DIFFERENCES IN PRESCHOOL STUDENTS' KINDERGARTEN READINESS SKILLS BASED ON THE USE OF TOUCH SCREEN TECHNOLOGY

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DIFFERENCES IN PRESCHOOL STUDENTS' KINDERGARTEN READINESS SKILLS BASED ON THE USE OF TOUCH SCREEN TECHNOLOGY

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ABSTRACT

This dissertation aimed to investigate the impact of technology use in preschool classrooms on student motor skill development. The study involved analyzing the pass/fail Desired Results Developmental Profile (DRDP) scores of students and whether their preschool classroom used technology or not. A chi-square test was performed on two variables for 3 school years (2018-2019, 2019-2020, and 2020-2021). The results of the study showed that there were different outcomes for each school year. In 2019, the null hypothesis was rejected due to weak negative statistical significance. In 2020, the null hypothesis was supported as there was no significant difference. However, in 2021, the null hypothesis was once again rejected as there was a strong negative statistical significance. The study was analyzed through the lens of Bronfenbrenner's ecological systems theory to help understand the complex relationships between technology use and student motor skill development. Overall, the findings suggest that technology used in preschool classrooms may have a negative impact on student motor skill development.

CHAPTER ONE

INTRODUCTION

Technology has advanced drastically in the last 10 years. The advancement of digital media has impacted every area of family life (Ly, 2018; de Oliveira et al., 2020; Rideout & Robb, 2020). Many children by the age of 2 have access to their own tablet, laptop, or mobile phone with the primary activity being video viewing (Coutinho, 2017; Ly, 2018). Researchers have found on average, 36% to 74% of mothers believe screen time had a detrimental effect on their child's development of social skills with over 75% of these mothers believing it negatively affected their child's physical well-being. Even with this knowledge the mothers in this study did not adhere to the limits set for their preschool-aged children (Ly, 2018). Technology has not only impacted the lives of families at home but has been increasing in usage inside classrooms (Niklas et al., 2020). The availability of digital devices has vastly expanded as well as a variety of applications that engage students and allow them to create an individual learning experience (McCausland-Hartman, 2017; Pila et al., 2019). During the school year, students spend much of their time in classrooms away from their parents. The amount of time they use technology at school can impact their development. The introduction of COVID-19 also impacted students and their use of remote digital technology as a learning tool (Rahmadi, 2021; Song et al., 2020).

The technology offered to early childhood-aged children has exploded in availability. Digital technology has been presented to make daily activities easier or more enjoyable. Many application companies present their product as a learning tool for educators and parents. Some have argued that when digital technology is conceptual, age

appropriate, and deliberate in its purpose it is beneficial to children's development (Dashti & Habeeb, 2020; Elmali et al., 2020; Kirkorian et al., 2020; McCausland-Hartman, 2017). Because of its differentiated interface, technology has been encouraged by the National Association for Education of Young Children (NAEYC) for use in the classroom according to the frameworks of developmentally appropriate practice (Pila et al., 2019). By providing children with developmentally appropriate digital technology educators are giving students a new way to interact with their educational environment (Lewis Presser et al., 2022). Classroom use of tablet technology has increased immensely due to the friendly interface for children and the many applications that can be downloaded (Leonard, 2013; Pila et al., 2019). This technology has been designed with programs to engage young children and help teachers customize their learning experience. Although most schools incorporate technology into the classroom, many schools and communities have not decided on the role technology should play in early education (McCausland-Hartman, 2017). Due to COVID-19, schools have modified their educational structure to include tablet technologies and virtual education (Gemelli & Boccalatte, 2022). Many of these are being offered as early as the preschool level to prepare students for virtual learning. This has been a momentous change in instruction and many teachers find themselves required to integrate technologies they have not used before with children of a younger age (McCausland-Hartman, 2017).

Technology is heavily relied upon for education as many schools must teach virtually, however, from the perspective of educators a reliable vision is needed for the integration of technology for early childhood classrooms. Though studies have been conducted on how technology such as tablets, computers, and touch screens impact

children's development, many studies provide conflicting information (Ackermann et al., 2020; Hatzigianni & Kalaitzidis, 2018; Kuzmiakova, 2020; Lauricella & Cingel, 2020; Lin, 2019; Ly, 2018; Reardon & Leonard, 2019; Rojas-Barahona et al., 2021). There is limited research on the effects screen time and digital technology have on children under the age of 6 and confusion as to what is developmentally appropriate for learners at this age. Many believe the priority of early educators should be to engage children in activities that develop social skills (Kracht et al., 2020; Lauricella & Cingel, 2020; McCausland-Hartman, 2017; Wang, 2004). With educators' attention drawn to the development of social skills, the effects of sedentary activity in young children are still not fully known. There is research to support cognitive and physical risks for young children who are exposed to screen time. Children in early childhood are developing their fundamental motor skills (FMS), which impact their physical activities later in life. With such importance on the development of FMS parents and schools have developed ways to keep their children active. However, as technology becomes more readily available an increasing number of children find themselves exposed to screen time or even have their own individualized touch screen device (Annarumma et al., 2020; Hadders-Algra, 2021; Hauck & Felzer-Kim, 2019; Martins et al., 2021; Tolocka et al., 2019). Though these studies have linked tablet usage and screen time to the development of social skills, studies have shown that the use of screen time and tablet technology can affect the development of a child's FMS (Hauck & Felzer-Kim, 2019; Ly, 2018; Martins et al., 2021; Tolocka et al., 2019). This study explored the effects of tablet, or touch, technology on the development of fine motor skills in early childhood education.

The first chapter will contain the theoretical framework, the problem, and the purpose of this study. Next, the research questions will be explored, and null hypotheses will be introduced. Once the problem and reasoning behind the study have been established, the limitations, delimitations, and assumptions of the study will be discussed followed by key terms.

Theoretical Framework

A child's environment shapes their growth and development of social and motor skills. Bronfenbrenner's (1981) ecological theory of development describes interactions between children and their environment as a foundation for their development. His research divides these interactions into five systems that have a unique interaction with the individual as they develop (Dooley, 2018; Esteraich, 2018). These systems include the following: (a) microsystem, (b) mesosystem, (c) exosystem, (d) macrosystem, and (e) chronosystem. Each interaction with devices and applications directly shapes the child's development. Screen time often takes time that would otherwise be spent playing using the imagination or manipulative play with the environment. It is this loss of time that can affect a child's development according to Piaget (Hadders-Algra, 2021; Piaget, 1936; Rowland, 2012; Wasilk & Odom, 2019).

Bronfenbrenner's Ecological Systems Theory

The framework of this study comes from Bronfenbrenner's (1981) ecological systems theory. This theory suggests there are five systems of contact that influence social and physical development. The first of these five is the microsystem. This is made of the individual's immediate surroundings such as where the individual lives, school, family, friends, and religious institution. The mesosystem is next and is made up of the

interconnections between environments found in the microsystem such as the involvement of parents in school organizations or how church organizations might support schools. The third system is the exosystem. This is a more encompassing social system where an individual might not interact directly but is still affected by things such as the parent's job, local politics, and any social services provided. Next is the macrosystem, which is comprised of the overall culture, laws, and values found in the other systems. The macrosystem lays a foundation in which the individual engages in their daily routines. Finally, it is the chronosystem that embodies the historical influences the individual might face. This system is the distinct point of time in which the individual lives (Bronfenbrenner, 1981; Dooley, 2018; Walker et al., 2019).

These five systems interconnect and often change over time for individuals. The individual is also subject to the timeline within which they are located and what events are occurring at the time. A child might experience changes in their ecological system over time due to technological advances, increased exposure to digital media, moving geographical locations, or several societal events. These influences on a child's development impact how the child develops and interacts with their environment, which stimulates their construct of knowledge noted by Piaget (Bronfenbrenner, 1981; Dooley, 2018; Ly, 2018; Piaget, 1936; Walker et al., 2019; Wasik & Odom, 2019).

Piaget's Theory

Piaget points out children must interact with their environment to construct their knowledge. In Piaget's (1936) theory of cognitive development there are four stages of growth: (a) the Sensorimotor Stage, (b) the Preoperational Stage, (c) the Concrete Operational Stage, and (d) the Formal Operational Stage (Joubish & Khurram, 2011;

Piaget, 1936; Rowland, 2012). Children in preschool are in the Sensorimotor and Preoperational Stages. In these stages, the child shows growth in representational thinking. This stage of cognitive understanding makes it difficult for children to grasp logic such as realizing objects on a media device represent real-life three-dimensional items (Joubish & Khurram, 2011; Ly, 2018; Piaget, 1936). There are four characteristics that occur in children who are in this stage of development: (a) egocentrism, (b) animism, (c) irreversibility, and (d) centration. Piaget noted children in this stage projected emotions onto inanimate objects. A child at this stage might think a tree has lost its leaves because it is sad winter is coming. Another possibility is when a child focuses only on one sensation or stimulus and rejects all others (Piaget, 1936; Rowland, 2012). Many applications, or apps, are designed to help children through these thought processes and develop these skills (Hoareau et al., 2020). However, much of what Piaget's theory calls for in healthy development is physical interaction with the environment (Lin, 2019; Piaget, 1936; Rowland, 2012).

Movement satisfies an eternal basic need in children (Piaget, 1936; Zukowski & Dickson, 1990). As technology and mobile media grow in popularity they become more available to children. This increase of usage has become a common phenomenon in households in recent years and now schools are incorporating this technology into everyday lessons (Heller, 2018; Lin, 2019). With the introduction of technology that only uses the touch of a finger, educators are questioning how the use of this technology might affect a child's motor development (Lauricella & Cingel, 2020).

Problem Statement

With the increasing availability of technology, children have become more sedentary and more reliant on-screen time (Lin, 2019; McCausland-Hartman, 2017). Because of technology's easy access, touch screen technology has been increasing in use in the classroom. Often schools exchange projection systems for interactive televisions or touch screen monitors. These changes in classrooms are occurring in more schools and across grade levels as each new touch screen technology is developed. Even with such changes there is little research that focuses solely on the preschool classroom and its use of touch screen technology (Pila et al., 2019).

The problem investigated in this study was the conflicting information on whether touch screen technology has a positive or a negative effect on the development of fine motor manipulative skills in young children. Research indicates that, on average, 36% to 74% of mothers believe screen time had a detrimental effect on their child's development of social skills with over 75% of mothers believing it negatively affected their child's physical well-being. Even with these reports, the mothers in this study did not adhere to the limits set for their preschool-aged children (Ly, 2018). Some researchers indicated that children who used tablets showed significantly lower scores in motor skills and visual perception when compared to nontablet users (Kracht et al., 2020; Lin, 2019). These views contradict the results other researchers found when looking at the physical guidelines being met by children using tablets. They found students who met the daily requirements for physical activity while using tablets had higher motor skill function (Kracht et al., 2020). Others support a positive correlation when looking at the educational function of tablets and touch screens for young children. A study in 2020

found a positive correlation in tablet usage in typically developing toddlers and their fine motor skills (Ackerman, 2020). Other studies found a positive correlation for augmenting students' fine motor skills. In these instances, tablets, smart phones, and apps aided differentiated teaching and facilitated meeting the needs of diverse students (Condruz-Bacescu, 2019; Hadders-Algra, 2021; Ly, 2018; Souto et al., 2020). Further studies on the impact of touch screen technology in the classroom are needed to provide clarity among such conflicting evidence (Esteraich, 2018; Ly, 2018; McCausland-Hartman, 2017; Souto et al., 2020; Verroulx, 2018).

