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DIGITAL PLAY-BASED LEARNING TOOLS ON EARLY LITERACY AND NUMERACY DEVELOPMENT OF KINDERGATEN LEARNERS

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EVELYN GETUABAN
University of the Visayas
evelyn.getuaban@deped.gov.ph

DR. RIA M. VERTULFO
University of the Visayas
rvertulfo@uv.edu.ph

ABSTRACT.

The research investigates the influence of digital play-based learning tools on the early literacy development of kindergarten learners at Alchemist Child Minding Center in Cebu. This study utilizes a descriptive-correlational research design. Thus, the participant group was composed of six preschool teachers and 90 kindergarten learners whose data was collected through teacher questionnaires and quarterly academic records. The findings revealed that digital tools were strategically deployed in classroom instruction, especially within literacy activities, since they enhance engagement motivation toward the quality of learning possible with such resources; therefore, learners demonstrated above-average performance in both literacy and numeracy assessments. A significant positive correlation was identified between the use of digital tools and literacy skills ($r = 0.336$, $p = .001$) & perceived effectiveness & literacy outcomes ($r = 0.303$, $p = .004$). The relationship was not statistically significant between the use of digital tools and numeracy development, a gap for how these tools support early mathematics learning. It underpins the finding itself, which drives more targeted and interactive numeracy tools and differentiated strategies in digital instruction. This led to the development of the LEAP Ahead Program based on these findings to improve literacy and numeracy through structured digital integration, teacher training, and home-school collaboration. The study highlights the need for developmentally appropriate practices in digital content, while more enhanced teacher support is advocated for effective technology integration. These insights drive a more conscious application of digital tools in early childhood education; they also serve real improvements for classroom instruction and learning outcomes.

Keywords: digital play-based learning tools, early literacy and numeracy development, kindergarten learners, numeracy skills, digital pedagogy, descriptive-correlational research

INTRODUCTION

Within the constantly changing field of early childhood education, digital play-based learning tools stand as new answers for promoting early literacy growth in preschool kids. Online learning apps, game-like reading systems, and multimedia storytelling programs show digital play-based learning tools that join tech and fun to attract young kids to good literacy experiences. It has been proven by multiple studies that digital play-based learning improves phonemic knowledge, word skill, and understanding by using active and interesting learning surroundings. As more children access digital media, using these tools in preschools gives a better way to improve literacy and match different styles of learning.

Several studies prove the effectiveness of digital play-based learning in developing early literacy. Researchers like Neumann and Neumann strongly believe that through multimodal engagement, emergent literacy skills can be developed with the help of digital tools. In the Philippines, Santos and Cruz asserted that interactive learning applications could promote reading readiness for preschool learners. A study carried out in Cebu City discovered that lessons using storytelling applications greatly fueled children's motivation to learn and identify words, proving that storytelling lessons have a significant positive effect on word recognition. These studies inform readers about the general benefits of digital literacy interventions; however, structured implementation and facilitation were raised as issues.

There is a lag in the adoption of digital technology in the kindergarten curriculum. At the Alchemist Child Minding Center in Cebu City, educators and parents whose observations have been proven by the first quarter performance reports of the learners indicated that digital tools were being introduced haphazardly and in an unstructured manner. Many educators face challenges like this due to inadequate training on how to fully integrate digital tools into the curriculum and the limited access to training material. At the same time, parents are concerned about their children's on-screen time and digital learning experiences. Children would benefit most from a well-designed digital environment that integrates purposeful play with sound literacy instruction. Filling this gap requires a joint effort

from parents, teachers, and school administrators to make sure that they use digital play-based learning tools responsibly to effectively support the children's literacy development.

In this study, the researchers analyzed the digital play-based learning tools for early literacy development, explored the opportunities and challenges posed by these tools, and explored their effects on preschoolers' reading skills, motivation, and general learning experience. The researcher had appraised the current application of these tools and how educators use them in early literacy instruction. Key challenges in finding sufficient teacher training and digital resources were also explored. The findings based on this study will be used to suggest a literacy program that leverages digital resources effectively without compromising guided and impactful learning experiences for children. The program could help bridge existing literacy gaps in schools, bringing evidence-based interventions to both classroom and home settings to help children learn better. This would be very helpful for teachers and school administrators who develop effective policies and programs that advance early literacy.

All relevant stakeholders will benefit from this study. For students, it will provide a more engaging and effective way of acquiring literacy and numeracy skills. Teachers will be able to get the best practices on how to use digital tools in teaching children at the early childhood stage. School districts can make more effective support for educators through resource provision and professional development opportunities. Parents can assist in improving their children's digital literacy outside school. With improved early literacy results, the community would benefit in return because a stronger educational foundation creates a better community. The research can serve as an excellent resource for digital literacy scholars in seeking to understand play-based approaches.

Theoretical Framework

The effects of digital play-based learning tools on early literacy and numeracy development can best be explained by theories that account for the acquisition of these basic skills in a technology-rich learning environment. Theories related to literacy and numeracy development, digital learning, and pedagogical design have been synthesized in this framework. In this study, digital learning tools are treated as independent variables, with literacy and numeracy development as dependent variables. The theories reviewed below serve as an avenue to justify the relationship between these variables and their importance in early childhood education.

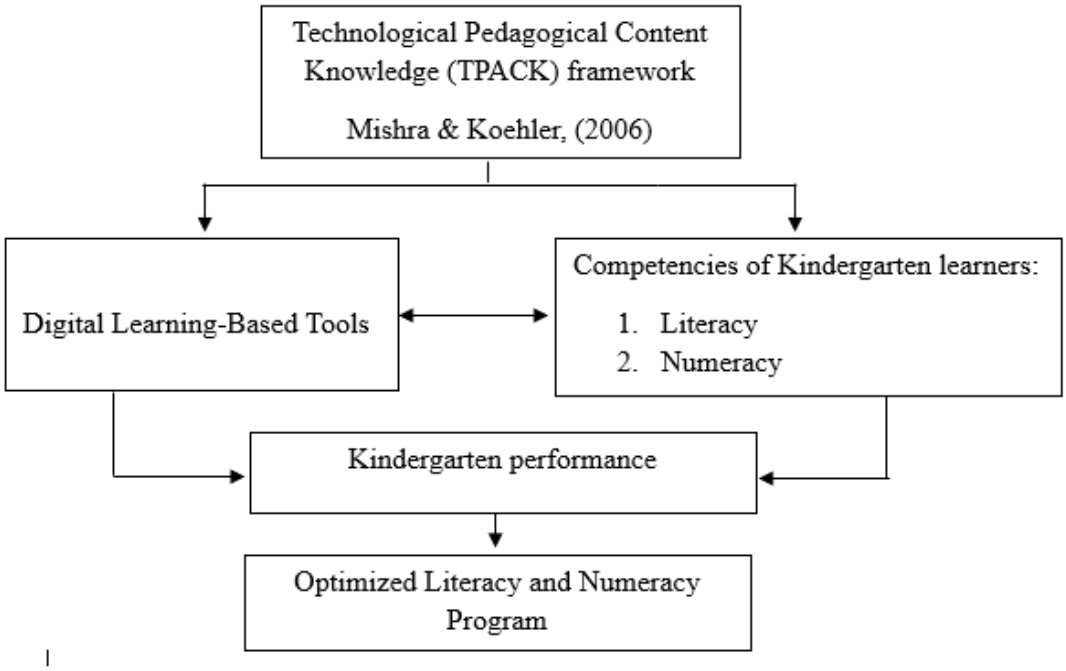
The Technological Pedagogical Content Knowledge (TPACK) framework asserts that an effective educational outcome requires a unified understanding of technology, pedagogy, and content knowledge. Technology for instructional use should be such that it can easily accommodate the cognitive and developmental capacities of students. Any digital tool purporting to support early literacy and numeracy ought to be intuitive, developmentally appropriate, and pedagogically sound in supporting meaningful learning experiences. Based on this principle, well-integrated digital learning environments responsive to early learner needs are highlighted. It highlights that teacher competence should not only lie in the use of technology but also in choosing and adapting digital tools appropriately across the vast learning contexts. Hence, professional development is necessitated for capacity building among educators to enable them to make prudent choices regarding the integration of digital tools within their classrooms.

Richard Mayer's Multimedia Learning Theory (2001) holds that learners understand and remember information more effectively when it is offered through more than one channel: for example, visual and auditory. Thus, digital learning tools adhere to this principle by offering multimedia—a combination of animated sequences, sound, video, and even interactive storytelling—within the process of teaching early literacy and numeracy to make the message clearer and better understood. All else being equal, such a platform would reduce extraneous cognitive loads; that is, clearly organize information so that learners can work with it at an active, learner-centered pace. Designed according to principles set forth by Mayer's Multimedia Learning Theory, digital tools for development in early childhood education might abstractly depict concrete, engaging activities for building primary literacy foundations. These theoretical frameworks collectively advocate for strategic, research-informed digital integration that is both instructionally sound and developmentally aligned.

