted by their educational background and professional development. Furthermore, training and continued professional development were consistently underlined as essential for successful digital tool use. Hatzigianni and Clark (2023) found that teachers who participated in structured professional development programs were better able to incorporate digital resources into their instructional practices, which improved learning outcomes.

Problem number 6. Is there a significant relationship between the extent of digital tool integration in early childhood education and the level of effectiveness of digital tool integration in teaching early literacy and numeracy of kindergarten pupils?

Table 6 shows the Pearson correlation coefficient for the integration of digital tools in early childhood education showed a negligible positive association with perceived efficacy in teaching early literacy among kindergarten pupils. The study suggests that factors beyond simple integration, such as teacher proficiency, instructional design quality, and resource suitability, may significantly influence the effectiveness of digital tools.

Table 6
Significant relationships between the extent of digital tool integration in early childhood education and the level of effectiveness of digital tool integration in teaching early literacy and numeracy of kindergarten pupils

		Level Of Effectiveness of Digital Tools Integration in Teaching Early Literacy of Kindergarten Pupils
The Extent of Integrating Digital Tools for Effective Early Literacy and Numeracy Instruction among Kindergarten Pupils	Pearson Correlation	0.093
	Sig. (2-tailed)	0.343
	N	105

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 11| Issue: 9| September 2025|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2025: 8.691 || ISI Value: 1.188

Supporting this, a meta-analysis by Li (2025) found a medium positive correlation between digital literacy and academic achievement, emphasizing that the effectiveness of digital tools is significantly influenced by how they are integrated into the learning environment. Furthermore, Yuan (2025) highlighted that factors such as digital literacy, self-efficacy for digital technology, and the learning atmosphere mediate the relationship between digital literacy and learning outcomes. This underscores the importance of teacher proficiency and instructional design in maximizing the benefits of digital tools. Additionally, a study by Clemente-Suárez et al. (2024) found that the effectiveness of digital learning tools is significantly influenced by how they are integrated into the learning environment, including factors like teacher competence and instructional quality.

Problem number 7. What intervention program on integrating digital tools may be proposed based on the results of the study?

Project Title:

ENHANCING EQUITY AND IMPACT IN DIGITAL TOOL INTEGRATION FOR EARLY LITERACY AND NUMERACY IN EARLY CHILDHOOD EDUCATION

I.RATIONALE

Early childhood is a critical period for the development of foundational literacy and numeracy skills, which significantly influence long-term educational outcomes. With the increasing availability of digital tools and platforms designed to support early learning, there is a growing opportunity to enhance teaching practices and student engagement. However, disparities in access, teacher readiness, and culturally responsive content have created inequities in how these tools are integrated and utilized across diverse early childhood education (ECE) settings.

Children from underserved or marginalized communities often lack access to high-quality digital learning tools, while educators may not receive sufficient training to implement them effectively. Without intentional design and implementation, digital tools may exacerbate educational inequities rather than mitigate them.

This initiative addresses the urgent need to promote equitable, evidence-based, and impactful integration of digital technologies in early literacy and numeracy instruction, ensuring all children—regardless of background—can benefit from the digital transformation in education.

II. OBJECTIVES

1. Promote Equitable Access to Digital Tools

Ensure that all early childhood education settings, particularly those in underserved or rural communities, have access to appropriate, high-quality digital resources that support literacy and numeracy development.

2.Support Educator Capacity and Professional Development

Build the capacity of ECE educators through training and ongoing support to integrate digital tools effectively and equitably into their instruction, with an emphasis on culturally responsive pedagogy.

3. Enhance Learning Outcomes through Evidence-Based Integration

Identify and promote best practices in the use of digital tools that demonstrably improve early literacy and numeracy outcomes, using data-driven insights to guide implementation.

4. Foster Inclusive and Culturally Relevant Content

Encourage the development and adoption of digital content that reflects the linguistic, cultural, and developmental diversity of young learners to ensure relevance and engagement.

5. Evaluate and Monitor Impact

Establish mechanisms for evaluating the effectiveness, equity, and impact of digital tool integration, focusing on both student outcomes and educator experiences.

6. Inform Policy and Practice

Generate insights and recommendations that inform national and local education policy, ensuring that digital integration strategies are aligned with broader goals of equity and quality in early childhood education.

Objective	Activities	Persons Responsible	Time Frame	Estimated Cost (PHP)	Expected Output
Standardize integration practices across age groups of teachers	Conduct peer-mentoring sessions pairing younger and older teachers for tech-exchange	School ICT coordinator, Lead teachers	Monthly (6 months)	15,000	Improved digital skills exchange between age groups
Address gaps due to differences in the highest educational attainment	Organize targeted digital pedagogy workshops for teachers with lower qualifications	Principal, Training facilitator	Quarterly (1 year)	20,000	Equalized proficiency in using digital tools for instruction
Support teachers with varying years of teaching experience	Develop modular digital toolkits with step-by-step guides and sample lesson plans	Curriculum development team	3 months	10,000	Resource kit for digital integration accessible to all
Increase training participation	Implement mandatory digital integration CPD (Continuing Professional Development) credits	DepEd Division Office, HR unit	Twice a year	25,000	Increased attendance in training sessions
Improve alignment of integration with instructional effectiveness	Facilitate collaborative lesson planning sessions focusing on measurable learning outcomes	Grade level heads, Master teachers	Bi-monthly (6 months)	12,000	Lesson plans linking digital tools to literacy/numeracy performance
Monitor and evaluate integration outcomes	Establish observation and feedback system with ICT integration checklist	Principal, Supervising teacher	Ongoing (every quarter)	8,000	Data-driven adjustments in integration strategies

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 11| Issue: 9| September 2025|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2025: 8.691 || ISI Value: 1.188

IV. CONCLUSION

The study found that most teachers in early to middle stages of their careers, aged 31-40, have a bachelor's degree, and have been teaching for 6-10 years. They generally agreed on the integration of digital tools in early childhood education, with consistent perceptions regarding the tools used, frequency of application, strategies employed, teachers' digital skills, and engagement of learners in literacy and numeracy activities. The level of effectiveness of integrating digital tools in teaching early literacy among kindergarten pupils was found to be moderate to highly effective, with Vocabulary Development and Word Recognition being the most effective. However, there was a significant difference in the extent of digital tool integration across respondent profiles, with variations observed based on age, educational attainment, years of teaching, and training received. The proposed intervention program aims to assist teachers from a range of backgrounds in using digital tools more effectively by providing targeted support through mentoring, specialized training, and creating new resources.

The study reveals that mid-career teachers need professional development to use digital tools effectively in early childhood education. Digital tools are widely used for vocabulary development and word recognition, but improvements in phonemic awareness and letter-sound identification could enhance literacy outcomes. Teachers' demographic profiles significantly influence their integration of digital tools, with variations in preparedness and exposure to contemporary teaching methodologies affecting the consistency and extent of technology utilization. The effectiveness of digital tools depends on teacher proficiency, instructional design quality, and resource appropriateness. The proposed intervention program aims to provide consistent digital teaching abilities through mentoring, specialized training, and resource development.

The report recommends specialized professional development programs for teachers to teach practical digital technology use in early literacy and numeracy lessons. It also advocates for the use of digital tools in early childhood education, focusing on improving literacy, numeracy skills, and student engagement. The report also emphasizes the importance of integrating digital tools in math lessons and developing professional development programs tailored to teachers' unique backgrounds. The report also emphasizes the need to improve teachers' skills and choose the right digital tools for effective teaching.

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ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
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