Purpose of the Study

The purpose of this quantitative causal-comparative study was to test Bronfenbrenner's ecological systems theory by comparing kindergarteners who used touch screen technology in preschool and kindergarteners who did not use touch screen technology in preschool, based on student scores on the Desired Results Developmental Profile (DRDP) in Missouri public schools (Sutter et al., 2017). This information could be utilized by preschool teachers and parents of young children to better facilitate their learning and development of fine motor skills. In most educators' experience, teachers believe touch screen technology has a negative effect on children's development of fine motor skills, but do not know to what extent (Hatzigianni & Kalaitzidis, 2018; Leonard, 2013; Makawawa et al., 2021).

Research Questions

RQ1. What are the differences in the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri

kindergarteners who used touch screen technology in preschool and those who did not?

RQ1a. What are the differences in the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2018-2019** school year?

RQ1b. What are the differences in the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2019-2020** school year?

RQ1c. What are the differences in the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2020-2021** school year?

Null Hypotheses

$H_0$1. There will be no statistically significant difference between the **kindergarten readiness scores** measured by the individual scores of the Desired Results Developmental Profile (DRDP) in Missouri of kindergarteners who used touch screen technology in preschool and those who did not.

$H_0$1a. There will be no statistically significant difference between the **kindergarten readiness scores** measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners

who used touch screen technology in preschool and those who did not in the **2018-2019** school year.

$H_0$1b. There will be no statistically significant difference between the **kindergarten readiness scores** measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2019-2020** school year.

$H_0$1c. There will be no statistically significant difference between the **kindergarten readiness scores** measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2020-2021** school year.

Significance of Study

The results of this study expand upon previous studies on technology in the classroom and its effect on children's health, gross, and fine motor skill development (Ackerman, 2020; Kardeş, 2020; Kirova & Jamison, 2018; Pila et al., 2019; Rajović et al., 2021; Rideout & Robb, 2020; Salimzyanova et al., 2021; Verroulx, 2018; Wali & Popal, 2020). Now, the use of more than one media device, also known as media multitasking, is taking place in younger generations of children. This multitasking occurs in 1 in 3 children under the age of 4. This type of usage of portable devices such as tablets and smartphones has been linked to inattentiveness, task inefficiency, and distractibility when performing specific tasks (Bandura, 2002; Esteraich, 2018; Eutsler et

al., 2020; Kabali et al., 2015; Rideout & Robb, 2020). Since the beginning of COVID-19, instructional technology use has been on the rise. Many teachers are looking for ways to make education mobile. The increase in touch screen technologies being used in the classroom makes understanding the effects on childhood development more important (Flynn, 2021; Müller et al., 2021; Szente, 2020). Through this study teachers might be able to deepen their understanding of the impacts touch screen technology can have on the motor skills of young learners. It could also give parents more information on the effects these technologies have on the development of their children.

Teacher perceptions of technology also impact the use of touch screen technologies in the classroom. Teachers who had a positive outlook on these technologies were more likely to use them whereas teachers who did not feel comfortable using touch screen technology were less likely to use them. Further studies were needed on the effects of touch screen technology on preschool-aged children to better inform teachers on how they affect their motor skill development (Ackerman, 2020; Connors et al., 2021; Lauricella & Cingel, 2020; Ly, 2018; Verroulx, 2018).

Definition of Key Terms

Active Screen Time. Active screen time occurs when a person is engaged in an activity that involves cognitive or physical engagement while using a digital device with a screen (Ly, 2018).

Desired Results Developmental Profile (DRDP). The DRDP is a test used as part of the School Readiness Tool for kindergarten screening. This tool evaluates these aspects of students' growth: (a) self-regulation, (b) social and emotional development, (c) language and literacy development, (d) cognition, including math and science, and (e)

physical development (Missouri Department of Elementary and Secondary Education [DESE], 2020).

Screen Time. Screen time does not occur when watching traditional television but instead is the time spent in front of a digital device such as a gaming system, smartphone, computer, or tablet while using applications or online (Leonard, 2013; Ly, 2018; Rideout & Robb, 2020; Verroulx, 2018).

Screened Media Device. A screened media device includes items such as a television, DVD player, computers, tablets, video game consoles, e-readers, and toys that connect to the internet (Ly, 2018).

Touch Screen Device. According to McCausland-Hartman (2017) a touch screen device, such as an iPad, is a portable, lightweight, digital device that uses touch, typically by fingers, as the main form of interaction and is often used in classroom settings. This can also be referred to as a tablet, which is any handheld device like an iPad or Microsoft Surface Pro, but it is not limited to these devices and does not include devices used as e-readers. A tablet can be used for digital literacy, play through various applications, problem solving, and tools for developing skills in young children (Leonard, 2013; Lundtofte, 2020; Rideout & Robb, 2020).

Limitations

The limitations in this study were as follows:

- Students' usage of digital technology while at home.
- Changes made to daily education by COVID restrictions or virtual learning.
- The teaching styles of preschool educators, how they use tablets in their curriculum, and what applications they use on these devices.

- Students who had Individual Education Plan (IEP) services that required them to have access to a tablet or touch screen device as their classroom modifications.
- The student's daily physical education classes and instruction while at school.
- The home environment in relation to the student's hierarchy of needs. This includes nutrition and physical movement, which are both needed for motor skill growth and development.
- The difficulty or lack of access to the screening documents.
- The number of DRDP scores provided by the participating school districts.
- The varied ways schools reported their DRDP scores to the Missouri Department of Education.

Delimitations

The delimitations that were identified in this study were as follows:

- Only public, in-district preschool programs in Missouri were used in this study.
- Anonymous individual DRDP scores were used in this study.
- Preschool classes that met a minimum of half a day were used in this study.
- The study was conducted through the lens of Bronfenbrenner's ecological systems theory.
- The participants were delimited to preschools who used touch screen technology for 3 years or more.

Assumptions

The assumptions of this study were as follows:

1. It is assumed this study is generalizable to other states' public preschools that use touch screen technology.
2. Preschool teachers were honest about their usage of touch screen or tablet technology in the classroom.
3. The students were actively using their tablet or touch screen device while in class for educational reasons.
4. The students tested using the DRDP were participants of that district's preschool program.

Design Controls

A casual-comparative research design was used to collect data for this study. A preliminary demographic survey was used to determine the participants of this study. This survey identified which schools fit the criteria for districts who offered in-district preschool classes, who met a minimum of a half day and offered one-to-one tablet technology for integrated use in their classroom, and which did not. Schools were then split into two groups: preschools who used tablets or touch screen technology in their educational setting and preschools who did not offer touch screen technology as part of their education services. Scores from participating schools' DRDP screening were used to address the question of whether there was a difference in students' fine motor skills in kindergarten who used tablets during preschool and those who did not use tablets. The survey also provided insight into the percentage of students who utilized tablets as part of an IEP. If a non-tablet-using preschool had a higher percentage than 5% using tablets as part of their IEP, their group scores were not accepted as part of the study. Once schools

were selected, kindergarten DRDP scores were anonymously collected redacting the names of the students, allowing for anonymity among participants.

It is important to consider there are factors outside of technology use that affect motor skill development that may have subsequently affected the results of the study. These factors included daily physical interactions with people inside the home, nutrition and physical needs of students, and touch screen technology access at home (Flôres et al., 2019). This was controlled in the study due to the varied nature of children's homes and lifestyles. This is no different than what is typical for students with already varied backgrounds and experiences that occur naturally in life. Classroom limitations of this study included the varied teaching styles of participating classroom teachers and the preferred applications for which the tablets were used.

Another limitation faced by this study was the varied times these devices were used in each classroom and any changes to this time due to restrictions or virtual learning accomplished by students. Due to these restrictions, some students participating were quarantined, so their exposure to touch screen technology differed from their classmates. Because of the vastness of COVID-19, all students experienced similar restrictions or virtual learning options. These differences could not be detected because of the anonymity of the scores. Anonymity also prevented the identification of students who received extra services due to an IEP, while this ensured the anonymity of students and confidentiality for preschool programs.

Another limitation was the difficulty of obtaining scores anonymously and relying on honest answers to the preliminary survey to pool scores suited for the study. To help

minimize this, only public schools in Missouri that used DRDP for kindergarten screening were used to obtain scores. These scores were also adopted for all public schools in the state of Missouri and provided a resource sample that was consistent. To reinforce the anonymity of students all students were included in the reported scores including students with an IEP. Due to federal mandates that come with IEPs, some students might have had access to touch screen technology. Because no restrictions on scores were in place other than the selection of schools reporting, these scores were included. Scores of students with IEPs were included as they were designed for the success of students and varied based on individual students' learning styles.

There is a gap in research regarding tablet use in educating younger children such as preschool classrooms and its effect on the development of fine motor skills. Studies have identified this gap, which has led to educational communities questioning the role of technology in the early education classroom (Leonard, 2013; Ly, 2018; McCausland-Hartman, 2017). With the advancement of technology and resources available to teachers using media for younger students, digital devices are advertised as tools to develop skills such as fine motor in young children. This study explored the differences of using digital devices, such as tablets, in the preschool classroom setting and its effect on the development of fine motor skills of children.

Summary

According to a study taken in 2020 parents are almost equally divided in their views of technology used for education (Lauricella & Cingel, 2020). In the Lauricella, and Cingel (2020) study 23% of parents believed using a tablet or digital device helped school performance whereas 22% believed the use of the hinders education. In the same

study 55% of parents disclosed the use of technology made no difference (Lauricella & Cingel, 2020). The perceptions of technology use in early education reflect this study as teachers and administrators' perceptions vary on the subject (Hinkley & McCann, 2018; Leonard, 2013). Available studies have also uncovered conflicting data on the use of touch screen technology in preschool classrooms (Bocks, 2021; Condruz-Bacescu, 2019; Lin, 2019; Ly, 2018; Wood, 2017). The purpose of this causal-comparative study was to investigate if there was a difference in fine motor skills between kindergarteners who used touch screen technology during their preschool program and kindergarteners who did not use touch screen technology in their preschool program. Through the lens of Bronfenbrenner's (1975) theory the research provides teachers with a foundational knowledge of how their use of technology can affect a child's development while in early education. The purpose of this quantitative causal-comparative study was to test Bronfenbrenner's ecological systems theory by comparing kindergarteners who used touch screen technology in preschool and kindergarteners who did not use touch screen technology in preschool using student scores on the DRDP in Missouri public schools.