Lev Vygotsky's Sociocultural Theory (1978) highlights the importance of social interaction, cultural settings, and the concept of scaffolding in cognitive development. The Zone of Proximal Development describes the difference between what a learner can do without help and what they can achieve with guidance or collaboration. Digital learning tools, especially interactive literacy and numeracy applications, can act as scaffolding, providing such things as immediate feedback, hints, and step-by-step help, allowing the child to learn beyond their present ability without much help from adults.

Similarly, Jean Piaget's Constructivist Theory (1952) describes that children build knowledge by actively exploring and solving problems. Piaget gave separate steps for the development of thinking; he noted that young learners gain literacy and numeracy skills through experience. Digital learning tools help constructivist learning because they allow children to manipulate virtual objects and numbers, recognize them, and support literacy skill development through interactive stories and gamified activities.

Figure 1
Schema of the Theoretical Framework of the Study



The Emergent Literacy Theory argues that the roots of literacy development spring from infancy and are largely shaped by the child's interaction with language, print, and reading-related experiences. Results have shown that early exposure to literacy-rich environments, especially digital platforms, significantly improves children's abilities to read and write. Through interactive storybooks and other 'literacy' applications, children get varied opportunities to develop phonemic awareness as well as vocabulary and comprehension -multimedia content remarkably conducive to learning!

Effective learning takes place when extraneous cognitive load is minimized– that is, when essential cognitive processes are allowed to work at their best. In this way, digital learning tools that feature intuitive interfaces, visual support, and interactivity may reduce the total cognitive load of children so that they can better concentrate on acquiring literacy and numeracy skills. Good educational applications present information in easily digestible pieces– how else could retention and understanding be improved?

Literacy and numeracy development relate to getting basic skills in these areas in young children. The use of digital tools greatly affects how kids develop these basic skills by giving interactive, flexible, and personal learning experiences.

Literacy growth involves sound awareness, letter knowing, word learning, and the first steps of writing. Online tools help make fun worlds where kids can take part in reading and telling stories with help from special features.

Numeracy growth includes number knowing, counting, pattern spotting, and simple math steps. Online tools help organize number practice and problem-solving games that build understanding.

Digital learning tools refer to technology-based resources, such as mobile applications, educational games, and e-books that will support early childhood education. Such tools help in improving literacy and numeracy skills through such factors as interactive engagement, personalized learning, immediate feedback, and collaborative learning. Interactive engagement refers to activities that capture the attention of children and keep them engaged; in personalized learning, the software adjusts content to fit the individual needs of learners. Immediate feedback offers reinforcement in terms of rewards, corrections, or even progress tracking; peer interaction opportunities and guided instruction by educators define collaborative learning.

The integration of digital learning tools in the teaching of literacy and numeracy among children has theoretical frameworks that base constructivist learning, engagement through multimedia, and pedagogy-based technology integration. It is also framed by how these digital tools relate to the children's cognitive development and teaching

strategies; therefore, it will enhance the learning experience of preschool children while promoting foundational literacy and numeracy skills. The theories discussed below will 'construct' the conceptual framework showing the relationship between digital tools and literacy and numeracy development in early childhood.

The Optimized Literacy and Numeracy Program is a strategic, data-informed pedagogical approach targeted at enhancing the capabilities of students in reading, writing, and mathematics. This plan comprises a mixture of evidence-based teaching methods emanating from focused interventions with adaptive learning technologies to take varying learning needs into consideration. Optimizing curricular, instructional, and assessment reforms for basic literacy and numeracy skills optimizes this program to upgrade students' academic performance in applying these skills in practical or real-life situations.

Literature Review

The launch of the iPad in 2010 marked a change in how mobile technology was used in education and more specifically in early childhood education. Since then, many studies have explored its effect on teaching and learning processes. However, despite the growth of mobile learning, research targeted to pre-kindergarten and kindergarten students is still minimal. For example, in a recent review by Huang et al. (2022), it is noted that while there is more research overall in early childhood about mobile learning, much of it is general and is not specific to important subject areas like literacy and numeracy.

In the broad scope of digital learning in early education, recent literature has shifted its focus toward exploring how young learners and their educators perceive the usefulness of technology. Research by Zhang and Lin (2021) emphasized that digital tool integration is often influenced by teachers' digital competence and attitudes. Studies like those from Alghamdi & Higgins (2020) and Kim et al. (2023) examined how digital tools contribute to literacy outcomes, while relatively fewer studies have focused on numeracy development, like McCarthy et al. (2021). Since teachers' comfort levels and pedagogical knowledge have a great influence on how technology is used in classroom settings, as noted by Kao et al. (2021), this review first examines teachers' perceptions, then discusses how digital tools like iPads support literacy and numeracy, and finally addresses concerns associated with their use in early learning environments.

Teachers' Perceptions of Technology Integration

Preschool teachers do not use digital tools as much as their counterparts at the elementary level. It has been shared that this difference is mainly because of less availability of devices and weaker lessons on how to use technology. Recent findings by Chen & Siry (2021) suggest that this disparity is largely due to limited access to devices and insufficient training in technology integration. Professional development helps give early childhood educators effective strategies for meaningful digital tool use.

A study involving early years teachers pointed out how iPads served as important tools in literacy teaching. The teachers used the devices to provide differentiated instruction and immediate feedback, making them effective supplementary resources during individualized and small-group learning. In addition, teachers found that digital tools helped with lesson preparation and classroom management, especially in settings with limited resources. (Wang et al., 2022)

The Role of Interactive Technology in Early Literacy Development

Several recent studies have brought forward the fact that using tablets for 'literacy teaching' has several benefits. Ghanbari and Nowroozi (2021) said that digital storytelling apps helped in better word learning and sound understanding of young students. Similarly, Sari et al. (2020) found that kids' willingness and interest went up a lot when using touch screen devices, which gave a simple and back-and-forth way. In the classroom study of Park and Nam (2022), iPads and simple educational apps were put into preschool environments. It was noted that kids who usually struggle with regular pencil-and-paperwork became more confident and engaged. The touch-based system helped these kids share their thoughts better and work with classmates. A study by Mitchell et al. (2023) showed that interactive e-books and learning games promoted both solo learning and peer teamwork, ending in major literacy gains.

Academic performance, particularly in phonological awareness and vocabulary development, has been observed to improve with tablet-based learning. Lee and Song (2023) concluded that structured use of mobile learning apps in early education settings has measurable effects on literacy, especially when instruction is scaffolded by trained teachers.

The Impact of Digital Play-Based Tools on Numeracy Development

Whereas literacy is under much more focus in the literature, digital technology has a minor role in the facilitation of early numeracy development. However, evidence is emerging that these tools can be very beneficial. Holmes and Butterworth (2020) indicated that math-oriented applications, framed within pedagogical principles for early childhood, enhance children's number sense as well as their problem-solving abilities.

Kwon et al. (2021) examined many numeracy apps made for preschool kids and found that children showed a stronger grasp of counting, pattern noticing, and basic math when playing with interactive games made with clear learning goals. Importantly, the study highlighted the need to choose apps that promote conceptual understanding instead of just rote practice.

The findings have been generally optimistic, but achievement gains remain a lacuna of consensus among the researchers. For example, Park and Lee (2023) reported that some children improved their basic mathematical skills, and others saw no significant change; more precisely, the application lacked real-world relevance or had no interaction, which is underlining the importance of integrating applications within play-based learning. Another study by Lim and Cho (2022) showed that numeracy learning happened best when digital tools were introduced in flexible environments of child-led play.

Addressing Concerns About Interactive Technology in Early Learning

Though the benefits of learning by interaction have been talked about at length, there is still a lingering worry about the possible harm that using digital tools may have on children. Most of the criticisms talk about the dangers of reduced development of fine motor skills and effects from screens. However, recent studies make a difference between sitting in front of a screen and using technology deliberately. For example, Carter et al. (2021) said that interactive digital activities encourage thinking involvement and sharing how people work together, which separates them from passive ways of using media.

The American Academy of Pediatrics and the National Association for the Education of Young Children have advocated for balanced use and underscoring structure, age-appropriateness, and teacher involvement in using technology and media. Structured implementation that can work with play-based, hands-on activities helps reduce risks and improve educational outcomes in children (NAEYC, 2022).

Research by Yoon and Kim (2024) supports this balanced view by the two American organizations, showing that using digital tools for collaborative play leads to enhancements in both academic outcomes and social-emotional development. Their study recommends that early childhood programs should integrate technology in a manner that promotes inquiry, creativity, and peer interaction rather than isolating the learners with screen-based tasks.

