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Technology Enhances Literacy & Numeracy Skills in a Play-Based Preschool Classroom

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Technology Enhances Literacy & Numeracy

Skills in a Play-Based Preschool Classroom

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Abstract

This research project investigated how technology can improve literacy and numeracy skills in a play-based preschool setting. This study looked at four basic literacy skills and four basic numeracy skills that could be enhanced through the use of the KidsAcademy iPad app. This study used a quantitative approach with a dependent sample t-test to look at how literacy and numeracy scores changed from a pre-test to a post-test. Data was analyzed using an average means between the students that used the technology. Findings suggest that the use of technology in preschool can advance literacy and numeracy skills, thus aiding in meeting early childhood curriculum standards.

Keywords: digital play, preschool, numeracy learning, literacy learning, iPads

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Technology Enhances Literacy & Numeracy Skills in a Play-Based Preschool

Technology has been used in education since the 1800s when the Magic Lantern, "a primitive version of a slide projector that projected images printed on glass plates" (Purdue Online, 2022) was introduced to improve learning. Technology advancements have evolved over the years to include tablets or Chromebooks in many students' hands. As students develop through the grades, they become more dependent on technology and the use of applications to complete work. Many preschool students are entering school with a stable knowledge of technology, and many have their own personal tablets at home (Mason, 2005). However, with all of this technology in daily life, the debate becomes how to integrate it with play in preschool classrooms. For centuries, play has been the forefront of preschool classrooms, as it helps with the development of social-emotional skills (Pyle & Bigelow, 2014). Teachers and administrators need to consider best practices for building a technology-integrated classroom that also integrates play.

Preschool has always been a play-driven source of learning. During the recent COVID-19 pandemic, many preschools had to depend more heavily on technology as a new source of learning. Teachers had to learn to integrate technology into their daily lessons and use this information to enhance their students' knowledge in unique ways (Tooms et al., 2004).

This action research determines how learning can be enhanced by using technology within a play-based classroom to further the literacy and numeracy skills of our early learning standards. Finding ways to integrate digital play within a preschool classroom and combine play and technology in unique ways can contribute to development and learning.

The research obtained in this study was gathered from peer-reviewed journals located in the DeWitt Library. The studies were published in the last ten years. Research has focused on

ways technology can be used in preschool, reactions of parents and teachers to technology in preschool, the platforms used in the classroom, and the benefits of play - including the impact to preschool students' social-emotional skills through digital play. Reviewing these categories shows the various uses of digital play in current classrooms and whether it is beneficial for development and learning.

Review of the Literature

Technology as Digital Play

Technology can be used in a play-based preschool setting to assist educators in developing an engaging, interactive environment. In a qualitative research study by Ackermann (2017), research focused on whether iPads should be used in a preschool setting. This study, which included 30 children and 35 parents, focused on ways that iPads can be used creatively within the classroom. Students were given the iPad to create digital drawings, and they were also provided paper and pencil to create physical drawings. This study showed that children were motivated by technology and enjoyed using the tablet as a drawing tool over the use of paper and pencil. When children are motivated to learn, they engage more with the material and can show an increase in development (Ackermann, 2017).

Incorporating digital play into the classroom can assist in many ways. In a quantitative research study by Disney et al., (2019), 80 children were given iPads to assist in their numeracy learning. The researcher assessed skills such as numerical identification, counting, arithmetic problems, shape identification, and patterns. Each student was given a pre-test, followed by two weeks of various numeracy apps on the iPads. Using the t-test method, results were shown after a post-test was analyzed. According to the findings, most of the children improved significantly in

all of the five measurements. Various iPad apps are shown to be appropriate ways for preschool

children to enhance their numeracy skills. These findings, however, show only that the students

learned, not how they learned (Disney et al., 2019). These findings cannot discern that the

learning came only from the iPads and not from some other source within the play-based

classroom, indicating that more research is needed to demonstrate how technology can enhance

learning in various steps of development.