In Chapter Two of this study a review of literature organized thematically will provide the foundations on which this study was conducted. The literature review will begin with the framework emphasizing the growth and development of children. Next, the researcher will provide the trending practices of digital media use and perceptions of parents and teachers. The benefits and risks of screen time will be addressed. Finally, the review focused on current studies on the effects of screen time on fine motor skills.

Chapter Three will include the quantitative method used to conduct this study. In this chapter the purpose of the study and research questions are discussed and the process

of conducting the research is identified. Chapter Four presents how data were collected and analyzed. The information will be addressed in Chapter Five, where the outcome of the data received is discussed.

CHAPTER TWO

REVIEW OF LITERATURE

Introduction

The introduction of the COVID-19 pandemic in 2019 caused a major shift in education across the world to include one-to-one technologies into their education plans. This push came from the necessity of education continuing despite families being quarantined in their own homes and the introduction of social distancing in classrooms (Angrist et al., 2022; Champeaux et al., 2022; Gemelli & Boccalatte, 2022; Hernandez, 2023). Prior to the pandemic early education classrooms were only beginning to introduce these technologies with teacher education programs reporting some of the common problems where teachers were not comfortable using technology in the classroom, they were not aware of the importance of experiences using technology during lessons, and were not engaging in activities utilizing technology unless compulsory (Kulaksiz & Toran, 2022). The increase of technology access combined with these ideas and reports inspired the idea for this research study.

Chapter Two will introduce literature focused on the topic of how tablets affect the development of fine motor skills in children. To begin the review, the theoretical framework surrounding the integration of technology into education and the development of children's fine motor skills will be addressed. These theories will then be connected to the perceptions of digital media use, school use of touch screens, the influence of screen time, and what current research indicates. Research indicates both positive and negative correlations regarding the use of digital media by children (Bocks, 2021; Joseph et al.,

2022; Kulaksiz & Toran, 2022). Next, both positive and negative outcomes will be addressed with the perceptions of parents and teachers at the forefront. Additionally, literature based on the development of fine motor skills and the effects screen time has on the development of those skills will be addressed. As a result of the review of literature, research, and subsequent data collected, this study sought to determine the difference in fine motor skills of students who used tablets in preschool and those who did not.

Theoretical Framework

Movement is a part of a child's life from the moment of birth. Even before speech, movement is used to express feelings and emotions. As children grow, they are capable of more complicated movements. These movements express a child's thoughts, feelings, and wishes through imaginative and unforced ways. This natural growth in movement leads to other aspects of learning (Taylor, 1975). One obvious way children learn is by observation, then practice. According to Simon Davies (2019), children do not need to be kept busy. Often, they are happy to watch others perform tasks and will learn the task through this observation (Davies, 2019). The interaction one has with their environment impacts their growth and development in numerous ways. Bronfenbrenner addressed this in his Ecological Systems Theory (Dooley, 2018).

Bronfenbrenner's Ecological Systems Theory

Ecological systems theory, also known as bioecological systems theory, considers the relationship the child has with their environment. Physical, social, symbolic, and cultural characteristics of an environment may invite, permit, or inhibit a mutual transaction between the immediate environment and the working child's engagement in diversified motor behaviors (McLinden, 2017). This theory focuses on the external

elements that affect a child's growth and development (Graham et al., 2022). Bronfenbrenner (1981) broke up this interaction into five distinct levels, which interact with one another. The first of these five is the microsystem. This is made of the individual's immediate surroundings such as where the individual lives, school, family, friends, and religious institution. The mesosystem, the second in the series, is made up of the interconnections between those found in the microsystem. These could be the involvement of the individual's school in the community, how their parents are involved in school, or how their religious institution is involved in their neighborhood. The third system is the exosystem. This is the more encompassing social system where the individual might not interact directly with the individual but still affects those interactions. These might be, for example, the parent's job, local politics, and any social services provided. Next the macrosystem, which is comprised of the overall culture, laws, and values found in the other systems, lays a foundation in which the individual engages in their daily routines. This is the individual's socioeconomic status, ethnicity, and any federal policy the individual must follow. Last, the chronosystem embodies the historical influences the individual might face. This is the distinct point of time that impacts the individual's environment (Bronfenbrenner, 1981; Dooley, 2018).

Following this theory the five levels were condensed into three: (a) the microsystem, (b) the mesosystem, and (c) the macrosystem. The core of this framework is the individual. Then in the first layer, the microsystem describes the relationship the individual has with their immediate and diverse environment and so forth. With such advances in technology and media being more accessible to the individual the question has been asked whether media should continue to belong to the exosytem, now the

macrosystem, and placed in the microsystem (Aksan & Kutluca, 2021; Bronfenbrenner, 1981; Dooley, 2018; Kirova & Jamison, 2018; Walker et al., 2019).

As touch screen technology and digital media become more advanced they become more accessible to families. As digital media enters the home or the microsystem of a child it has a higher impact through the inner systems. The perceived use of technology by parents often affects the exposure children and even adolescents have to the media and their own perceptions of its use. Parent attitudes and their behavior have shown an immediate effect on children through their modeling of the behavior. A child's perception of positive or negative use is developed following their interactions with parents and their beliefs. This has been found true for drug, alcohol, and media use (Bandura, 2002; Lauricella & Cingel, 2020; Lundtofte, 2020). Technology accessibility has become the center for school-supporting nonprofits, such as Bridge to Broadband, which have used research-based practices to inform school districts how they can help reach rural students and connect them to the internet (Connors et al., 2021). Since 2011, the gap separating high-income households and low-income households who have high speed internet has decreased 28% (Heller, 2018). This has impacted Bronfenbrenner's second system connecting the community to families by connecting those families to schools (Dooley, 2018).

Another important aspect of the microsystem is the introduction to the internet. The addition of the internet into most homes has added a new element to Bronfenbrenner's theory. In 2011, 52% of households with 1- to 8-year-olds reported having a mobile device. In 2017, that percentage grew to 98% of households (Heller,

2018). Before the microsystem consisted mostly of the individual's immediate surroundings such as family, friends, school, and church. However, with the introduction of mobile devices connected to the internet, that circle of influence has suddenly grown. Individuals, including children, have been exposed to much more of the world in their daily interactions than before. For some individuals school has even become a part of their mobile device and digital environment (Kirova & Jamison, 2018; Salikhova et al., 2020).

The effects the systems have on an individual change over time as these influences change when an individual's environment changes. The idea that play develops fine motor and gross motor skills is not new. However, the focus of what play develops physically in a child has changed over time. Pre-World War I play focused on gross motor development. Post-World War II play moved to fine motor development. As time moved into the late 1900s, play became more creative. Today's play includes the use of digital media (Lundtofte, 2020). This ecological transition can affect the individual's or child's growth and development as stated by Piaget's theory of physical development if the environment differs enough from system to system. If a particular change occurs during one of the four stages of Piaget's theory of physical development, then it will affect the child's growth in that area (Dooley, 2018; Lin, 2019; Nobre et al., 2020).

Piaget's Theory of Physical Development

Piaget's (1936), theory points out children must interact with their environment to construct their knowledge. This environment as stated by Bronfenbrenner includes the individual's immediate surroundings and how those in the individual's immediate environment interact with other aspects of their surroundings (Dooley, 2018). In Jean

Piaget's (1936), theory of cognitive development there are four stages: (a) the Sensorimotor Stage, (b) the Preoperational Stage, (c) the Concrete Operational Stage, and (d) the Formal Operational Stage (Rowland, 2012). Children in preschool are in the Preoperational Stage. This stage of development is where the child shows growth in representational thinking. There are four characteristics that occur in children who are in this stage of development: (a) egocentrism, (b) animism, (c) irreversibility, and (d) centration. Piaget noted children in this stage projected emotions onto inanimate objects. A child at this stage might think a tree loses its leaves because it is sad winter is coming (Lin, 2019). For a child in this stage their microsystem would be a foundational source of what an object might feel. The microsystem would also help establish what objects a child meets, which could include digital devices (Dooley, 2018). Another occurrence is when a child focuses only on one sensation or stimulus and rejects all others. However, much of what Piaget's theory calls for in healthy development is physical interaction with the environment (Lin, 2019; Rowland, 2012).

Movement satisfies an eternal basic need in children (Zukowski & Dickson, 1990). This need for movement drives learning as infants and toddlers grow. For this reason, early childhood educators need to break motor skills down into two categories: one for small muscles (fine motor) and one for larger muscles/gross motor (Wang, 2004).

Purpose of Instructional Technology

Since the creation of the Macintosh personal computer, technology has been considered a tool for problem solving and expanding structural knowledge. It has been widely accepted as a positive influence in the classroom and the development of children. Children learn when they are engaged with their environment (Brofenbrenner, 1981;

Leonard, 2013). With this belief it is effective to integrate technology into the curriculum and not try to integrate the curriculum into the technology (Leonard, 2013). The National Association for the Education of Young Children (NAEYC) (2020) suggested technology is an outlet for early childhood-aged children to further explore their creativity using a wide variety of interactive media.

Trending Practices of Digital Media Use

In 2017, 78% of families with children 8 and under owned a tablet and 95% of families reported having a smartphone in their home (Heller, 2018). In 2011, only 52% of households of 1 to 8-year-olds reported having a mobile device. In 2017, this increased to 98% of homes. This study also found since 2011 the average amount of time a 1 to 8-year-old spent on a mobile device increased an average of 43 minutes a day (Heller, 2018; Ly, 2018; Rideout & Robb, 2020). The home environment plays a key role in the development of motor skills in school-aged children. Parent perception of digital technology affects the microsystem of a child's development. If the family has a high value of digital media, the child will develop a high value and use will increase; however if the family does not see value in digital media, it will not be utilized or used in a smaller function. Parental involvement in a child's use of digital media has impacted the use by children (Ferreira et al., 2018; Joseph et al., 2022; Lundtofte, 2020).

As technology has become more common in households, younger children have become owners of personal devices. This has become common through a phenomenon known as "pass-back." This happens when an adult gets a new digital device such as a smartphone and passes down their old phone to the children in the household (Leonard, 2013). With more people owning personal digital devices it is common for individuals to

be connected constantly through multitasking. Multitasking occurs when individuals play games on their smartphone while watching television or listening to music while working on the computer. Although multitasking has become commonplace the effects it has on cognitive performance are detrimental (Verroulx, 2018). Even with this evidence many educators still utilize digital devices such as tablets and smartphones in the classroom (Sari et al., 2020).