Summary of the reviews

The incorporation of digital play-based learning tools has proven promising in the development of literacy and numeracy in young children. The concerns about screen exposure and its effects on the development of motor skills, however, remain valid. It is through a research-driven approach that educational applications were made with pedagogical design to improve motivation, engagement, and learning outcomes. Future investigations could look at the traits of apps that very well catch young learners in a play-based setting, making sure digital tools are both fun and educationally good. By giving teachers enough professional growth and access to high-quality digital resources, tech can be used by early childhood education to best help with foundational learning experiences. When kids are having fun in digital worlds, they often show greater levels of focus and effort. The game-like parts offered in many apps— such as quick feedback, rewards, and stories— have been proven to keep attention and support repeated learning cycles. The digital tools have the potential to customize teaching by meeting the varied learning speeds and needs of a single class. This, in turn, gives educators useful information from the data created by these applications that supports them to make more focused assistance and intervention. Education should not stop transforming in this time of digitization; rather, it needs an equilibrium between screen time and meaningful hands-on learning for the wholesome development of learners

METHODOLOGY

This section discusses the methods used, the research environment, research participants, sampling technique, research instrument, data-gathering process, and data analysis method to ensure the proper and accurate conduct of the study.

Methods

This study used descriptive-correlational research to look at the use of digital play-based learning tools in teaching early literacy and numeracy as well as their relationship with kindergarten learners' competencies. A descriptive design was used to find out how much preschool teachers used these digital learning tools, and a correlational one

for exploring the relationship between the usage of these tools and the learners' literacy and numeracy competencies. This combination enabled both a critique of current practice and an assessment of its measurable effects on student outcomes. The study sought to find patterns and trends in the use of digital tools that relate to better performance by learners and establish those relationships so it can suggest evidence-based recommendations for improving instructional methods. It can also help bridge a significant gap in knowledge about how technology aids primary skill building at the key stage 1 learners. Through this design, more effective evaluation could take place between educators and policymakers about which digital interventions are most impactful. Holistically, this gave the understanding of the influence of play-based techno tools on early childhood academic development.

The study would solely depend on secondary data collection, that is, data mining from already available academic records- the quarterly test results of kindergarten students. There would be no direct interaction with the students, as competencies in literacy and numeracy would be determined based on documented test results noted by their teachers. This procedure makes sure there is an unobtrusive and ethical way of collecting data, protecting the privacy as well as the interests of the young learners. Using archived records enables the researcher to work with authentic data that accurately reflects real classroom situations and assessment practices. Furthermore, relying on teacher-recorded results ensures that the information reflects their professional judgment as qualified educators; therefore, only verified and consistently reported test scores would be included in the analysis. This increased the credibility of the results and at the same time caused minimal disturbance to the normal functioning of the classes. It also afforded the opportunity to the researcher to examine large data sets over a period of time, hence providing a better understanding of longitudinal patterns in learner performance.

Environment

This study was conducted at the Alchemist Child Minding Center in Upper 4 Tunghaan, Minglanilla, Cebu. The school focused on early childhood education, emphasizing a child-centered approach that encouraged creativity and curiosity alongside basic literacy skills. In line with its mission to nurture young learners in a stimulating and supportive environment, the institution used both traditional and digital learning aids for the development of early literacy. The school has 25 staff members, both teaching and non-teaching, who work together to develop preschool children holistically. Over the years, the school has built up a good name for innovative educational practice with structured programs around how best to support early literacy through interaction and play-based activities; therefore, this is an ideal setting where one can explore the role of digital play-based learning tools for preschool children concerning effects upon literacy enhancement and related challenges. The curriculum of the school integrated learning through themes with play and interaction with technology so that children become interested and retention by them is increased. Classrooms had digital storybooks, child-friendly tablets, and internet access for supporting multimedia learning experiences. Learning corners were planned to help students explore both individually and as a group, making use of physical and digital resources. The school also conducted regular monitoring and documentation of student progress, which helped in academic data analysis for research purposes.

Participants

This study involved six preschool teachers and 90 kindergarten learners at the Alchemist Child Minding Center. These teachers were selected for their direct experience using digital play-based learning tools in the literacy instruction of children; hence, their insights would be relevant to the effective implementation of such tools. Learners were not directly involved in data collection; rather, their existing academic records will be used to determine the impact of digital tools on literacy and numeracy development. All participating teachers have at least three years of teaching experience and hold degrees in early childhood education. They have also received training in educational technology from basic to advanced levels and use digital tools regularly for classroom instruction. Such selection ensures credibility and depth of analysis regarding instructional strategies. Demographic information of the learners, like age, gender, and attendance, was also looked at to give background for their academic results. This careful choice of participants makes the study more trustworthy and important in looking at digital help in preschool places.

Sampling Technique

This study adopted a total enumeration approach whereby all teachers handling kindergarten classes are taken as respondents. The educators would fill out a standardized questionnaire toward giving their views on the effectiveness of digital play-based learning tools in the teaching of early literacy and numeracy. It thus ensures adequate information coverage of the whole population of interest and improves the validity and representativeness of findings. The questionnaire had both closed-ended and open-ended items that allowed for capturing quantitative data as well as qualitative insights into their teaching practices and experiences. From their responses, common trends, challenges, and effective strategies for integration of digital tools in the classroom will be identified. By involving all kindergarten teachers, the study aims to gain a complete understanding of how digital play is used in different teaching environments. This method also reduced sampling bias and made sure that the unique views of each educator in the center were properly shown in the results.

Instrument

The literacy and numeracy skills of the kindergarten learners were assessed based on their quarterly examination results, which were obtained directly from the teachers' class records. Using a standardized questionnaire, teachers' insights regarding the learners' proficiency in literacy and numeracy were gathered. This questionnaire was adapted from validated assessment tools, including the Technology Integration Matrix (TIM) by the Florida Center for Instructional Technology and the ISTE Standards for Educators. Importantly, no direct learner participation occurred during the data collection process; only their existing exam records, as documented by their teachers, were used for analysis. This approach allowed for a comprehensive evaluation of both the teachers' perspectives and the learners' academic performance without requiring direct interaction with the students.

To interpret the extent of digital tool integration in classroom instruction, a descriptive scale was used. At the lowest level, negligible use referred to situations where digital tools were either absent or applied in ways that did not meaningfully support teaching. The basic level described occasional use, with limited impact on instructional strategies. When digital tools were used consistently to support learning objectives, this was categorized as appropriate. The purposeful level reflected deliberate integration, where digital learning tools were carefully applied to enhance teaching delivery and actively engage learners. Transformative use indicated that digital learning tools were seamlessly embedded into instruction, significantly enriching the learning experience and promoting innovative, learner-centered teaching practices.

Data Gathering

The data-gathering process took place in three distinct phases: pre-data collection, actual data collection, and post-data collection. This structured approach ensured that the data collected remained valid, reliable, and ethically sound while maintaining the integrity of the research.

Pre-Data Collection. Before initiating the study, the researcher obtained approval from both the Graduate School Dean of the University of the Visayas and the principal of Alchemist Child Minding Center to involve the teachers as participants. Written consent was secured from the school head, authorizing engagement with selected teachers who shared insights on the use of digital play-based learning tools in literacy and numeracy instruction. In addition, ethical clearance was sought from the Research Ethics Committee (REC) to ensure compliance with established ethical standards. An orientation was conducted with the participating teachers to explain the purpose, scope, and expectations of the study, emphasizing that their participation was voluntary.

Actual Data Collection. Following the necessary approvals, the data collection phase commenced. The primary participants consisted of six preschool teachers from the Alchemist Child Minding Center. Each teacher answered a standardized questionnaire that captured their perspectives on the use and perceived effectiveness of digital play-based learning tools in early literacy and numeracy instruction. The same tool was also used to assess the literacy and numeracy performance of the kindergarten learners by referencing their quarterly examination scores. These scores were retrieved directly from the teachers' class records. To preserve ethical standards, no direct interaction with the learners occurred during this process; only their documented academic records were used for evaluation.
Post-Data Collection. After completing the data collection, the researcher compiled all questionnaire responses and organized the learners' assessment results for analysis. The collected data were carefully processed and interpreted in alignment with the ethical protocols set during the planning phase. All data remained confidential and were accessible only to the researcher. Upon conclusion of the study, all raw data were permanently deleted to protect the privacy and identity of participants. The final analysis aimed to draw meaningful insights into the influence of digital play-based learning tools on preschool learners' literacy and numeracy performance, with the goal of contributing to improved instructional strategies in early childhood education.