Similar findings were uncovered by Kirova et al., (2018) when researching literacy skills

within preschool students. This study included 25 students using iPads to create videos using

multi-literacy practices. The results revealed that once students had the skill level and knowledge

of the digital platforms, the teachers could better support children to reach their maximum

performance. When the teacher was able to digitally model and use discussions throughout the

entire process, the students were able to create technology that was meaningful for learning

(Kirova et al., 2018). In contrast to the Disney (2019) study, Kirova's (2018) findings were only

supported by the knowledge of digital skills before the research began. The skill level of digital

play was a determining factor within the findings. While one student in this study was able to

work independently and complete the work, this study did not allow for the independent work by

the rest of the students. Using technology within the classroom is a tool that can enhance

learning, but only when used at the student's capability level (Kirova, 2018).

Improving literacy skills in early childhood can show many benefits to education. A

qualitative research study by Kaynar et al., (2020) looked at using e-books to improve literacy

skills in early childhood education. Using 13 teachers as the focus of study, the research looked

at their perceptions of using a specific literacy app, Raz-Plus, along with challenges and

advantages of using this technology within the classroom. The results of the interviews with the

teachers identified three main themes. The first theme was that teachers use e-books for different purposes. In order to provide accurate research results of e-book use, research should look at one main purpose and study the effects of the use and their purpose. Another theme was the challenges while using this platform. Similar to the study by Kirova (2018), this method of technology requires adult involvement to be an effective method of learning. The last theme involved various ways to use the e-books in an early childhood classroom. The need for assistance during use of technology is the main barrier that teachers face when implementing this strategy. While other apps may allow for independent work, the studies by Kirova (2018) and Kaynar (2020) show that involvement and consistent time, training, and support are needed to be useful. In summary, teachers need more training and support to successfully implement technology within a preschool classroom.

Digital play in a classroom can show different outcomes. Another quantitative research study by Verenikina et al., (2016) reviews children's responses to the application of technology. This study focused on ten students who were allowed to play with an iPad and included observations of digital play as students interacted with the app and with each other. While the other studies specifically focused on literacy and numeracy apps, this study focused more on the interaction with the iPad and with peers. Observations fell into two categories: peers playing side by side and the interactions during digital play. The findings showed that peers playing the same game showed more interactions than those playing different games. Additionally, when the app used imaginative play, the interactions between students increased. In contrast to the studies completed by Kirova et al., (2018) and Kaynar et al., (2020), students in Verenikina's (2016) study worked independently, allowing the students to interact and play within the technology without assistance from parents or teachers. When researchers analyzed the data obtained from

the video recordings, they found that children are motivated to play with technology and that the

interactions increased when the app chosen used interactivity. Important considerations when

using digital play is allowing the children to control their play and progress at their own pace.

Choosing the right apps for digital play will increase self-motivation and discovery during play

with each other (Verenikina et al., 2016). The apps that teachers choose to use within the

classroom should provide the children flexibility to grow and learn through play and allow

independent use to encourage motivation and learning within the classroom (Verenikina et al.,

2016).

Parent and Educator Views

Using technology in the classroom has mixed reviews from parents and educators. In a

mixed method study by Erdogan et al., (2018), digital play was determined to be the least

preferred type of play by parents across four different countries (USA, Turkey, China, and South

Korea). The study included a quantitative questionnaire given to 500 parents. On average, these

parents preferred traditional play over digital play, however, the study's findings noted digital

play has the potential to provide a lot of benefit to learning and development (Erdogan et al.,

2018). This study found that parents need more education and training in the correct uses of

technology to ensure that it is meaningful and educational. While slight differences exist among

responses from each country, the study showed an overall consensus that traditional play is

preferred over digital play, but that the future may show higher preference toward more

technology (Erdogan et al., 2018).

A similar study was completed by Otterborn et al., (2019), exploring teachers' views on

using technology in the classroom. While the study by Erdogan et al., (2018) highlighted

parental views, Otterborn et al., (2019) looked at how teachers viewed using digital play with

students. This study used online questionnaires with 199 preschool teachers in Sweden. The

findings found the same need for training and increased knowledge of technology before

implementation. In both of the studies, those interviewed emphasized the importance of

traditional play, but both parents and educators understand that there is a need for technology in

the future (Otterborn et al., 2019).