Recent Trends of Digital Media Use in the Classroom

The expansion of 4G, LTE, and 5G technology has led to the progression of devices such as tablets and smartphones. Many teachers have adopted this technology because of accessibility and the usefulness of applications in the classroom. Teachers and educational programs have developed a range of educational apps for use in the classroom. Using these devices makes education more comfortable, flexible, and efficient for students to practice or demonstrate knowledge (Ackerman, 2020; Baudier et al., 2020; Neumann & Merchant, 2022). As a tool for education, technology has grown in popularity among young teachers. Some research showed the use of digital media has become beneficial to children's development. The educational content of these devices has also become commonly supported and can provide scaffolding for students' cognitive skills through apps on iPads, movies, television shows, and video games (Neumann & Merchant, 2022; Verroulx, 2018).

Students have a more positive outlook on a teacher and their education when technology is introduced to a classroom that did not previously have technology. This perception has led to the placement of innovative technologies in classrooms with struggling students as motivation and a tool to give those students extra support. The

need for technology in the classroom has drastically grown in the past year. Although teachers knew they needed to utilize this technology during the COVID-19 pandemic, their utilization of technology could only be implemented as far as their perceptions and training would allow. Some teachers see themselves as more of a facilitator than an educator when utilizing these technologies (Wali & Popal, 2020).

For decades, teachers have had debates with administration and policymakers surrounding the skills preschoolers need to enter kindergarten successfully. The reliance on relevant research has increased as educators try to find the best balance of technology integration as part of their students' school readiness. As such, some research suggests that technology does have efficacy in improving students' reading and mathematics skills, which impacts the perceptions teachers have towards using this technology in the classroom overall. As apps are improved and more age-appropriate options become available, teachers are finding it easier to integrate touch screen technology into their lesson plans (Tran, 2021).

Tablets and Touch Screens

Since the introduction of the iPad in 2010 tablets have entered the classroom as educational devices. Unlike computers, tablets provide a mobile interface that only requires use of touch for interaction. These portable devices come with applications with a wide variety of functions. With the ability to connect to the internet through Wi-Fi or networks such as 3G or greater, accessibility is easy and manageable. Their size also makes them more desirable than computers or laptops for smaller children. They can be used for small group lessons, whole group lessons, or one-on-one instruction (Ackerman, 2020; Leonard, 2013; Ly, 2018).

In 2015 a study by Hatzigianni and Kalaitzidis (2018) found 96.6% of children can use mobile devices by the age of 4 years old. Most of these children could do so before the age of 1. The increase in children using mobile devices has been strongly opposed by the American Academy of Pediatrics, however, parents continue providing touch screen technologies for their children (Hatzigianni & Kalaitzidis, 2018). Even with this evidence schools are introducing tablets at a younger age as part of integrating technology in the classroom. A study by Lin (2019) concluded that children who utilized tablets as part of their education showed a significantly lower ability in visual discrimination, memory, and special awareness than those who were non-tablet users. Children who were non-tablet users showed higher fine motor skill ability than those who used tablets. However, there were limitations to this study. One limitation was the small sample, which might not have been comparable to a larger population (Lin, 2019).

Screen Time

By the age of 5 the use of screened media devices decreases presumably because children of this age have become more involved in school activities, leaving less time for screen activities (Ly, 2018). According to the American Association of Pediatrics preschool-aged children should have no more than 2 hours of screen-based interaction a day and children under 1 should not have any screen time (Hatzigianni & Kalaitzidis, 2018). With the introduction of smartphones in 2007 and tablets following shortly after, touch screen technology is more available as a tool for education and entertainment for families and educators (Esteraich, 2018; NAEYC, 2020). Educators are now faced with the decision of when and how to use these technologies to help students properly develop even as some tablet application companies advertise to educators their services as training

for visual perception and fine motor skills (Lin, 2019). However, some studies are finding that interactions with touch screen technologies have a negative impact on a child's fine motor skill development. According to the study by Ling-Yi Lin (2019), there is a negative correlation between the time spent on a tablet and the performance of fine motor skills in preschool-aged children. Students who used tablets in this study had significantly lower fine motor integration and manual dexterity than students who did not access tablets (Lin, 2019).

Factors Contributing to Screen Time

As technology increases in usage in the private home, parents have begun to utilize screened media to pacify, educate, and even be a digital babysitter for their children (Leonard, 2013; Ly, 2018). Although television has been present in the lives of many families for decades the ease and accessibility of smartphones and tablets make streaming video easy regardless of the location. Although most children are exposed to screen-based media constantly, studies have found differences in socioeconomic status changes the amount of screen time to which children are exposed. This difference in an individual's macrosystem has changed how they perceive digital devices, which has caused parents to pass down different beliefs in the value of this mobile technology. Because of this, children in lower socioeconomic households tend to use more screen-based media than middle to higher income families (Dooley, 2018; Heller, 2018). Noninteractive media, such as television and portable games, can lead to passive viewing in children. This form of viewing is noninteractive and cannot be an alternative for educational engagement (Leonard, 2013). Easy use of technology and touch screens

provide a quick and easy tool to quiet a restless child or to provide instant gratification when the child wants to see something.

Children are more optimistic and open to changes in technology. Because of this, they tend to be more inquisitive about it than adults. As children grow up as digital natives, they often learn how to use technology faster and more efficiently than their parents. This is also true for educators. Educators benefit from the availability of technology as a tool of communication, but often do not have the training to use the technology effectively. Educators are often supplied with technology that they have not been trained to use. Because of this, students who have been exposed through use at home are more knowledgeable on how to use the device (Kardeş, 2020; Leonard, 2013; Reardon & Leonard, 2019; Salimzyanova et al., 2021).

In 2019, a drastic shift in technology use took place within schools with the introduction of COVID-19. Even though prior to the pandemic technology systems were being adopted rapidly throughout schools, the outbreak of COVID-19 accelerated the use of digital devices as part of the curriculum. Teachers and parents found themselves leaning on personal technology devices for the purpose of education. Governments and schools were providing devices to homes that otherwise had none, expanding the use of personal screen devices at a rapid rate (Angrist et al., 2022; Bruins, 2022; Champeaux et al., 2022; Joseph et al., 2022). Studies on the impact COVID-19 had on education are only in the infancy stage of data being collected. According to a study by Joseph et al., (2022) the extended use of digital devices impacted mobile dependency, socialization, cognition, and behavioral patterns in children between the ages of 3 and 6. This heightened exposure to screen time has increased the need for studies on the impact

screen time has on children in relation to their education and development (Hauck & Felzer-Kim, 2019; Joseph et al., 2022).

Benefits of Screen Time

Parents identified benefits associated with screen time, which are consistent with published studies. It is widely accepted that technology in educational settings has a strong positive presence in the development of children. Ninety-four percent of parents in a study conducted by Common Sense Media believed technology positively affects their children's schoolwork and education (Heller, 2018; Leonard, 2013). Studies have shown children's educational skills can benefit from time spent with a digital device (Hinkley & McCann, 2018). Classroom teachers utilize eBooks and textbooks due to their interactive nature. Young children using eBooks can access photos, video, and a variety of texts (Neumann & Merchant, 2022). With the appropriate care from parents and teachers, precautions can be made to ensure a meaningful and effective use of screen time (Lammers et al., 2022; Ly, 2018). When using screen time to watch videos such as PBS educational programing some studies found children had higher executive functioning skills. There is evidence suggesting the content of an environment to which children are exposed also impacts their development (Brofenbrenner, 1981; Esteraich, 2018).

With the introduction of distance learning during the COVID-19 pandemic, the exposure to screen time increased for all ages. Families began communicating using Zoom calls instead of meeting in person, teachers and schools began posting videos of lessons and discussions, and classes of all ages met online when they would otherwise be in person. Entire classrooms who would not have access to one-on-one devices such as laptops or tablets were using them daily to attend school from home. Today, some

districts still offer distance education and allow students to continue meeting online from home as educators have become adjusted to teaching and utilizing digital technology as a teaching platform (Bruins, 2022; Champeaux et al., 2022; Pandya & Lodha, 2021). Even with these changes there is still evidence that suggests the environment students are in at home continues to drive screen time exposure. A study by Konca (2022) found that children who live in digitally rich home environments still had less screen time than their parents in the same household. It also revealed parents limited their child's screen time or made a point to accompany them during the use of digital technologies. However, studies also support that the amount of screen time fluctuates when families of different socioeconomic status are compared (Mollborn et al., 2022).

Risks of Screen Time

Ly (2018) stated children's future media habits can be predicted by how their parents chose to expose them to media. Even as parents become aware of the potential risks of screen time to their child's development, they do not adhere to the recommended exposure time for preschool-aged children (Ly, 2018). The American Academy of Pediatrics encourages parents to avoid any screen media for children under the age of 2, and only recommend between 1- and 2-hours screen time during a 24-hour period (Leonard, 2013). Preschool children who had more screen time exposure at a younger age were found to have lower executive functioning skills than children who began screen time usage at a later age. This activity can also be linked to lower memory function and attention spans in children (Esteraich, 2018; Nikolopoulou, 2020).

Kracht et al. (2020) conducted a study identifying the relationships between movement, screen time, and fine motor skill development. Their research found an

appropriate balance of physical activity and screen time motor skill development was unchanged when compared to children who had little to no screen time. This study also found that with an inappropriate balance of screen time and physical activity children might experience a poor health-related quality of life. Children who follow physical movement guidelines could experience long-term benefits regarding their motor skill development (Kracht et al., 2020).

Fine Motor Skills

Children develop rapidly up until the age of 5. During this time movement is critical to the growth of the child both physically and cognitively. Piaget suggested the motor skill development at this age is critical for cognitive development in children (Lin, 2019; Rajović et al., 2021). Clark and Metcalf (2002) argued there were 6 stages of motor skill development in children: (a) the reflexive period, (b) the preadapted period, (c) the fundamental patterns period, (d) the context specific period, (e) the skillful period, and (f) the compensation period. Children in the reflexive period have just begun to discover voluntary movement. This stage is the first and occurs as soon as the child is born. The preadapted period takes place as the child begins developing fine motor skills to walk and crawl. The third period, the fundamental patters period, takes place from the age a child walks to about age 6. If a child does not develop the proper skills physically in the first three periods, they will have difficulty later in life developing more complex systems of movement or might not develop them at all (Pelligrino, 2009).

These motor skills are primarily impacted by the first and second systems in Bronfenbrenner's (1981) theory. The relationship the child has with those around them is important but also what those in the second system do to interact with the child. This

includes schools, daycare, and home life. If the facilities do not provide the needed motivation to move or play, then the development of motor skills suffers. Motor skills are critical to the development of cognitive functions. Children who are exposed to more than 2 hours of television in a 24-hour period are more likely to develop delayed motor skills than those who were exposed to fewer than 2 hours of television (Dooley, 2018; Palmer et al., 2020; Verroulx, 2018).