Data Analysis

The current study made use of means, standard deviations, and Pearson r to analyze data as guided by the sub-problems of the study. Through these statistics, it was possible to corroborate the influence that digital play-based learning tools have on kindergarten learners' literacy and numeracy skills. To determine the level of use of digital learning tools by preschool teachers, the mean and standard deviation of their responses to a standardized questionnaire will be calculated. While the mean would provide an overall average for tool usage among teachers, the standard deviation would indicate how much variation there is in their responses; that is, whether the use of digital learning tools is an even more constant factor among educators or varies widely. This would give information about how well digital tools have been embedded within early childhood teaching. A high standard deviation may point to a greater need for general training aimed at normalizing digital tool usage across different classrooms. In contrast, a low standard deviation would mean that the digital strategies are implemented in a more consistent way among educators. These findings will be used to assess the center's readiness for scaling up technology-enhanced instruction to measure the abilities of kindergarten students in reading and writing, math, and the average, and how much their scores vary will be calculated using information taken from teachers' notes. The average would show

overall how well the students did in reading and writing skills, giving a summary of their skill level. The variation would show how much the scores differ, thus pointing out differences in learning success among the students; this would help identify differences in how well different groups perform that might be affected by differences in teaching methods or student readiness or availability of online materials. Reading into the data, one has to consider other factors like class size or teacher experience that could lead to such differences. A pattern of wide variability may indicate a need for differentiated instruction and targeted interventions. More uniform performance may indicate that existing teaching strategies, integrated with digital components, are effectively addressing the majority of learners. This statistical insight was critical in designing responsive, evidence-based educational programs. To determine if there was an association between the use of digital learning tools and learner competencies, Pearson r would be applied. This test statistically measured the strength and direction of the relationship between two variables: teachers' reported use of digital tools as learning resources (independent variable) and learners' assessment results (dependent variable). A positive correlation would imply an increase in usage is associated with increased literacy and numeracy competency; a negative or weak correlation would imply there is little or no relationship between these factors.

Statistical significance would also be considered to see whether any of the observed relationships happened by chance. More so, disaggregated data could indicate whether certain subgroups showed different patterns of correlation, for example, boys versus girls and age categories. Such a deeper level helps make sense of how various learner characteristics may coordinate with their exposure to digital tools. If a strong correlation is identified, it could strengthen arguments for more investment in digital infrastructure and teacher training. The use of Pearson r here would not just quantify associations but also help in strategically designing curriculum interventions.

To determine the literacy and numeracy skills that kindergarten learners have the least mastery of mean scores for components of these skills would be taken. The lowest mean-scored skills would be assumed to be the least mastered ones and therefore require supplemental instructional emphasis. Standard deviation values would further clarify how much variability there is in the performance of learners in those areas of skill and show specific learning gaps within the group. A low-scoring average and a high standard deviation would direct remedial efforts that need to be focused on particular skills. Such an elaborate approach helps more precisely identify particular competencies where learners are having trouble rather than relying on somewhat cruder, more general categorizations; digital play-based activities can therefore specifically address these identified areas of weakness as part of its focused intervention plans. Bar graphs or tables may help in showing these gaps for better understanding. This part of the analysis is very important because it helps tailor the digital learning program to better meet the developmental needs of young learners.

Based on the findings, a literacy and numeracy program should be crafted to maximize the exploitation of digital play-based learning aids. This program would target those skills least mastered in an effective integration of digital tools into preschool instruction as structured and guided learning experiences. Drawing from insights obtained through statistical analysis, the proposed program is set to improve early childhood education with fresh, data-informed methodologies. Teacher feedback and learner outcomes would guide the selection and tuning of suitable digital tools. It will also recommend professional development sessions for teachers to enable them to extract the maximum educational value from these aids.

The program would advocate a balanced approach between screen-based learning and hands-on interactive play. The pilot test of this intervention may run to evaluate its feasibility and impact a little before wider implementation. In the long term, the study would try to contribute to technology-enhanced learning environments that are supportively sustainable in promoting growth in literacy and numeracy starting from the earliest stages of development.

Ethical Consideration

This study adhered to rigorous ethical standards to ensure the protection and respect of all participants. Informed consent was obtained from all participants, including parents or guardians, prior to their involvement. Confidentiality was maintained by anonymizing data and securely storing all information. Participants' rights and well-being were prioritized, and the research was conducted with transparency and integrity. All procedures complied with institutional guidelines and ethical research practices.

Beneficence. Beneficence imposed a duty on researchers to minimize harm and maximize benefits. Human research was intended to produce benefits for participants or, in a more common situation, for others.

Respect. Respect for human dignity was the second ethical principle in the Belmont Report. This principle included the right to self-determination and the right to full disclosure.

Justice. The third broad principle articulated in the Belmont Report concerned justice, which included participants' right to fair treatment and their right to privacy.

Content, Comprehension and Documentation of Informed Consent

Participants Status. Prospective participants needed to understand the distinction between research and treatment. They should have been informed about which healthcare activities were routine and which were implemented specifically for the study. They also should have been made aware that the data they provided would be used for research purposes.

Study Goals. The overall goals of the research should have been stated in lay rather than technical terms. The use to which the data would be put should have been described.

Type of Data. Prospective participants should have been informed about the type of data that would be collected, specifying whether it was quantitative or qualitative.

Procedures. Prospective participants should have been given a description of the data collection procedures and the procedures to be used in any innovative treatment.

Nature of Commitment. Participants should be told the expected time commitment at each point of contact and the number of contacts within a given timeframe.

Sponsorship. Information on who sponsored or funded the study should have been noted; if the research was part of an academic requirement, this information should have been shared.

Participant Selection: Prospective participants should have been informed about how they were selected for recruitment and how many people would be participating.

Potential Risk: Prospective participants should have been informed of any foreseeable risks (physical, psychological, social, or economic) or discomforts, along with the efforts that would be taken to minimize these risks. The possibility of unforeseeable risks should also have been discussed, if appropriate. If injury or damage was possible, treatments that would be made available to participants should have been described. When risks were more than minimal, prospective participants should have been encouraged to seek advice before consenting.

Benefits: Participants might have benefited from access to an intervention that could otherwise be unavailable to them, and they might have found comfort in discussing their situation or problem with a friendly, objective person. They could also have gained increased self-knowledge, either through opportunities for introspection or through direct interactions with the researcher. Additionally, participation might have offered a welcome escape from routine and the excitement of being part of a study, along with the satisfaction of knowing their contributions could help others with similar conditions. Finally, they might have received direct monetary or material incentives, such as stipends or other rewards.

Potential Benefits. Other possible benefits
Alternatives: If appropriate, participants should have been informed about alternative procedures or treatments that might have been advantageous to them.

Incentives and Compensation: If stipends or reimbursements were to be paid (or if treatments were offered without fee), these arrangements should have been discussed. It should have been declared whether the compensation was monetary or not, and if it was not, other options for giving back to the respondents should have been outlined.
Confidentiality Pledge: Prospective participants should have been assured that their privacy would always be protected. If anonymity could be guaranteed, this should have been stated.

Confidentiality Procedure study participants had the right to expect that the data they provided would be kept in strict confidence. Participants' right to privacy was protected through various confidentiality procedures. Anonymity, the most secure means of protecting confidentiality, occurred when the researcher could not link participants to their data. When anonymity was impossible, confidentiality procedures needed to be implemented. A promise of confidentiality was a pledge that any information participants provided would not be publicly reported in a manner that identified them and would not be accessible to others. This meant that research information should not be shared with strangers or with people known to participants (e.g., relatives, others) unless participants gave explicit permission to do so. Researchers could take several steps to ensure that a breach of confidentiality did not occur, including the following: First, identifying information (e.g., name, address) from participants should have been obtained only when essential. Next, an identification (ID) number should have been assigned to each participant, and the ID number should have been attached to the actual data instead of other identifiers. Third, identifying information should have been maintained in a locked file, with access restricted to only a few people on a need-to-know basis. Identifying information should not have been entered onto computer files, and any identifying information should have been destroyed as quickly as practical. Additionally, research personnel should have signed confidentiality pledges if they had access to data or identifying information. Lastly, research information should have

been reported in the aggregate; if information for an individual was reported, the person's identity should have been disguised, such as through the use of a fictitious name.

Authorization to Access Private Information. The authorization to access private information was integrated within the consent form, specifying who would receive access to participants' information. Participation in the study was entirely voluntary, with no penalties or loss of benefits for those who chose not to participate. Additionally, participants retained the right to withdraw from the study at any time or withhold specific information, with researchers outlining any conditions under which they might need to end the study on participants' behalf.