    While the study by Erdogan et al., (2018) showed that parents prefer traditional play over

technology play, a quantitative study by Rose et al., (2013) looked at whether the use of

technology was a factor in a parental choice of a childcare program. Rose et al., (2013) looked at

whether the use of technology and the internet is a factor in this decision. The results of a

questionnaire sent to 82 parents of preschool children, showed that students having access to

technology is a contributing factor. Parents understand that technology is a part of their

children's future and that using the internet for educational programs provides a lot of benefits.

However, the study also noted that parents want a balance of traditional play throughout the day.

This phenomenon shows that while there is a need for technology in early childhood education,

educators should not forget the importance of traditional play within the daily schedule (Rose et

al., 2013).

    In contrast to the previous studies, Dong (2018) uncovered negative opinions about

technology when he looked at how Korean parents viewed digital play. In a study with 13

Korean parents of preschool students, none of the parents related learning to digital play. For

these parents, the use of digital play was related to video games and YouTube. The parents

considered it a reward, not an educational platform (Dong, 2018).

    The results of these studies hold one common theme about technology and the use in an

early childhood classroom. While there is a place for technology, educators and parents urge

classrooms to use it minimally and keep traditional play an important part of the development of preschool students.

Importance of Play

Many studies have been done on the importance of play in preschool. In a qualitative study by Pyle & Bigelow (2014), three kindergarten classrooms were observed to explore the purpose of play and how play is used within the classroom. This study showed varying results among the classrooms, showing the students approach to play a "peripheral to learning, play as a vehicle for social development, and play as a source of academic learning" (Pyle & Bigelow, 2014). Each classroom teacher in this study exhibited different approaches to play and highlighted these three varying learning techniques. While one teacher focused on how play benefits social-emotional skills, another teacher focused on play as a vehicle for academic learning, and the third teacher used play as a way to enhance the lessons as a teacher-led strategy (Pyle & Bigelow, 2014). According to these findings, teachers should look at how play is used in their classroom and look for ways that play can link all of these approaches.

A similar study by Fatai et al., (2014) examined 30 children in Malaysia and the effects of unstructured play time during the day. The researchers used observations and video recordings to watch how children played through the day. Through field notes and data analysis, the researchers found similar themes to the findings from Pyle & Bigelow. Through play, children can learn academically, engage in social emotional development, and gain cognitive skills. This study shows that allowing play within the classroom can give children many developmental skills that are needed for growth and academic achievement (Fatai et al, 2014).

Similar findings were also found in a study done in Australia by Sumsion et al., (2014). The researchers did observations and performed interviews at approximately 40 early childhood

centers looking at how play is used in the classrooms, specifically how free play and play-based learning are brought together. Many of the centers showed differences between how play was approached and the outcomes from play. While some educators were positive about this play-based learning environment, many were inexperienced users of this model (Sumsion et al., 2014). In order to properly integrate play-based learning with free play, teachers must be engaged with the children and have an active role within the play, rather than just observe and provide children with contexts to learn. Children are more engaged when they see educators showing active involvement in the classroom (Sumsion et al., 2014).

Banerjee et al., (2015) discusses considerations to link play with language and literacy development. The findings to link these skills are shown through evidence-based practices with some recommended strategies (Banerjee et al., 2015). Literacy is one of the key developmental milestones in early childhood development, many studies look at how play can provide rich context in learning literacy and language skills. Creating an environment that can promote these skills is the first step. Similar to the study by Sumsion (2014), Banerjee also notes that adults should interact with the students to show meaningful play. This type of interaction includes directing, observing, and participating with the children during play time (Banerjee et al., 2015). The studies performed also showed that at least one hour is necessary for the children to become fully immersed in the play and shows more engagement. In other words, providing the right environment and actively participating with the students shows key learning taking place during the day.

Impact on Social Skills

The first five years of a child's life is a critical period of learning and development. Play is a key factor in this development and can impact social skills. In a study done in Makkah, Saudi

Arabia with over 60 preschool and kindergarten students, Khomais et al., (2019) found that one

of the strongest predictors of self-regulation skills is from dramatic play. The study used

questionnaires, a self-regulation scale, and children's interviews (Khomais et al., 2019). Despite

this correlation, there are many defects in this study that look at the type of play and the

environment of play that is offered to the children. The quality of play can have an effect on how

children interact and play. Offering a wide range of rich learning is important for core academic

development (Khomais et al., 2019).