Contributing Factors to Children's Motor Skill Development

Physical activity and screen time are two factors that have been found to affect young children's health and development (Rajović et al., 2021; Hinkley & McCann, 2018). Children from infanthood through early education develop their motor skills through playing with the environment around them. By cultivating a relationship through feel and body positioning children develop their fine and gross motor skills (Madrona et al., 2018). There is evidence that suggests physical activity positively supports the development of children's motor skills and that a child's microsystem has an important influence on how much physical activity a child receives (Hinkley & McCann, 2018; Nobre et al., 2020). Most digital technology use does not require large or deliberate forms of movement, which can lead to sedentary habits in young children. However, in another study, researchers found tablet usage in children equaling only about an hour a day resulted in slightly better fine motor skill function. This study used both passive and active activities on the tablet and noted the children did not exceed usage recommendations for their early age (Souto et al., 2020).

COVID-19 has created the largest disruption of education and instructional institutions in recent years. Due to the drastic changes in classrooms due to social

distancing, virtual learning, and the amount of time schools were not in session, many children fell behind in their development. According to a study by González et al. (2022), in children assessed between the years of 2018 and 2020 a loss of motor and cognitive skills was observed. These losses were less pronounced for students attending schools in higher socioeconomic systems.

Effects of Screen Time on Motor Skills

The use of technology is increasingly of interest to families and educators with the introduction of touch screen applications in early childhood classrooms. A balance between screen time and physical activity has also been found to be effective and appropriate for preschool-aged children and their development (Kracht et al., 2020). According to a recent study by Kracht et al. (2020), students who had met the guidelines for physical activity while using tablets had higher motor skill function than students who did not meet those guidelines. With studies both providing positive and negative associations to use of touch screen technology it is also important to understand the educators' views and practices when faced with using this technology (Abnathya, 2021; Hatzigianni & Kalaitzidis, 2018; Özbay Karlidag, 2022; Souto et al., 2020).

Media Content

Though the amount of time children spend watching or engaging in screen time is important, the content must be taken into consideration to determine what is appropriate and effective for development. Digital media in the classroom is only effective if used appropriately and the content is supportive of the lesson taking place (Leonard, 2013). Educators play a critical role when selecting developmentally appropriate applications for use with tablets. It is critical for teachers to only use this technology to promote

interactive learning and follow guidelines that the use of the tablet is efficient and effective (Ly, 2018). However, when selecting applications to use on digital technology, teachers will use the recommendations of other teachers, the applications' advertisement based on merit to education, or simply no reason at all (Leonard, 2013). Applications should be selected using guidelines that encourage high-quality experiences that do not have superfluous imagery that can detract from the learning experience and help the child make meaningful connections to their environment (Heller, 2018; Ly, 2018).

Time Spent

The primary activity performed on digital devices is video viewing. This viewing takes place on platforms such as YouTube, Netflix, Amazon Prime, and more and comprises up to 17% of time spent on the device. This exposure to screen time rises significantly when background television is present (Ly, 2018). A study by Kabali et al. (2015), found children spent an average of 45 minutes a day watching television, 22 minutes using applications, 27 minutes watching videos on a tablet or smartphone, and 15 minutes playing video games. This time increased in families of low-income households (Ly, 2018). During the COVID-19 global pandemic, virtual learning grew rapidly among school districts to continue education even when guidelines were set in place to prevent in-person education. As a result, students were meeting virtually using digital technologies such as computers and tablets. This increased average screen time among students during the time they would have normally been in a classroom being instructed in person (Joseph et al., 2022).

Summary

The evidence of research shows conflicting information on the benefits of technology in the development of young children. The literature review conducted a thorough investigation for further research by investigating the background theories supporting the development of motor skills in children and current studies on the impacts of digital devices on children. Children develop by interacting with their environment. These interactions provide physical growth and development of their motor skills while in the Preoperational Stage of Piaget's theory of cognitive development (Rowland, 2012). While a balance of physical activity and screen time did not have as much negative effect on children's motor skill development, children are being exposed to digital media at younger ages through their parents and caregivers, resulting in more exposure to screen time. This exposure is causing children to interact with their environment less. While high-quality applications do provide an interactive educational experience, many parents and teachers do not have the training to make positive selections of applications (Joseph, et al., 2022; Lammers et al., 2022). Chapter Three introduces the methodology of the study to answer the research questions and fulfill the purpose of the study. Next, in Chapter Four there will be a discussion of the results of this study and in Chapter Five the study will conclude with recommendations for further studies and a discussion about the findings.

CHAPTER THREE

METHODOLOGY

Introduction

The researcher thoroughly reviewed literature and found though schools are increasing their usage of touch screen technology, information on the impact of touch screens on preschool-aged children and their development of fine, gross, and locomotive skills is lacking (Ackerman, 2020; Kirova & Jamison, 2018; Lauricella & Cingel, 2020; Pila et al., 2019; Verroulx, 2018). This research is increasingly important as technology has become a mainstay of teaching in the classroom, and it has been predicted students alive today and beyond will never know a world without technological devices or the internet (Groves, 2021). Bronfenbrenner's (1981) theory recognizes that a person's surroundings can affect their growth and development. With technology being incorporated into the classroom it is important to research how these technologies impact the growth of the children who use them (Dooley, 2018).

Current research concludes there is a gap in understanding the effects touch screen technology has on the development of motor skills in young children (Ly, 2018; Wali & Popal, 2020). The information provided by this study could be utilized by teachers and parents of young children to better facilitate their learning and development of fine motor skills. In most educators' experience, teachers believe touch screen technology has a negative effect on children's development of fine motor skills, but do not know to what extent (Hatzigianni & Kalaitzidis, 2018). In this chapter the researcher presents the methodology of the study and the purpose of the study, and research questions are discussed. Next, the researcher addresses the variables of participants,

selection, and sampling used in the study. The research setting involved a quantitative analysis of the data collected using the scores from the DRDP evaluation. Following this the study discusses the procedures and the process by which the data were analyzed.

Purpose of the Study

The purpose of this quantitative causal-comparative study was to test Bronfenbrenner's ecological systems theory (1981) by comparing kindergarteners who used touch screen technology in preschool and kindergarteners who did not use touch screen technology in preschool, based on student scores on the DRDP in Missouri public schools. This information could be utilized by preschool teachers and parents of young children to better facilitate their learning and development of fine motor skills. In most educators' experience, teachers believe touch screen technology has a negative effect on children's development of fine motor skills, but do not know to what extent (Hatzigianni & Kalaitzidis, 2018; Leonard, 2013).

Research Questions

RQ1. What are the differences in the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not?

RQ1a. What are the differences in the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2018-2019** school year?

RQ1b. What are the differences in the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2019-2020** school year?

RQ1c. What are the differences in the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2020-2021** school year?

Null Hypotheses

$H_0$1. There will be no statistically significant difference between the **kindergarten readiness scores** measured by the individual scores of the Desired Results Developmental Profile (DRDP) in Missouri of kindergarteners who used touch screen technology in preschool and those who did not.

$H_0$1a. There will be no statistically significant difference between the **kindergarten readiness scores** measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2018-2019** school year.

$H_0$1b. There will be no statistically significant difference between the **kindergarten readiness scores** measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2019-2020** school year.

$H_0$1c. There will be no statistically significant difference between the **kindergarten readiness scores** measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2020-2021** school year.

Selection and Sampling

The purpose of this study was to compare the motor skills of kindergarteners who used touch screen technology as part of their learning environment to those who did not use the technology. The participants in this study were kindergarteners in the state of Missouri who attended an in-district public preschool and took the DRDP as part of their kindergarten screening. These participants were anonymous to the researcher. The class data were obtained without the names or any identifiable information for the individual student. Schools who participated were selected using a survey that was sent out through email. This survey determined if the preschool utilized touch screen technology as part of student learning and activity or if the classroom was free of touch screen technology. The survey also determined if the preschools met the criteria of providing lessons for a minimum of a half day. Using the preliminary survey two school districts were chosen to participate. Two school district's data were collected for the study.

Participants were selected by survey and their placement in an in-district preschool upon entering kindergarten. A survey was used to determine if the participants were tablet users or non-tablet users while in preschool and how long their program had been using tablets if they were tablet users.

Schools selected were limited to school districts in the state of Missouri who had a preschool program included in the district. If a school indicated during the study, they received tablets during the school year and not for the full year, their scores were not included in the study. The survey also provided insight into the percentage of students who utilized tablets as part of an IEP. If a non-tablet-using preschool had a higher percentage than 5% using tablets as part of their IEP, their group scores were not accepted as part of the study.

Research Setting

At the time of the research conducted, schools in Missouri were practicing post COVID-19 policies. The state of Missouri and the federal government had lifted all restrictions regarding the quarantine status of teachers and students and allowed for full seated classes. However, schools' individual policies still varied across the state as they would in any other given year. The research setting was Missouri public preschool classes, which fed into district kindergarten programs. Missouri consisted of three geographic settings including rural, urban, and suburban districts. These districts were divided into nine regions known as Regional Professional Development Centers (RPDC; DESE, 2023). Two districts were selected out of the population of school districts in Missouri based on the variety of programs available. The preliminary survey was sent to these districts to obtain a diverse sample of classrooms and demographics. Districts that are represented in this study varied in geographic locations, population, income, socioeconomic status, and access to education. This study took place following the rise of technology in the classroom as a direct result of classroom modification due to the increase of the virus COVID-19 during the 2020 epidemic. As a result, it can be

concluded more schools are utilizing technology to meet the standards set by the Centers for Disease Control and Prevention for social distancing and quarantine and because of extra funding for schools to distribute more one-on-one technologies in the classroom (Gentles & Hayes-Brown, 2021). Participants were presented with the purpose of the study and an informed consent to participate for (Appendix A). The subjects of this study remained anonymous and only anonymous individual scores were used to conduct the study.

Research Design

A quantitative study was chosen to answer each of the three research questions. According to Albers (2017), a quantitative study collects and analyzes numerical data to draw conclusions in a scholarly study. Due to the statistical nature of the data collected, the researcher chose to complete a casual-comparative quantitative report comparing the DRDP scores of the two groups. With the vast number of schools being exposed to one-to-one touch screen technology following the COVID-19 pandemic, the data collected by this study will provide information to teachers in early education how best to use technology to promote healthy growth of fine motor development in their students (Hernandez, 2023). As a result of COVID-19, teachers have become polarized on their beliefs of how to teach following a pandemic and as a result a quantitative study based on interviews and teacher perceptions would result in data that would be more suited determining such things as perceptions or opinions (Gentles & Hayes-Brown, 2021). Due to the independent variable not being manipulated the researcher chose to complete a casual-comparative quantitative report to remove emotions from the data and provide results as accurate as possible. By utilizing only data of the DRDP tool, the researcher

was able to minimize any bias due to heightened emotions of technology use as much as possible. To complete this study a casual-comparative quantitative report was completed in conjunction and with approval of the Southwest Baptist University Institutional Review Board. The desired sample size for this study was 25 individual DRDP scores and a total amount of surveys collected was 14. From this the researcher collected data from two school districts.