Contact Information. The researcher should have informed participants whom they could contact in the event of further questions, comments, or complaints. The UV-IRB Ethics Review Panel approved the study and could be reached through the following contact information regarding the rights of study participants, including grievances and complaints:
University of the Visayas- Institutional Review Board
5th floor, Inday Pining Building
Colon Street, Cebu City
Telephone No. (032) 253-7401 local 116 or email at: rec@uv.edu.ph

Debriefing, Communications and Referrals. A researcher could show respect and minimize emotional risks by interacting graciously with participants, phrasing questions tactfully, and being sensitive to cultural and linguistic diversity. To further demonstrate concern for participants' well-being, the researcher might have offered a debriefing session after data collection, especially if the process was stressful or involved minor ethical adjustments, such as the use of deception. Following up with participants after the study to express appreciation for their involvement would also have been considerate, and, when appropriate, the researcher might have assisted participants by providing referrals to relevant health, social, or psychological services.

Conflict of Interest. A conflict of interest arose when financial or personal considerations had the potential to compromise a researcher's objectivity or professional judgment. This included both apparent conflicts, where a reasonable person might suspect a bias, and potential conflicts, which could develop into actual conflicts. It was essential to understand that a conflict of interest signified only the potential for bias, not an actual influence on decisions. Additionally, a conflict of interest did not constitute research misconduct, as misconduct was strictly defined as fabrication, falsification, or plagiarism. For IRB approval, a statement of agreement acknowledging and managing any conflicts should have been submitted in the template provided.

Treatment of Vulnerability Groups. The researcher working with vulnerable populations, such as individuals unable to give fully informed consent (e.g., those with mental disabilities) or those at risk of unintended side effects (e.g., pregnant women), took special ethical precautions throughout the study. Following established guidelines on informed consent, risk/benefit assessment, and approved procedures, the researcher ensured that studies involving high-risk groups were conducted only when the risk/benefit ratio was low or when no alternative existed. For child participants, who could not legally or ethically provide informed consent, the researcher obtained consent from a parent or legal guardian and sought the child's assent when appropriate, particularly for children aged 7 and older. For older children, such as those around age 12, the researcher obtained written assent to further respect their autonomy. In conducting the study, the researcher adhered to ethical guidelines, including those outlined by Lindeke and colleagues (2000) and Kanner and colleagues (2004), and followed additional protections for children detailed in Subpart D of the Code of Federal Regulations

RESULTS AND DISCUSSION

This section presents the data that have been fully analyzed, which were obtained from the responses of kindergarten teachers and recorded student academic performance. The findings will look at how digital learning tools are used in the classroom, the teachers' perceptions of their effectiveness, and how these relate to a student's literacy and numeracy results. It also looks at possible links between using digital tools and developing academic skills. Interpretation is informed by relevant literature within early childhood education frameworks to contextualize findings appropriately. The main access trends to digital tools are outlined- both the most frequently used applications and areas with much weaker digital presence. Student performance differences are considered alongside their instructors' technology practices, uncovering evidence that suggests highly specific use of digital resources that may impact learning gains. Teachers expressed both enthusiasm and concern, citing motivation and engagement as benefits but noting challenges related to limitations of devices and time. Further comparison is made between the results in different classes to see how consistent the outcomes are. In general, these findings cast a comprehensive view on how digital play-based tools impact classroom learning and inform instructional decisions.
Usage of Digital Learning Tools of Kindergarten Teachers

The first table focuses on how kindergarten teachers assimilate digital learning tools into their teaching practices. The tools ranged from interactive storybooks to numeracy apps. They analyzed based on their usage frequency and

purpose. The data showed that most teachers regularly used digital learning tools to introduce new concepts and strengthen lessons through guided play. Additionally, the table showed that such tools were most frequently used during literacy instruction, while numeracy-related applications were used less frequently.

Table 1
Extent of Digital Learning Tools Usage of Kindergarten Teachers

No.	Indicators:	Mean	SD	Description
1	I integrate digital play-based learning tools in literacy lessons (e.g., interactive storybooks, phonics apps).	4.67	0.516	Strongly Agree
2	I use digital games or applications to teach numeracy skills (e.g., counting, number recognition).	5.00	0.000	Strongly Agree
3	Digital tools are incorporated into group activities to enhance engagement.	4.83	0.408	Strongly Agree
4	I provide learners with individual digital tasks.	1.00	0.000	Strongly Disagree
5	Digital learning tools supplement my traditional teaching methods.	4.83	0.408	Strongly Agree
6	I utilize digital platforms to assess learners' literacy and numeracy skills.	4.83	0.408	Strongly Agree
7	Digital tools are part of my lesson planning and instructional design	4.67	0.516	Strongly Agree
8	I receive training or professional development on using digital tools for literacy and numeracy instruction.	3.17	0.753	Somewhat Agree
9	I experience technical challenges that hinder the integration of digital tools.	3.00	0.000	Somewhat agree
10	I collaborate with colleagues to enhance digital learning practices in the classroom.	5.00	0.000	Strongly Agree
	Average	4.10	0.141	Purposeful

Legend: 1.00-1.80=Strongly Disagree/Not Purposeful, 1.81-2.60=Disagree/Less purposeful, 2.61-3.40=Somewhat agree/Somewhat Purposeful, 3.40-4.20=Agree/Purposeful, 4.20-5.00=Strongly Agree/Strongly Purposeful

The data shows that kindergarten teachers demonstrated a purposeful use of digital learning tools. These tools were not treated as supplementary add-ons but were deliberately integrated in classes to enrich instruction. Teachers infused digital resources into both literacy and numeracy activities, being present in lesson planning and classroom routines.

The use of digital learning tools like digital games and applications for teaching concepts relating to numeracy was the most notable part of the data in the table. Teachers used such digital learning tools to support number recognition, counting, and early arithmetic through interactive and engaging platforms. One teacher shared that "When I use math games with animated characters, the children really focus—they get excited about counting and love repeating the levels until they get it right. It's like learning without them realizing they're learning." This is affirmed by Yelland et al. (2021), who state that game-based digital learning enhances mathematical understanding by presenting concepts in playful and developmentally suitable formats.

In literacy, digital tools such as interactive storybooks and apps related to phonics were also utilized in a useful manner. These resources were not only limited to isolated lessons but were also integrated into group work, assessments, and the overall instructional design of the teacher. As one teacher put it, "We always start our literacy block with a short phonics video. The kids sing along, and by the end of the week, they've memorized the sounds without needing flashcards." Plowman and Stephen (2020) similarly noted that when digital play is aligned with learning goals and is connected within routines, it fleshes out early literacy development.

However, a significant gap was observed in the use of individualized digital learning tasks. Many teachers seldom assign digital activities that fit individual learners, often due to limited access to related tools or unavailability of devices. "I would love to give each child their own reading app," one teacher explained, "but we only have five tablets and 25 kids. We end up doing everything in groups." Alper and Irwin (2021) presented similar challenges in early learning environments wherein infrastructure issues often hinder different technology use by each teacher and child. Meanwhile, Neumann and Kaefer (2019) found that at home, children benefit from customized apps that support emergent literacy development—highlighting the opportunity to improve classroom and home-based practices.

Teachers also noted limited access to sustained training in digital instruction, which expressed a need for professional development programs that offer hands-on strategies for using technology in early childhood settings. "Most of what I know about digital tools, I figured out on my own or learned from co-teachers," one teacher admitted. This mirrors Lindahl and Folkesson's (2020) emphasis on the need for practical, ongoing training to build educator confidence and competence in digital integration.

Technical issues still exist in digital instructional material but did not pose major barriers to integration. Teachers were able to adapt to such issues and rely on strong peer support systems. One participant shared, "When I couldn't open a program last week, my colleague helped me troubleshoot it during break time—we always find ways to help each other." This cooperative culture echoes Murray et al.'s (2022) findings, which highlighted the importance of professional learning communities in sustaining technology use in early education.

Teachers noted that, generally, children in these classrooms could identify uppercase and lowercase letters, letter sounds, and form simple words. Teachers also noted that learners followed stories closely, repeated familiar phrases, and completely expressed ideas. Media like videos and games appeared to enhance acquiring vocabulary and fluency in reading. In numeracy, children showed progress in counting, number recognition, and simple operations, though some needed additional support and repetition.

This has great implications for classroom practices and educational policy. More general access to adaptive digital tools will allow personalized learning, so children can learn at their own pace. Targeted professional development will make educators understand how to effectively use digital tools. Better infrastructure—such as internet access that works well and enough devices—will help lower the problems happening and make sure usage continues. The current collaborative culture among teachers can be used to set up formal peer mentoring and learning groups focused on digital innovation.

In conclusion, the use of digital tools in early education had already been proven purposive and effective. However, the shortcomings in the personalization of lessons, professional training, and infrastructure need to be addressed for more significant impact. The teachers' firsthand experiences have made them realize the need for much more systemic support to effectively achieve the potential of digital learning towards fostering both literacy and numeracy skills among young learners.

Perceived Effectiveness of Digital Learning Tools

To better understand the impact of digital learning tools in early childhood education, kindergarten teachers were asked to rate their perceptions based on instructional value, engagement, and academic outcomes. Their responses offer analysis into both the strengths and limitations of digital integration in the classroom, including its role in enhancing literacy, numeracy, and learner autonomy.