   The various types of play offered in school link many skills that children need to develop

and learn. In a study by Li et al., (2014), 28 students were studied to find out how social

interactions occurred during various types of play. Using a mixed method approach, the

researchers were able to use observations and questionnaires to compare the types of play and

how social skills are developed. Similar to the study by Khomais et al., (2019), the social skill

that emerged most frequently was the interaction with others. When the type of play offered

involved interactions, social skills increased. The type of play offered to students and the

environment provided can affect children's development (Li et al., 2014).

   While social skills can develop through pretend play, using technology can also manifest

social emotional behaviors. In a study by Ralph (2017), three students were observed using

traditional play, and technology with play, in various scenarios to determine their sharing

behaviors. The variable that emerged was whether technology had an effect on the play. The

scenarios all centered around various iPad applications and the types of play offered. While

certain technology offers more opportunity for social interactions, the study found that the use of

technology increased social behaviors (Ralph, 2017). Ralph noted that children need to learn to

share iPads like they do any other toy. This phenomenon shows us that like the other studies by

Khomais et al., and Li et al., on social-emotional development, technology can play an important

role in learning through play and can have an impact on children's social-emotional

development.

Digital Platforms

Assorted studies have been done on the effects of different platforms used within the

classroom. Davidson et al., (2014) studied a classroom in Australia using YouTube as a way to

teach and learn. As the article states, much research has been done on the ways that technology

enhances skills, rather than how technology can provide shared understanding (Davidson et al.,

2014). This study focused on one child and a video his family made during a trip. The

researchers looked at the children's interaction with the video, their interpretation of the subject,

and the ways they communicated through the learning process. According to the findings,

children can learn with technology if educators look for the experiences that these platforms

offer (Davidson et al., 2014). In other words, YouTube is a valuable resource for children and

can lead to more engagement.

Another platform that is used with preschool is digital storytelling. In the study by Kervin

& Mantei (2016), 27 children used digital stories to showcase how they participate in the

classroom. The children used the platform Meadows (2003, 2011) to structure their stories. The

children were asked to create a story about what they like to do in the classroom. Using ten

pictures and video recordings, they presented a unique perspective into their daily learning. As

the researchers analyzed the data, they noted key aspects of the story, such as the children's

understanding of the setting, the activities they chose as their favorite, and their engagement

within the recordings (Kervin & Mantei, 2016). In this qualitative study, Kervin & Mantei

(2016) noted that using technology can help support children in future grades and help educators gain insight into how children learn and apply what they are learning.

Similar findings on the way we use digital platforms were later found in a study by Fleer (2018) when 16 teachers were observed engaging with children during free time. Using digital animation, educators worked to create a new play condition to support play activity within the classroom. Similar to the study by Kervin & Mantei (2016), Fleer used a creation app called MyCreate. This app allowed animation to be used during free time to enhance the imagination and creativity of the play. Using another qualitative approach, Fleer (2018) observed the children in five different play-based scenarios using nursery rhyme stories. After the story was read to the children, they were set up to role play and animate the story through props using their own creativity. All of these platforms suggests that the students are more engaged in their learning with the use of technology. This study showcases that play-based settings can benefit from the use of technology to improve children's academic learning, social-emotional, and cognitive development in early education.

Technology can play many roles in early childhood education. Providing educators with training and support into the technology they use, preschool children can learn social-emotional skills, literacy, and numeracy skills, and find ways to be more engaged in their education. Providing a rich digital play environment can produce many benefits that support learning.

Methods

This study uses a quantitative methodology to determine how technology can enhance literacy and numeracy scores in an early childhood classroom. This study used a pre- and post-test to determine children's literacy and numeracy scores after exposure to a developmentally appropriate app, Kids Academy, that helps build various skills for early childhood.