Once the survey was completed the data were separated into three categories. These categories represented the three types of motor skills reflected in the three research questions, which are fine motor, gross motor, and locomotive movement. Following this, the researcher divided the results by the 2018-2019, 2019-2020, and 2020-2021 school years. To demonstrate the differences between the variables the data were collected and divided by the researcher, who then ran a Chi-square Goodness Fit test using the Statistical Package for Social Sciences (SPSS).

Instrumentation

The researcher used the DRDP to gather performance scores of kindergarten students' fine motor, gross motor, and gross locomotor skills. The DRDP is a test that was developed through a collation between the California Department of Education's Early Learning and Care Division and experts in child development and assessment from WestEd's Center for Family Studies and the University of California's Berkeley Evaluation and Research Center. The DRDP was developed for public-funded education and early care programs in the state of California. In 2015 an updated version of the DRDP assessment was created for infants, toddlers, and preschool-aged children, however, it has now been developed for use in kindergarten. Through the research of

literature in child development, collaboration with leading experts in child development, and refined quantitative and qualitative research with early childhood and kindergarten teachers these instruments were produced. The DRDP provides educators and parents with a data profile measuring the student's developmental growth from infancy to the end of kindergarten. It also highlights areas where children need future support regarding their growth (Karelitz et al., 2010). The design of these tools is intended to serve students and children in early learning environments including students with special needs or dual language learners. This assessment is used by Missouri teachers as an evaluation for students entering Kindergarten. For this study, data were only collected from the Physical Development Domain on the DRDP of participating schools. These scores were acquired to answer the research questions proposed in this study. The validity of the instrument was tested through a study conducted by Karelitz et al. (2010). Their work used the confirmatory factor analysis model. The researchers split the 39-point scale into five domains: (a) self-awareness and identity, (b) mathematics, (c) social skills, (d) language and literacy, and (e) domain-general cognitive skills. This five-factor model, which is based on the driven Q-sort exercise, was confirmed using Confirmatory Factor Analysis (CFA), which measures the latent variables (Hoyle, 1995).

The acceptable reliability of the coefficient for Cronbach alpha is .70 or higher (Creswell, 2005; George & Mallery, 2003). The factor loadings of the study were large and statistically significant at $p < .001$ enough so the researchers determined this five-factor model to be the preferred model. This model was confirmed using CFA and fit the data well for the fall period.

The validity of the five-factor model used in this instrument was tested through the reliability of the comparative fix index (CFI) reporting at .99, the root mean square error approximation (RMSEA) reporting at .05, the Tucker-Lewis Index reporting at (TLI) .99, the standardized root mean squared residual (SRMR) reporting at .01, and Cronbach's α reporting at .88 for the fall time point in the validity study conducted by Karelitz et al. (2010). For the wintertime period the five-factor model was tested with the CFI reporting .98, the RMSEA reporting .07, the TLI reporting .97, the SRMR reporting .02, and Cronbach's α showing .91. Karelitz et al. (2010) for the springtime points produced a CFI of .99, RMSEA of .07, SRMR of .01, TLI of .98, and Cronbach's α of .91. In Table 1 these data are presented by time and structure.

Table 1

Confirmatory Factor Analysis Model Fit Statistics

Time point	Structure	CFI	RMSEA	SRMR	TLI	Standardized factor loadings	Cronbach's α
Fall	Unidimensional	.89	.10	.09	.90	0.69-0.82	.83
	Seven-factor	.94	.09	.08	.91	0.63-0.76	.85
	Five-factor	.99	.05	.01	.99	0.74-0.81	.88
Winter	Unidimensional	.90	.10	.09	.89	0.66-0.78	.81
	Seven-factor	.92	.09	.09	.93	0.64-0.75	.86
	Five-factor	.98	.07	.02	.97	0.66-0.75	.91
Spring	Unidimensional	.90	.09	.09	.90	0.65-0.79	.82
	Seven-factor	.92	.08	.09	.94	0.60-0.79	.81
	Five-factor	.99	.07	.01	98	0.68-0.77	.91

Procedures

To ensure the research was compliant with the Southwest Baptist University guidelines protecting the rights of human participants, the researcher followed the recommendation to request for review with the Research Review Board (RRB) for approval to survey two preschools in the state of Missouri and follow up by gathering DRDP scores of students who participated in those programs. The principal from each school building was contacted and provided with an overview of the purpose of the study, notification that participation was voluntary, and the information collected would remain anonymous. Principals were also informed they would be given access to the results of the study and, for incentive to participate, entered in a drawing for four $50.00 gift cards. A survey using Google Forms was sent to all preschools in the state of Missouri with a questionnaire (Appendix B), which would determine which schools would be contacted for acquisition of kindergarten screening scores using the DRDP. This survey was developed to account for the delimitations and included questions asking administrators about their attendance, demographics, classroom use of technology, philosophy on technology, and student access to touch screen technology (Appendix B). As a result, two administrators who fully participated in the survey were contacted to participate in this study.

Once contact was made and permission given, the researcher sent a second more detailed survey using Google Forms to obtain details about the school's usage of technology. This allowed the researcher to set some delimitations such as if a school indicated during the study they received tablets during the school year and not for the full year, their scores were not included in the study. The survey also provided insight into

the percentage of students who utilized tablets as part of an IEP. If a non-tablet-using preschool had a higher percentage than 5% using tablets as part of their IEP, their group scores were not accepted as part of the study. Using this information schools were selected to then provide their DRDP scores as a group and were asked to not include any student information, only the scores. Data were collected using email as the primary method of communication. Using this data, the researcher compared the scores of schools that did not use technology to those who were using technology in the classroom. These results, which will be discussed in further detail within Chapter Four, are what the researcher used to determine if there were any significant differences in students' motor skills based on their usage of touch screen technology.

Data Analysis

For this study, the researcher chose a casual-comparative study using quantitative research. This quantitative casual-comparative study compared the differences between the means of motor skills found in kindergarten students who used touch screen technology in preschool and kindergarteners who did not use touch screen technology in preschool. All school districts in the state of Missouri were invited to participate in the study. Using a survey, participants were asked to provide specific details on the use of technology in their preschool classrooms to determine which schools utilized touch screen technology in their preschool curriculum and which schools did not. This information determined the independent variables for the study. In preparation of the data 15% of school districts contacted via the preliminary survey returned their DRDP data. Using this information, the researcher included two and excluded none of participating school districts based on their responses to the preliminary survey.

The research question examined the differences in the DRDP scores of students who used touch screen technology in their preschool year and those who did not use touch screen technology. DRDP scores include a student's physical development which is subdivided into students' fine motor manipulative skills, gross motor manipulative scores, and gross locomotor manipulative scores. The dependent variable addressed this research question. This research question was divided into three school years: (1) 2018-2019, (2) 2019-2020, and (3) 2020-2021. The researcher used the pass/fail scoring from the DRDP for the dependent variable due to the accessibility of the scores from the school district's administrators.

The researcher investigated if there were differences between the DRDP scores of kindergarteners who used touch screen technology and those who did not to determine if a significance $p < .05$ existed. To accomplish this the researcher ran chi-square tests. The data analysis of the study began with cleaning the data to determine that the variables were scored correctly. Duplicate responses were removed, and partial responses were omitted. Once survey data were analyzed to determine the touch screen use of preschool classrooms within the Missouri public school districts who participated, the researcher collected DRDP motor skills scores. These scores formed the dependent variables for this study using the DRDP pass/fail scores and were split into two groups based on their technology use in preschool, which were used to form the independent variables for this study. The demographic asking school districts whether they used touch screen technology as part of their daily instruction in kindergarten was accumulated to identify whether a disparity of motor skill ability existed during their kindergarten screening. The responses collected were further examined to analyze if there were any other statistically

significant differences that existed within the groups studied. The demographics for the three sets based on the 2018-2019, 2019-2020, and 2020-2021 school years of DRDP scores were examined closer to report any differences in urban and rural school districts. To determine differences between the group of scores from students who used technology in the classroom and students who did not, a chi-square test was run.

To conduct this study the researcher chose a chi-square test. Chi-square test is a statistical method used to determine if there is a significant difference between observed frequencies in one or more categorical variables. The chi-square test compares the observed data to the data expected then calculates the difference between them. This difference is then determined to identify if it is statistically significant. For example, a chi-square test is run for two groups of samples where one sample's scores do not influence the scores in another sample (Laerd Statistics, n.d.). For this study, participants' anonymous DRDP scores were split into two groups based on their use or nonuse of touch screen technology while in preschool. For each of the three research questions three tests were run analyzing the differences in these conditions for each for the 2018-2019, 2019-2020, 2020-2021 school years.

Using each of the three sets of school years for the research question the researcher ran a total of three chi-square tests to determine if there was a statistically significant difference in the DRDP scores of kindergarteners in participating schools. Once the data were gathered from participating districts the researcher utilized the SPSS computer software program to analyze the data collected from the DRDP scores. The data were inputted into the SPSS program and three chi-square tests were conducted to analyze the data. From this program, the descriptive statistics of frequencies, percentages,

standard deviations, and means were analyzed to describe the differences in motor skills. This program analyzes the data using a group statistics table that includes the mean, standard deviation, and standard error mean. If the researcher's statistical analysis of DRDP scores shows a significance level below .05 the null hypothesis will be rejected (Creswell, 2005; George & Mallery, 2003).

To perform a chi-square test the researcher determined if two assumptions were met. The first was the assumption of a nominal variable. This means that the observations used to construct the contingency table should be independent of each other and the data from one group should not be influenced by the other. The data collected were of varied students across the state who would not have any interaction or effect on one another. This assumption was that each category was mutually exclusive and there was no overlap between categories. The assumption creates categories in which the participants fall into one or the other. In the case of this study the students would fall into the category or pass or fail for their DRDP scores and either use or do not use technology. The second assumption was the assumption of two or more categorical or independent groups. Here the observations should be randomly sampled from the population of interest but do not have any relation to one another. Students who attended one school did not have any effect of students attending another. These independent variables existed separately of one another. The sample sizes should be sufficient to provide enough statistical power to detect significant differences in the test (Laerd Statistics, n.d.). Data that differ significantly from other data points are outliers and could have disproportionately influenced the results (Daniel, 2022; Laerd Statistics, n.d.; Leavy, 2022).