Table 2
Perceived Effectiveness of Digital Learning Tools

No.	Indicators:	Mean	SD	Description
1	Digital tools enhance learners' literacy skills	4.33	0.516	Strongly Agree
2	Digital play-based tools improve numeracy proficiency	4.33	0.516	Strongly Agree
3	Learners show higher engagement in digital-assisted lessons.	5.00	0.000	Strongly Agree
4	Digital tools help cater to diverse learning styles.	4.67	0.516	Strongly Agree
5	The use of digital learning tools fosters independent learning.	3.00	0.000	Somewhat Agree
6	Digital learning tools improve assessment accuracy and tracking of progress.	4.17	0.408	Agree

7	I feel confident in using digital tools effectively in my teaching.	5.00	0.000	Strongly Agree
8	Digital tools positively impact students' motivation and interest in learning	5.00	0.000	Strongly Agree
9	Digital learning-based tools facilitate differentiated instruction for diverse learners.	4.83	0.408	Strongly Agree
10	The use of digital tools has led to measurable improvements in literacy and numeracy outcomes.	5.00	0.000	Strongly Agree
	Average	4.53	0.103	Highly Effective

Legend: 1.00-1.80=Strongly Disagree/ Not Effective, 1.81-2.60=Disagree/ Less Effective, 2.61-3.40=Somewhat Agree/Somewhat Effective, 3.40-4.20=Agree/Effective, 4.20-5.00=Strongly Agree/Strongly Effective

These findings show that kindergarten teachers perceive digital learning tools as highly effective in enhancing both instruction and learning. Between different indicators, there is strong agreement that these tools have a meaningful contribution to early childhood education. Teachers constantly emphasized that digital resources increase learner engagement, build motivation, and strengthen their own confidence in delivering lessons through technology. They also believe that these tools play a significant role in improving literacy and numeracy outcomes.

High levels of learner engagement and interest were often linked to the interactive and gamified nature of digital tools. Recent studies support this observation. Wang and Liao (2022) found that young learners show increased enthusiasm and consistent focus when digital content is incorporated in play and interaction. Similarly, when educators feel confident using technology, their instruction tends to become more responsive and effective, something Ahmad and Rehmani (2021) were able to discover in working on digital teaching competence in early learning environments.

Teachers emphasize the value of digital learning tools in supporting different learning styles and differentiated instruction. Enhancing learning content and presenting concepts visually, audibly, or in a kinesthetic manner allows for greater inclusivity in the classroom for children, supporting the claim by Brown and Davis (2021) that technology in the early childhood stage can help meet diverse learner needs more effectively than mere traditional methods.

Despite perceived effectiveness being high overall, one area stood out as less emphasized—fostering independent learning. Teachers expressed doubts about whether digital learning tools were enough to promote learner autonomy, especially among very young children, reflecting findings by Lau and Yuen (2020), who noted that while most digital platforms in early education are excellent for group engagement, they are often unsuccessful in encouraging self-directed learning. Similarly, Neumann and Kaefer (2019) reported that young learners can demonstrate emergent independence when using age-appropriate apps at home, suggesting that the classroom environment may limit such behavior due to structure or resource constraints.

Teachers also observed specific academic benefits from consistent use of digital tools. Learners reportedly became more confident in recognizing letters, blending sounds, and performing basic counting tasks. Even children who were initially shy were more likely to participate during activities that involved digital games or interactive visuals. These tools were also credited for making difficult concepts easier to grasp through animated demonstrations, engaging visuals, and timely feedback.

Additionally, teachers reported that using digital platforms allowed them to monitor progress properly and adjust instruction based on what was needed. They emphasized that these tools should complement—not replace—hands-on play and real-life interactions, maintaining a balance between technology and traditional methods. As noted by Tan and Velasco (2022), effective integration of technology in early education lies in using it to build up the learning experience and not monopolize it.

This level of digital fluency can be used to support professional development and allow experienced teachers to teach their peers what the best practices are in integrating technology in learning instruction. Such initiatives can foster a culture of constant learning and collaboration within early childhood education settings.

With these insights, school administration and policymakers may consider integrating digital learning tools into formal early literacy and numeracy programs, with built-in systems for tracking progress and learner development. The data affirm that when thoughtfully managed, digital resources can enhance instructional quality, make learning engaging, and improve academic outcomes in early childhood settings.

Literacy and Numeracy Skills of the Kindergarten Learners

To assess the academic readiness of young learners, the study measured kindergarten pupils' literacy and numeracy competencies. These foundational skills are critical indicators of school preparedness and help determine the

effectiveness of early instructional strategies. Table 4 presents the results of this assessment, focusing on how learners performed in both domains, based on a 24-item evaluation for each skill area.

Table 3
Literacy and Numeracy Skills of the Kindergarten Learners

Skills	Number of Items	Mean	SD	Description
Literacy Skills	24	23.23	0.87	Above Average
Numeracy Skills	24	22.84	1.11	Above Average
Totality	48	46.08	1.64	Above Average

Legend: 22-24=Above average, 18-20=Average, below to17=Below Average

The data revealed that kindergarten learners demonstrated strong overall performance in both literacy and numeracy domains. These results suggested that early instructional efforts had successfully supported the development of foundational academic skills. Learners showed readiness in essential learning competencies expected at the kindergarten level, reflecting appropriate and well-implemented teaching strategies.

This outcome aligned with the findings of Fleer and Robbins (2020), who noted that early childhood programs that integrated structured instruction with developmentally appropriate activities, including digital play, promoted meaningful gains in academic readiness. The learners' consistently high performance across literacy skills also implied that the instructional environment had supported a wide range of abilities, helping children learn at their own pace and through various modalities.

In contrast, while numeracy skills also reflected above-average performance, they were relatively lower compared to literacy outcomes. Several factors may help explain this gap. First, teachers reported greater confidence in using digital tools for literacy instruction, which may have led to more frequent and effective integration in reading-related tasks. Numeracy, on the other hand, often required hands-on materials, step-by-step scaffolding, and repetition—resources and strategies that were not always consistently available or used in all classrooms. Second, learner engagement during math-related tasks appeared more difficult to sustain, particularly for children who struggled with number concepts or sequencing. Lastly, some classrooms faced limited access to age-appropriate digital numeracy tools, which affected the reinforcement of mathematical concepts outside of direct instruction.
The use of digital tools seemed to play a contributing role in supporting academic outcomes. As discussed earlier, the use of educational games, interactive storytelling apps, and visual content had enhanced learner engagement and comprehension. Herodotou, Rienties, and Boroowa (2021) found that digital learning experiences tailored to early childhood settings fostered deeper attention and adaptability, which may have contributed to the consistent literacy performance.

However, these positive outcomes must be balanced with a deeper understanding of conceptual mastery. Plowman and Stephen (2020) cautioned that strong performance in structured assessments did not always equate to transferable understanding. Children might succeed in familiar, guided tasks but still struggle in applying these skills independently or in less supported contexts. This highlighted the importance of varied and meaningful applications of learned concepts to build true comprehension.

In literacy skills, learners were generally able to recognize both uppercase and lowercase letters, identify letter sounds, and begin forming simple words. Teachers observed growth in learners' ability to follow stories, understand basic plot elements, and express ideas in their own words. Vocabulary building was often strengthened through visual and audio tools.

For numeracy skills, children showed progress in counting up to 20, recognizing numbers, and solving simple addition or subtraction problems with the help of visual aids. A few learners also began recognizing patterns or sequencing. That said, not all children developed at the same pace—some required more repetition, hands-on activities, and targeted support to master key math concepts.

One teacher shared, "When we used digital flashcards for letter sounds, my students were very responsive—they sang along and quickly picked up new words. But when I introduced number patterns using similar tools, some got distracted easily or needed me to walk them through each step. It showed me that for math, I need to combine tech with concrete objects like blocks or counters to really make the concept stick." This reflection highlights the varied impact of digital tools across subject areas and the importance of pairing them with tactile or visual aids to maximize learning.

These findings suggest several key ramifications. The above-average performance indicated that the kindergarten program was effective in laying the foundation for academic success in literacy and numeracy through the careful use of digital content that aligns with development goals together with traditional teaching, which may have contributed to such progress. The strong results presented an opportunity for teachers to introduce leveled or

enhanced activities for learners who had already demonstrated mastery, which can foster engagement and support further cognitive development.

Furthermore, learner performance consistency could serve as a basis for watching progress over time. Schools might use this data in future planning, identifying learning patterns, and monitoring learners' growth in both literacy and numeracy. As Tan and Velasco (2022) emphasized, constant documentation of learner progress helps ensure a responsive and flexible early learning program.