Participants

Of the 27 students enrolled in two preschool classes in a small private school in Iowa; 20 students participated in the research study. Of the 20, 9 (45%) were female, and 11 (55%) were male. The age range of the students was 4-5 years old. In this study, half (50%) of the students attend the all-day program, while the other half (50%) attend the five-day morning program.

Data Collection

The testing for numeracy skills used the myIGDI assessment to measure four basic early childhood standards: (a) oral counting, (b) quantity comparison, (c) number naming, and (d) one-to-one correspondence. The oral counting test identified how far students can count without error within 60 seconds. The quantity comparison test used cards comparing dominos and asked the children to identify which side had more through visual observations within 60 seconds. The third test identified how many numbers ranging from 0 to 20 the students could identify by name within 60 seconds. The last test looked at one-to-one correspondence counting. The students counted dots from one to 20, pointing to the dot as they counted. The score was counted based on the correct number of dots counted without an error.

The testing for literacy skills used the PELI literacy assessment for Pre-K. This test looked at four literacy early learning standards: (a) alphabet knowledge, (b) phonological awareness, (c) vocabulary, and (d) comprehension. The alphabet knowledge section evaluated how many upper and lowercase letters the children could identify when they were in a random order. The phonological awareness test showed awareness of beginning sounds and syllables using various picture cards. The vocabulary section of the test allowed the students to name and describe various words using their own words; the transcriptions were recorded and analyzed based on how descriptive the sentence was in relation to the vocabulary word. In the last test, the students read a book, the researcher looked at comprehension and retelling of the story by asking questions throughout and at the end of the book.

After the week one pre-test was completed, the students were allowed use of technology in the classroom to work on these skills using the classroom iPads. Students were allowed use of the iPads during free choice time and in the morning when work was completed. The students were observed during the digital play, with the researcher noting interactivity within the app and motivation to use the platform. After two weeks of digital play using the iPads, the students were assessed in week four using the same myIGDI and PELI assessments to analyze data.

The independent variables used in this study include the age of the students, the assessments used, and the technology app, *Kids Academy*. The dependent variables are the literacy and numeracy scores showing development of early childhood early learning standards in a preschool classroom.

With Institutional Review Board (IRB) approval from Northwestern College and approval from the preschool department of the private school that enrolls preschool students ages 3-5, consent letters were sent to two of the four classes. Twenty parents opted for their student to participate in this study to determine technology's impact on literacy and numeracy skills.

Findings

Data Analysis

A dependent sample t-test was used to compare the average mean between the pre- and post-test results of numeracy and literacy skills in digital play. Using myIGDI and PELI assessments, four areas of numeracy skills were assessed: (a) oral counting, (b) quantity comparison, (c) number naming, (d) one-to-one correspondence (see Table 1). Four areas of literacy skills were also tested: (a) alphabet knowledge, (b) phonological awareness, (c) vocabulary, and (d) comprehension (see Table 2). The results demonstrated a score increase in all areas tested.

Table 1. Pre-test and post-test results of four numeracy skills

Children's Numeracy Skills

Variables	Means of pre-test results (n=20)	Means of post-test results (n=20)	t, df(19)	standard error of difference
Oral Counting	42.05	45.10	1.08	2.807
Quantity comparison	27.70	29.45	3.25	0.537
Number naming	17.70	18.60	1.38	0.648
One-to-One Correspondence	18.65	19.45	1.59	0.501

Table 1 shows that numeracy skills improved between pre-test and post-test results in all four areas. These results show that children learned numeracy skills while using the iPad over a

two-week observation period. The greatest increase in abilities occurred in quantity comparison resulting in a t-score of 3.25. This skill was practiced most within the app during free-choice time. The lowest change was in oral counting with a t-test of 1.08. The iPad app chosen did not represent oral counting within the number of game options, resulting in a lack of practice counting using technology.