The study had three null hypotheses. Using the SPSS program, the researcher conducted three chi-square tests for each of the research questions. The independent variables of this study were pre-k use or lack of use of touch screen technology in the classroom. The dependent variable was the DRDP scores of pass or fail. The dependent variable scores from the DRDP test scores were inputted by student scores using 1 for students who passed the DRDP and were considered at a kindergarten readiness level and 2 for students who failed or were deemed not at kindergarten level. Once all the data were entered into SPSS the data were analyzed to compare the observed to the expected through a chi-square test. This is to determine if the two groups being compared are the same or different. The dependent variables were placed into the test variable section and the independent variables were placed into the grouping variable. To conduct the test the researcher created the contingency table. This table listed two groups compared across columns and outcomes (whether technology was used or not) across the rows. Each cell contained a code which distinguished into which category the participant fit. The researcher entered 1 for the code for students who used technology in their preschool education and 2 for the code for students who did not use technology in their preschool education for the independent variables in the value box. Here the SPSS test statistic calculated the sum of squared differences between observed and expected cell frequencies, divided by the expected frequency. The SPSS statistics test details included the alpha level, effect size, and what would be reported. The alpha level, or significance level, was used to determine whether the null hypothesis is rejected or not. The alpha represents the significance or the probability there is a mistake of rejecting the null hypothesis when it is true (Laerd Statistics, n.d.). If the alpha of .05 was the acceptable

probability value, then a *p*-value greater than the alpha of .05 represented a failure to reject of the null hypotheses. According to Laerd Statistics (n.d.) a Phi test is used for strength of association. A small effect was 0.1, a medium effect was 0.3, and a large effect was 0.5 (Ellis, 2016; Laerd Statistics, n.d.).

Utilizing the DRDP scores the researcher gained a broader perspective on the differences in children's motor ability who used touch-screen-based technologies as compared to those who did not while in preschool. The data were reported using SPSS and analyzed to discover any statistical significance. In Chapter Four the researcher has analyzed the data using a chi-square test and the assumptions needed to run the statistics. The instrumentation provided a comprehensive view of which types of motor skills differed.

Summary

The purpose of this study was to answer what are the differences in the fine motor manipulative skill scores measured by the anonymous individual scores of the DRDP of Missouri kindergarteners who used touch screen technology in preschool and fine motor manipulative skills scores of kindergarteners who did not use touch screen technology in preschool. The researcher, through the review of literature, identified Missouri kindergarteners as the focus due to the centralized location of the state and its use of the DRDP assessment. The data collected provided the researcher with a comparison of fine motor, gross motor, and gross locomotor skills of children who used and did not use tablets as part of their instruction. Using this information, the researcher sent surveys to schools in Missouri to determine if their use or nonuse of technology fit the needs of the study. Once schools were selected to participate, their DRDP scores were collected and

analyzed. Chapter Four will give a descriptive overview of the findings provided by the research conducted. Then in Chapter Five the researcher discusses the final conclusions from the study and includes recommendations for future studies.

CHAPTER FOUR

RESULTS

Introduction

With the increasing amount of technology available to a younger generation, the views of technology's role in education have become more widespread. Children learn when engaged with the environment, which now includes touch technology such as tablets and cell phones (Brofenbrenner, 1981; Leonard, 2013). In response the researcher collected data using the DRDP scores. This research is increasingly important as technology has become a mainstay of teaching in the classroom, and it has been predicted students alive today and beyond will never know a world without technological devices or the internet (Groves, 2021). Bronfenbrenner's (1981) theory recognizes that a person's surroundings can affect their growth and development. With technology being incorporated into the classroom it is important to research how these technologies impact the growth of the children who use them (Dooley, 2018).

Current research concludes there is a gap in understanding the effects touch screen technology has on the development of motor skills in young children (Ly, 2018; Wali & Popal, 2020). The information provided by this study could be utilized by teachers and parents of young children to better facilitate their learning and development of fine motor skills. The rapid growth of technology and its use in classrooms has alarmed some educators. The effect on children's development is not fully understood (Hatzigianni & Kalaitzidis, 2018). For this study, the researcher looked through the lens of Bronfenbrenner's (1981) ecological systems theory. This theory focuses on the impact an immediate environment has on the development of children. Recognizing that a

student's classroom and school experience has an effect of their development is critical when deciding whether to introduce technology to the learning environment. In this chapter the researcher presents the results of the quantitative study and the data analysis comparing students who used technology in their preschool to those who did not. Next, the researcher will conclude with their interpretation of the data collected and the results of the chi-square test.

Purpose of the Study

The purpose of this quantitative causal-comparative study was to test Bronfenbrenner's (1981) ecological systems theory by comparing kindergarteners who used touch screen technology in preschool and kindergarteners who did not use touch screen technology in preschool, based on individual student scores on the DRDP in Missouri public schools. This information could be utilized by preschool teachers and parents of young children to better facilitate their learning and development of fine motor skills. In most educators' experience, teachers believe touch screen technology has a negative effect on children's development of fine motor skills, but do not know to what extent (Hatzigianni & Kalaitzidis, 2018; Leonard, 2013).

Research Questions

RQ1. What are the differences in the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not?

RQ1a. What are the differences in the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile

(DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2018-2019** school year?

RQ1b. What are the differences in the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2019-2020** school year?

RQ1c. What are the differences in the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2020-2021** school year?

Null Hypotheses

$H_0$1. There will be no statistically significant difference between the **kindergarten readiness scores** measured by the individual scores of the Desired Results Developmental Profile (DRDP) in Missouri of kindergarteners who used touch screen technology in preschool and those who did not.

$H_0$1a. There will be no statistically significant difference between the **kindergarten readiness scores** measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2018-2019** school year.

$H_0$1b. There will be no statistically significant difference between the **kindergarten readiness scores** measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners

who used touch screen technology in preschool and those who did not in the **2019-2020** school year.

$H_0$1c. There will be no statistically significant difference between the **kindergarten readiness scores** measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2020-2021** school year.

Data Analysis and Findings

The study aimed to investigate the relationship between using technology in public preschool classrooms and students' performance on the DRDP. The sample consisted of $N = 443$ preschool students in 2019, $N = 432$ preschool students in 2020, and $N = 398$ preschool students in 2021 from two preschools, one that used technology in their classroom and one that did not. The participants' performance on the DRDP was measured as a oppositional variable, with "pass" and "not pass" as the two categories. The use of technology in the classroom was also measured as a dichotomous variable, with "used" and "not used" as the two categories.

The analysis involved computing a Pearson chi-square goodness-of-fit test to examine whether there was a significant difference between the observed frequencies of passing the test and the expected frequencies based on chance alone. This test compares the observed frequencies of categorical data with the expected frequencies under a null hypothesis that there is no difference between the observed or expected data.

The instrumentation for this study included a preliminary survey and scores from the DRDP. Although the DRDP provides educators and parents with a data profile

measuring the student's developmental growth from infancy to the end of kindergarten regarding their motor skills, the schools that participated in this study did not have access to the individual physical development scores that obtained information on motor skill development. A detailed report of the DRDP allows educators to see a full profile of where students are lacking in their development. Students who need future support are often deemed not ready for kindergarten and are not passed (Karelitz et al., 2010). For this study, the researcher looked at the pass/fail results for the DRDP as administered by the school districts that participated. The researcher developed a survey using Google Forms to categorize the DRDP scores into two categories: (a) scores that included students who used technology as part of their regular education, and (b) scores that included students who did not use technology as part of their regular education. The questions in this survey asked administrators if their preschool classrooms utilized touch screen technology as part of their regular education activities (See Appendix B). These data were compared to the pass/fail data provided by the two school districts chosen for this study. These participating schools' administrators sent their DRDP pass/fail scores to the researcher using spreadsheets that did not contain the names or ages of students. These scores were then entered into the SPSS program using two variables and a chi-square test was performed.

Samples

For this study scores from Missouri public school kindergarten screening were collected. The researcher reached out to schools across the state of Missouri and received 14 survey responses, with two rural school districts sending in DRDP scores. The scores used in the study had multiple early childhood and elementary buildings. According to

DESE (2023), these schools are considered both rural school districts both located in the southwest part of the state. The school district that did not utilize technology as part of the integrated educational experience in the preschool setting had on average 58.6 students in their preschool programs attending each year. An average of 365.6 students attended the preschool classrooms of the district that utilized technology in their classrooms each year. Because of the anonymous nature of the DRDP results sent in by school districts the researcher did not have access to data pertaining to age, gender, or whether students had an IEP while in preschool. The demographic of a typical public preschool classroom is naturally diverse.

Data Cleaning

Chi-square tests are used to analyze categorical data. The researcher chose this test because of the type of categories being compared. Each of the categories have non-zero expected frequencies and have at least one observation. By comparing the relationship between the two categorical variables, use of technology or not, and the DRDP scores of incoming kindergarteners the researcher arranged data in contingency tables to help organize the data and perform the analysis more easily using SPSS. The researcher then checked for sparse cells. Small cell frequencies can lead to unstable estimates and inaccurate results. The researcher checked for sparse cells in contingency tables and noted there were none before conducting the test. Before conducting the test each statistical assumption was reevaluated and understood to ensure valid results.

The first assumption was each variable was measured at a ordinal or nominal level. For this study, the categorical data fell into either pass or fail and uses or does not use technology. After the researcher gathered the student DRDP test score data, the

scores were put into the category of either uses technology or does not use technology. For the second assumption the researcher found each group was independent from one another. Students attending School 1 did not have any interaction with students or teachers from School 2, thus scores were not dependent on one another.

Research Question 1a

Each participant filled out the survey for the researcher to identify which school's DRDP scores would be grouped into which constructs. These constructs were then used to create a 2x2 chi-square test to answer Research Question 1a: What are the differences in the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2018-2019** school year? For RQ1a student scores were collected from the 2018-2019 school year from two rural school districts. A case processing summary was automatically provided by the SPSS test to provide information about the quality and completeness of the dataset and to allow the researcher to identify any potential issues or areas that require additional attention during data cleaning. For this test, a total of 443 DRDP test scores for kindergarten readiness were analyzed.

A cross-tabulation of the data was provided to aid in interpreting the chi-square test result. Table 2 shows the relationship between the categorical variables by recording the frequency of observations. Of the scores the researcher collected, 269 of students who used technology in preschool during the 2018-2019 school year passed their DRDP whereas 54 who did not use technology passed their DRDP. One-hundred fourteen students who used technology were classified as failing the DRDP and six who did not

use technology were classified as failing their DRDP. The expected counts for technology usage were 279.3 and 43.7 for not using technology based on the assumption of independence between the two variables. The expected failure count for using technology was 103.47 and for not using technology was 16.3.

Table 2

Kindergarten Readiness (2019) Technology Use Cross-Tabulation

			Technology use		
			Technology used	Technology not used	Total
Kindergarten readiness (2019)	Pass	Count	269	54	323
		Expected count	279.3	43.7	323.0
	Fail	Count	114	6	120
		Expected count	103.7	16.3	120.0
Total		Count	383	60	443
		Expected count	383.0	60.0	443.0

The chi-square test compared the observed distribution of cases in the crosstabulation to the distribution that would be expected if there was no association between the two variables. Following the Chi-square test the researcher's analysis revealed a significant association between technology use and DRDP scores (Pearson Chi-square = 10.26, $df = 1$, $p = .001$) as seen in Table 3. These results indicate that there was a difference between the two categories of students. Further, Fisher's exact test indicated that the difference in scores between the two groups was statistically significant ($p = .001$). The Fisher's exact test calculates the probability of obtaining the observed

frequency distribution or one more extreme, assuming that the null hypothesis is true (Sauro & Lewis, 2016).