In summary, learners' above-average skills in both literacy and numeracy attest to the effectiveness of current instructional practices. To sustain this momentum, however, would require constant teacher support, a responsive and evolving curriculum, and strategies that allowed for differentiated instruction to meet the varied needs of young learners.

Correlation Between Learners Literacy and Numeracy Skills and their Teachers Usage of Digital Tools
It was hypothesized that teachers' usage and perceptions of digital learning tools would influence learners' literacy and numeracy skills. Table 5 presents the results of the correlation analysis, offering insights into the extent to which the instructional use and perceived effectiveness of digital tools relate to actual student performance in these two foundational learning areas.

Table 4
Correlation Between Learners Literacy and Numeracy Skills and their Teachers Usage of Digital Tools

Pair of Variables	r value	P value	Decision	Significance
Literacy Skills and Usage of Digital Tools	0.336*	.001	Reject Ho	Significant
Literacy Skills and Perceived Effectiveness of DT	0.303*	.004	Reject Ho	Significant
Numeracy Skills and Usage of Digital Tools	0.047	.708	Do not reject Ho	Not Significant
Numeracy Skills and Perceived Effectiveness of DT	0.096	.399	Do not reject Ho	Not significant

*N=90 *significant at >.05*

The data in the table revealed key insights into the relationship between kindergarten learners' academic skills and their teachers' use and perception of digital learning tools. A moderate positive correlation was observed between learners' literacy skills and both the frequency of digital tool usage by teachers ($r = 0.336$, $p = .001$) and their perceived effectiveness ($r = 0.303$, $p = .004$). These relationships were statistically significant at the 0.05 level, leading to the rejection of the null hypothesis in both instances. This indicated that learners tended to perform better in literacy when teachers actively used and valued digital tools in their instructional practices.

This result aligned with the findings of Neumann and Kaefer (2019) and Brown and Davis (2021), who reported that digital storybooks, phonics games, and interactive reading applications contributed to improvements in vocabulary, comprehension, and reading fluency. These tools offered multimodal input and opportunities for repeated exposure—features that matched the natural acquisition process of language in young children. The positive correlations in this study supported the idea that when integrated meaningfully, digital tools could significantly enhance early literacy learning.

In contrast, the correlation between numeracy skills and teachers' digital tool usage ($r = 0.047$, $p = .708$), as well as perceived effectiveness ($r = 0.096$, $p = .399$), was not statistically significant. This suggested that, in this study, the use and perception of digital tools had no measurable relationship with learners' numeracy outcomes. Several underlying factors may explain this result.

First, many of the classrooms observed used digital tools that were predominantly literacy focused. Teachers had greater access to and familiarity with reading-related applications, while math-specific tools were limited in number or quality. This imbalance in tool availability may have restricted opportunities for children to practice foundational math skills through interactive digital platforms.

Second, instructional practices often leaned more heavily on whole group teaching for numeracy, with less emphasis on differentiated or exploratory learning. Teachers reported fewer instances of using adaptive math apps or hands-on digital manipulatives, which may have reduced the depth of mathematical engagement. One teacher shared, "Most of our math activities are paper based. The only digital thing we do is a counting song now and then. It's not as interactive as our literacy games."

Third, learner engagement during numeracy activities was reportedly harder to sustain. Unlike the singing and storytelling features of literacy apps, math activities were often described as repetitive or lacking dynamic visuals. "They get bored quickly when it's just numbers on the screen," another teacher explained. This suggests that available numeracy tools may not have been designed to match the developmental needs or attention span of early learners.

Lastly, classroom infrastructure posed limitations. In some cases, the number of devices was insufficient to provide meaningful digital math experiences, especially those requiring individualized interaction. Teachers prioritized literacy when scheduling digital time, as reading tools were easier to manage and showed clearer results. This practice inadvertently widened the gap in digital support between literacy and numeracy instruction.
Interestingly, this finding contrasts with the study of Papadakis et al. (2021), who demonstrated that mobile-based math tools grounded in the Realistic Mathematics Education (RME) framework could improve counting and number sense among young learners. The absence of such tools in many classrooms surveyed here may help explain the lack of correlation.

These results offered several implications. First, the significant correlations in literacy suggested that digital tools could play a vital role in enhancing reading instruction and should continue to be integrated and supported. However, the absence of similar benefits in numeracy pointed to a gap in either tool selection, teacher training, or instructional emphasis. There is a pressing need to explore math-specific digital tools that are interactive, developmentally appropriate, and aligned with early learning standards.

Second, professional development programs should include strategies for digital math instruction, helping teachers build confidence and competence in this area. Finally, schools must evaluate and expand their digital toolkits to ensure balanced support for both literacy and numeracy, with equal attention to infrastructure, learner engagement, and adaptive learning features.

In summary, while digital learning tools have proven effective in supporting literacy development, their impact on numeracy remains limited in the current context. Addressing instructional, technological, and pedagogical barriers will be essential to fully realize the potential of digital integration across all learning domains in early childhood education.

Program Title: **LEMAP Ahead: Literacy and Early Math Advancement Program**
Enhancing Kindergarten Learning Through Purposeful Digital Play

Program Rationale:

In today's classrooms, technology has become an essential part of teaching and learning, especially in early childhood education. While digital tools have clearly helped improve literacy among young learners, their impact on early numeracy remains less developed. Recent findings show that children engage well with digital storybooks, phonics games, and reading apps, often demonstrating stronger vocabulary and early reading skills. However, this level of success has not been mirrored in digital math instruction, particularly when it comes to activities that require hands-on exploration, individual pacing, or basic problem-solving.

The LEMAP Ahead program was created in response to this gap. It seeks to offer a more balanced learning experience by promoting both literacy and numeracy through purposeful digital play. This initiative focuses not only on boosting academic performance but also on encouraging learner independence and building teacher confidence in using technology. By integrating developmentally appropriate apps and interactive tools, the program ensures that children engage in meaningful learning rather than passive screen use. It also provides structured professional development sessions for teachers to strengthen their pedagogical strategies in a digital setting. Ultimately, LEMAP Ahead aims to foster a classroom culture where digital tools serve as bridges—not barriers—to holistic and inclusive learning.

To make the program practical and classroom-ready, digital activities are kept short, focused, and developmentally appropriate. Teachers are guided in selecting tools that match specific learning goals, allowing them to use technology with intention, not just convenience. Children are encouraged to explore, create, and reflect—rather than passively consume content—through interactive tools that promote critical thinking. The program also offers flexibility, making it adaptable to different teaching conditions, including those with limited digital access. Family involvement is also supported through simple home-based tasks, helping to strengthen the link between school and home learning. With clear planning, hands-on training, and consistent support, LEMAP Ahead provides a doable, meaningful model for enhancing early childhood education in the digital age.

Program Objectives:
1. To boost literacy and numeracy skills using carefully selected digital tools that are fun, developmentally appropriate, and curriculum aligned.
2. To provide differentiated, child-centered activities that promote autonomy, creativity, and critical thinking.

3. To empower teachers with practical strategies and digital confidence through targeted training and peer learning.
4. To enrich math instruction through thoughtfully chosen apps and engaging routines that make numbers come alive.

Program Phases, Components, Schedule, Activities, Expected Outcomes, and Budget:

Phase	Component	Schedule	Activities	Expected Outcomes	Budget (PHP)
Pre-Implementation	Orientation & Planning	Last week of June	• Launch meeting with parents and staff • ESGI diagnostic testing • Inventory of available digital devices • Survey of teacher tech needs	Teachers and families aligned; readiness data collected	5,000
Pre-Implementation	Digital Pedagogy Bootcamp for Teachers	First Friday of July	• Hands-on training using Seesaw, Starfall, Khan Kids, Math Tango • Modeling of guided reading and math tech tasks • Teacher tech confidence mapping	Teachers equipped with skills and confidence to launch digital integration	5,000
Implementation	Digital Literacy Discovery (DLD)	Mon & Wed, 30 min sessions	• Storytime with interactive books (Vooks, Epic!) • Rhyming and phonics games • Seesaw video responses • Small-group digital guided reading	Stronger vocabulary, listening skills, and expressive language	1,500
Implementation	Math Explorers Hub (MEH)	Tues & Thurs, 30 min sessions	• Number scavenger hunts with virtual manipulatives • Interactive math storytelling • Tablet-based math games with movement breaks	Improved number sense, counting fluency, and math vocabulary	2,000
Implementation	Choice Time: Independent Explorers Zone	Every Friday, after lunch	• Kids choose from reading or math digital centers • Self-paced learning with checklists • Reflection journaling with emojis or voice notes	Fosters independent learning, decision-making, and learner agency	1,500

Implementation	Home-School Digital Link Kits	2nd Friday of each month	• Parent-child digital stories • Seesaw home activities with math games using real-life items (spoons, coins) • Parent feedback surveys	Strengthened home learning culture; parents involved in digital literacy & math	3,000
Implementation	Monthly Learning Labs for Teachers	1st Friday of each month	• Peer sharing of what works • Try-a-tool spotlight: one new app per month • Reflective practice journals • EdTech troubleshooting support	Encourages collaboration, reduces tech anxiety, builds a professional learning culture	5,000
Post-Implementation	Monitoring and Celebration of Growth	Mid-year and Year-End	• ESGI post-assessment • Showcase of student digital portfolios • Parent-teacher reflection circles • Adjustments to plan based on review	Data-driven adjustments, shared accomplishments, documented learner growth	1,000
Total Estimated Budget: PHP 24,000					

Implementation Plan

To effectively bring the LEMAP Ahead Program into action, a structured and collaborative plan will be implemented. This approach ensures that both literacy and early numeracy receive equal attention through the purposeful integration of digital tools into daily classroom experiences.