Table 2: Pre-test and post-test results of four literacy skills

Children's Literacy Skills

Variables	Means of pre-test results (n=20)	Means of post-test results (n=20)	t, df(19)	standard error of difference
Alphabet Knowledge	20.85	24.00	3.86	0.815
Phonological Awareness	9.85	11.70	2.34	0.789
Vocabulary	23.70	24.25	2.46	0.223
Comprehension	21.60	22.40	3.76	0.213

Table 2 shows a significant increase in all four areas of literacy skills. The iPad app that was used within this study included many games and skill practice in all four of these areas of development. During the observation period, 80% of the students chose literacy games over numeracy games during their allotted times. In this table, the highest increase is alphabet knowledge with a t-difference of 3.86. Sixty-five percent of the students tested during the post-test were able to identify all 26 letters of the alphabet versus only 40% of the students in the pre-test assessment. Most of the games in the app focused on the letters of the alphabet using videos and games to practice this skill. The lowest increase in scores was phonological awareness with a t-difference of 2.34. This test did not show a lot of improvement for many students. Only 15%

of the students had a significant increase in this skill. Fifty-five percent of the students scored full points in the pre-assessment, allowing no room for improvement in the post-assessment.

Discussion

Summary of Major Findings

This research shows technology's positive contributions to the preschool classroom. The findings showed an increase in all eight areas of development, in both numeracy and literacy. Using the iPad as a tool to practice and gain these skills can increase development of these skills in a play-based setting. The results from this study support the findings by Vaughan & Beers (2016) showing that technology should be integrated into early childhood curriculum as a significant source of growth in student learning. The use of technology in a play-based classroom should be done using age-appropriate apps in a meaningful way. Vaughn & Beers (2016) also noted that with support for the teachers and proper assistance and training, technology can be another factor of learning in early childhood play-based settings.

Where this study showed an increase in all areas of learning, one cannot conclude that the only learning came from technology. While this study showed that the students did learn, the researcher could not verify the source of learning, as other lessons were used during the study period.

Limitations of the Study

Several limitations existed with this study. This study used a small sample that restricted a generalization of these results. In addition, this study used only a two-week testing and observation period that restricted time and use of the technology. While many children used the technology frequently during the two-week period, not all students had the same access to the app. This study only looked at one app on the iPad and did not investigate other apps that

develop numeracy and literacy skills. Many apps may offer more development of skills within these areas and have more early learning standard studies.

Further Study

As technology is being used more often in early childhood settings, studies should look at the long-term effects of using technology at a young age. Whereas this study focused on quantitative data only, future research should examine qualitative data, and more attention to the cognitive side of learning should be considered. Additionally, testing various apps, as well as other platforms, can show the effects of how technology can enhance or restrict learning within a classroom setting. As Reeves et al., (2017) state in their study, choosing the appropriate app is the first step in engaging early learners. With the evolution of technology and new programs continuously being introduced, limitless opportunities exist to showcase how these apps and platforms work with current curriculum guides for early childhood education. This study focused on learning within a private setting in a mid-size area in the Midwest region, further implications should include a more diverse setting in other regions of the world. As technology grows and evolves, more data will be available to explore how technology can play a role in children's education.

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Conclusion

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The results of this study can help future research and studies. The findings highlight that technology could enhance numeracy and literacy skills with developmentally appropriate apps. Early childhood educators can use technology to assist in teaching and engaging the student to provide an increase in overall learning. As Vaughan & Beers (2016) noted in their study, technology can be an educational tool to save time, money, and space. Instead of buying and storing physical books and music, technology can be used to highlight stories and songs to

children in a new way. Technology also has the opportunity to reach places educators may not be able to reach in a classroom, bringing real-world learning each day. Students have the ability to explore space, see world monuments, and go on virtual field trips from the comfort of their desk. Technology has allowed educators to have up-to-date material with engaging lessons that they didn't have before when using outdated textbooks.

Early childhood educators should use the tools available to them to help learners be successful. This study gave students the ability to practice skills learned in the classroom in an engaging way and allowed the students a chance to move at their own pace, work on the skills they need help on, and engage in developmentally appropriate practice. Each student in this study was at a different area of learning and needed assistance in diverse ways. The app was able to identify and offer more one-on-one practice to ensure the maximum benefit. Educators are tasked daily with offering lessons that accommodate all learning styles while reaching all levels of knowledge. Technology can be a tool to assist individualization in a meaningful way. Overall, educators need to look at how technology can help enhance young children's learning.

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