Program Management and Coordination

A designated program team—composed of the Kindergarten Coordinator, ICT lead teacher, and selected grade-level representatives—will oversee day-to-day implementation. This team will be responsible for organizing schedules, preparing materials, supporting classroom delivery, and monitoring progress. Regular check-in meetings will be held to review accomplishments, address emerging concerns, and ensure alignment with intended goals.

Integration with Daily Classroom Routines

Digital activities will be embedded into regular instructional time to avoid overloading the schedule.

- Mondays and Wednesdays: Focus on digital literacy activities such as phonics games, storybook read-alongs, and language-building tasks.
- Tuesdays and Thursdays: Dedicated to digital math experiences using counting games, interactive manipulatives, and number storytelling.
- Fridays: Reserved for independent learning, where learners choose activities that interest them, promoting autonomy and engagement.

This structure ensures a balanced and predictable digital learning experience for young learners.

Teacher Capacity Building

Teacher preparation will begin with a Digital Pedagogy Bootcamp, offering practical training on the use of selected educational apps and classroom management strategies for digital activities. Teachers will learn how to guide learners in using tools such as Seesaw, Epic, Khan Kids, and Math Tango.

To sustain professional growth, Monthly Learning Labs will be held. These sessions will feature:

- Peer sharing of classroom experiences
- Introduction of one new digital tool per month
- Reflective journaling
- Troubleshooting and technical support

This promotes a collaborative learning culture and builds teacher confidence over time.

Learner-Centered Approach

The program prioritizes differentiated instruction and learner independence. Digital tasks will be designed to allow children to work at their own pace, make choices, and reflect on their learning. Activities may include:

- Voice-recorded reflections
- Emoji-based check-ins
- Digital drawings and simple journals

These outputs encourage creativity and ownership of learning while helping teachers monitor progress in a child-friendly way.

Monitoring and Evaluation

Progress will be monitored through multiple methods:

- Mid-year and end-of-year ESGI assessments to track literacy and numeracy development
- Teacher observation logs to document learner engagement and challenges
- Parent feedback surveys to gather insights on home-based digital activities

Findings from these tools will inform necessary adjustments and guide continuous improvement of the program.

Home-School Connection

To reinforce learning beyond the classroom, Home-School Digital Link Kits will be distributed monthly. These kits will include:

- Suggested parent-child digital activities
- Everyday math tasks using household items (e.g., coins, spoons)
- App recommendations and simple instructions

Parent orientations or digital literacy briefings will also be conducted to support families in using the kits effectively, promoting a stronger learning partnership between school and home.

Flexibility and Responsiveness

The implementation plan is designed to be practical and adaptable, allowing teachers to adjust activities based on learner readiness and classroom realities. The focus is on maintaining high engagement and ensuring that every child has the opportunity to benefit from both literacy and numeracy-focused digital learning experiences.

Sustainability Plan:

To ensure the sustainability of the LEAP Ahead Program, it will be institutionalized as a core initiative under the School Improvement Plan (SIP) and embedded in the school's Annual Improvement Plan, aligning closely with the goals of the Kindergarten Curriculum Guide. This will guarantee long-term integration and accountability within the school system. To support implementation, the school will establish partnerships with local EdTech providers and non-government organizations (NGOs) to enhance access to developmentally appropriate digital tools and provide ongoing teacher support. In parallel, the school will seek funding from the Department of Education's Learning Resources and Technology Development Division, as well as financial assistance from local private stakeholders, to sustain digital resources, training programs, and technology upgrades. A teacher tech leadership team will also be organized to mentor colleagues, share best practices, and maintain consistent digital innovation across grade levels. Furthermore, a centralized digital resource repository and toolkit will be developed to give all teachers easy access to curated apps, instructional guides, and sample classroom outputs. Finally, parent digital literacy workshops will be conducted to strengthen home-school collaboration and encourage the responsible use of digital tools at home, thereby extending the impact of the program beyond the classroom.

Ways Forward

The research as the basis for the LEAP Ahead Program notes a promising future for digital integration in early childhood education—particularly in strengthening literacy development. However, it also reveals a critical gap in how digital tools support early numeracy skills. Moving forward, this program takes intentional steps to close that gap.

By placing equal importance on literacy and numeracy, promoting learner independence through choice and self-paced tasks, and equipping teachers with relevant digital teaching strategies, LEAP Ahead provides a realistic and responsive model for classroom innovation. As the program continues, future endeavors will focus on refining math-specific digital learning tools, deepening family engagement, and building a culture of cooperation among the teachers and school administration. With consistent support from school leadership, local stakeholders, and the Department of Education, this initiative is meant to make a lasting impact on early learning experiences and academic preparedness for all kindergarteners.

CONCLUSION AND RECOMMENDATIONS

Conclusion

The study concludes that kindergarten teachers are effectively using digital learning tools in their teaching, particularly in ways that support literacy development. Learners' above-average literacy and numeracy outcomes suggest that the early use of digital tools contributes positively to academic preparedness. The significant correlation between digital tool use and literacy skills emphasizes the strength of digital learning in language development and early reading.

On the other hand, the lack of significant connection between digital learning tool use and numeracy skills indicates a potential disconnect between the tools used and the nature of mathematical learning at the kindergarten level. This calls for a more consistent selection and usage of digital learning tools that support strong, hands-on numeracy and literacy learning. It also notes the need for capacity-building initiatives and enhance professional development to strengthen teachers' expertise in utilizing digital learning tools effectively across all learning areas, especially in key stage 1 learners.

Recommendations

The findings of this study highlighted the purposeful use of digital learning tools in kindergarten classrooms, particularly in enhancing literacy instruction. However, gaps were identified in the use of digital tools for individualized learning and numeracy development. These insights provide a basis for practical improvements in teaching strategies, policy development at the institutional level, and future research on digital integration in early childhood education. The following recommendations are proposed to address these gaps and further strengthen the use of educational technology in the kindergarten setting.

To improve classroom practice, there is a need to support kindergarten teachers in delivering differentiated digital instruction. Most teachers were not assigning individualized digital tasks, pointing to a potential underutilization of learner-centered technologies. Providing hands-on training and continuous capacity-building sessions can help teachers become more confident and skilled in using platforms that personalize learning. Additionally, teachers can benefit from integrating digital assessment tools to track individual learner progress more accurately. These strategies not only improve instruction but also ensure that digital tools are used more meaningfully and equitably.
At the policy level, the Department of Education and school leaders should consider developing clear guidelines for the responsible and developmentally appropriate integration of digital tools in early childhood settings. These policies should cover essential areas such as screen time, digital content quality, and the ethical use of technology in classrooms. There is also a need to embed digital literacy into the kindergarten curriculum to support foundational skills in both reading and mathematics. Furthermore, ensuring that schools are equipped with adequate digital infrastructure, such as devices, internet access, and technical support, will be critical to sustaining the use of technology in teaching and learning. Encouraging schools to form professional learning communities (PLCs) centered on digital pedagogy may also foster collaboration and innovation among teachers.

For future research, it is recommended to explore the effectiveness of specific digital tools designed to support early numeracy development. Since the study found no significant correlation between digital tool use and numeracy outcomes, further investigation is needed into how certain applications—especially those that simulate hands-on activities—might enhance number sense and problem-solving skills. Longitudinal studies can also be conducted to track the long-term impact of digital tool exposure on learners' academic growth, particularly in the transition from kindergarten to primary grades.

Finally, examining how home-based digital learning experiences influence classroom performance could offer additional insights. Young children often interact with technology outside of school, and understanding this connection may help educators align home and school learning environments. Research on teacher attitudes and readiness to

adopt adaptive learning technologies would also be valuable in informing the design of future digital programs and training initiatives. Altogether, these recommendations emphasize a balanced approach to improving pedagogy, guiding policy, and advancing research, ensuring that digital learning tools are used not just widely—but wisely—in early childhood education.

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