Table 3

Chi-Square Tests (2019)

	Value	*df*	Asymptotic significance (2 sided)	Exact sig. (2-sided)	Exact sig. (1-sided)
Pearson Chi-Square	10.26[a]	1	.001		
Fisher's exact Test				<.001	<.001
N of Valid Cases	443				

[a]0 cells (0.0%) have expected count less than 5. The minimum expected count was 16.25.

Table 4 displays the phi coefficient, $\varphi = -0.1$, which suggested a weak negative association between technology and DRDP scores (Laerd Statistics, n.d.). This means that as the use of technology increases it may have a negative impact on DRDP scores. In conclusion, the researcher's findings suggest that there may be a small negative association between the use of technology in preschool classrooms and preschool students' performance on the DRDP. However, the association is too weak to support a strong conclusive inference. Further analysis is needed to fully understand the relationship between the use of technology and the readiness of preschool students for kindergarten using the DRDP. The null hypothesis for this research question was there will be no statistically significant difference between the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP)

in Missouri of kindergarteners who used touch screen technology in preschool and those who did not. Even though the association was weak, according to the Pearson's Chi-

Table 4

Symmetric Measures (2019)

		Value	Approximate significance
Nominal By Nominal	Phi	-0.15	.001
N of Valid Cases		443	

square test result of .001 the difference between the two scores was statistically significant, rejecting the null hypothesis.

Research Question 1b

For the second set of data student scores were collected from the 2019-2020 school year from two rural school districts. For the year 2020 the total number of samples was 442. This sample size only decreased by one for this school year. Table 5 shows the cross-tabulation of the data. Of the scores for this dataset the researcher collected 324 of students who used technology in preschool during the 2019-2020 school year passed their DRDP while 48 who did not use technology passed their DRDP. Fifty students who used technology were classified as failing the DRDP and 10 who did not use technology were classified as failing their DRDP. The expected counts for technology usage were 322.1 and 49.9 for not using technology based on the assumption of independence between the two variables. The expected DRDP fail count for using technology was 51.9 and for not using technology was 8.1.

Table 5

Kindergarten Readiness (2020) Technology Use Cross-Tabulation

			Technology use		
			Technology used	Technology not used	Total
Kindergarten readiness (2020)	Pass	Count	324	48	372
		Expected count	322.1	49.9	372.0
	Fail	Count	50	10	60
		Expected count	51.9	8.1	60.0
Total		Count	374	58	432
		Expected count	374.0	58.0	432.0

For this dataset, a second Chi-square test was conducted. The researcher's analysis revealed no significant association between technology use and DRDP scores (Pearson Chi-square = .630, $df = 1$, $p = .428$) as seen in Table 6. These results indicate that there was no significant difference between the two categories of students. To reinforce this, the Fisher's exact test indicated that the difference in scores between the two groups was not statistically significant with results of $p = .417$ for a two-sided test.

Table 6

Chi-Square Tests (2020)

	Value	*df*	Asymptotic significance (2 sided)	Exact sig. (2- sided)	Exact sig. (1-sided)
Pearson chi-square	.63[a]	1	.428		
Fisher's exact test				.417	.270
N of Valid Cases	432				

[a]0 cells (0.0%) have expected count less than 5. The minimum expected count was 8.06.

The phi coefficient of $\varphi = .038$, as seen in Table 7, suggested there is no meaningful association between technology and DRDP scores (Laerd Statistics, n.d.). This means that the use of technology in a preschool classroom likely has no effect on student performance on the DRDP. In this test the null hypothesis stating there will be no statistically significant difference between the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the 2019-2020 school year was supported. The data observed were not significantly different from what would be expected if there was no real difference between the use of technology and the non-use of technology. It is important to note that a nonsignificant chi-square test does not necessarily mean there is no relationship between the two variables but rather there is not enough evidence to reject the null hypothesis.

Table 7

Symmetric Measures (2020)

		Value	Approximate significance
Nominal By Nominal	Phi	.038	.428
N of Valid Cases		432	

Research Question 1c

For RQ1c student scores were collected from the 2020-2021 school year from the same two rural school districts as test 1 and 2. A case processing summary was provided, which allowed the researcher to identify any potential issues or areas that required additional attention during data cleaning. For this test only 398 student scores were collected. The cross-tabulation of this data was provided to interpret the chi-square test result. Table 8 shows the relationship between the categorical variables by recording the frequency of observations. In this test none of the students who used technology in preschool during the 2020-2021 school year passed their DRDP whereas 51 who did not use technology passed their DRDP. Three-hundred forty students who used technology were classified as failing the DRDP and seven who did not use technology were classified as failing their DRDP. The expected counts for technology usage were 43.6 and 7.4 for not using technology based on the assumption of independence between the two variables. The expected failure count for using technology was 296.4 and for not using technology was 50.6.

Table 8

Kindergarten Readiness (2021) Technology Use Cross-Tabulation

			Technology use		
			Technology used	Technology not used	Total
Kindergarten readiness (2021)	Pass	Count	0	51	51
		Expected count	43.6	7.4	51.0
	Fail	Count	340	7	347
		Expected count	296.4	50.6	347.0
Total		Count	340	58	398
		Expected count	340.0	58.0	398.0

Following the Chi-square test the researcher's analysis revealed a significant negative association between technology use and DRDP scores (Pearson Chi-square = 342.91, $df = 1$, $p < .001$) as seen in Table 9. This value represents the overall goodness of fit for the chi-square test. These results indicate that there was a difference between the two categories of students. Further, Fisher's exact test indicated that the difference in scores between the two groups was statistically significant ($p < .001$). It should be noted that with the chi-square test, it is important that a count of zero in one category can result in potential problems with the interpretation of the test statistic and the calculation of p-values. In this case, the expected count for the technology used category was relatively high compared to the actual count of zero, which may be indicative of a problem with the

Table 9

Chi-Square Tests (2021)

	Value	*df*	Asymptotic significance (2 sided)	Exact sig. (2- sided)	Exact sig. (1-sided)
Pearson chi-square	342.91[a]	1	<.001		
Fisher's exact test				<.001	<.001
N of Valid Cases	398				

[a]0 cells (0.0%) had an expected count less than 5. The minimum expected count was 8.06.

assumptions of the chi-square test. This occurred in the fail count and expected fail count where the fail count of 7 was considerably lower than the expected fail count of 50.6 for students not using technology. It is important to consider that during the time these students would be participating in DRDP testing COVID-19 restrictions and modified teaching practices were in place. This may be why there were no students who passed the DRDP in the technology used category.

Table 10

Symmetric Measures (2021)

		Value	Approximate significance
Nominal By Nominal	Phi	-0.93	.001
N of Valid Cases		398	

The phi coefficient, φ = -0.93, shown in Table 10, suggested very strong negative association between technology and DRDP scores (Laerd Statistics, n.d.). This means that as the use of technology increases it may have a negative impact on DRDP scores.

This supports the rejection of the null hypothesis that there will be no statistically significant difference between the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the 2020-2021 school year. The conclusion of the third test indicated in the researcher's findings that there may be significant negative association between the use of technology in preschool classrooms and preschool students' performance on the DRDP. However, because of the large differences in expected count and the actual count these results may be skewed as a result of no students passing the DRDP from the district who utilized technology. Using these results the conclusion may be made that there is a significant association between the use of technology in the classroom and kindergarten readiness, but to do this further research will be needed.

Conclusion

The tests run in this study were used to compare preschool developmental growth through the DRDP according to who used technology with those who did not. Due to the limited access to fine motor, gross motor, and gross locomotor skill data the DRDP tests for, administrators allowed access to their overall DRDP scores for analysis. The Chi-square test allowed the researcher to compare the overall readiness of preschoolers entering kindergarten and compare the scores of those who used touch screen technology with those who did not while in their preschool classes using 2x2 crosstabulation. Through the three tests run for the years 2018-2019, 2019-2020, and 2020-2021, a variety of data was gathered that indicated there may be a relationship between the use of technology and the scores of the DRDP for kindergarten readiness. However, the data

collected varied year to year and further studies must be conducted to investigate further. Chapter Five will give a descriptive overview of the findings and the researcher's analysis of the data through the lens of the literature review and the theories of Bronfenbrenner (1981) and Piaget (1936). The researcher will also discuss the final conclusions from the study and the limitations that were faced when collecting the data, and will include recommendations for future studies.

CHAPTER FIVE

CONCLUSION

Introduction

"Children are the living messages we send to a time we will not see" (Cobb, 2019). Educators should be sure to send children the correct messages and be sure they are well versed in technological proficiency without the sacrifice of human interaction. The purpose of this quantitative causal-comparative study was to test Bronfenbrenner's (1981) ecological systems theory by comparing kindergarteners who used touch screen technology in preschool and kindergarteners who did not use touch screen technology in preschool, based on student scores on the DRDP in Missouri public schools. Early understanding in this area is scarce due to the limited studies on early education use of touch screen technology. The researcher reached out to the 518 school districts in Missouri via email or phone call. Of these districts 14 administrators filled out the survey and two participated by submitting their anonymous individual student DRDP scores. When evaluating curriculum and educational practices educators and administrators look for the following components: (a) developmentally appropriate practices, (b) standards alignment, (c) differentiated instruction, (d) evidence-based practices, (e) parent involvement, (f) cultural relevance, and (g) play-based learning. The way educators deliver the curriculum weighs on research-based practices and available technologies teachers have at their disposal (American Academy of Pediatrics, 2018).

Chapter Five includes a summary of the findings, a discussion of each research question, educational implications, and limitations surrounding the study. The chapter also includes recommendations for future studies surrounding the topic of motor skill

development and touch screen technology integration in early education classrooms. The chapter then ends with a conclusion of the study.

Summary of Findings

The research from this study aimed to close the gap in research for the differences in kindergarten readiness scores of students who used touch screen technology in preschool and those who did not across 3 school years. The researcher attempted to close the gap in research with the following research question: What are the differences in the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not? The researcher developed the null hypothesis: There will be no statistically significant difference between the **kindergarten readiness scores** measured by the individual scores of the Desired Results Developmental Profile (DRDP) in Missouri of kindergarteners who used touch screen technology in preschool and those who did not. To conduct the study a 2x2 chi-square test for each of the 3 years of data was completed to determine the significance of findings. Each of the three tests run had different results, resulting in two rejections of the null hypotheses. In the discussion the researcher explains the direction of the study from motor skills specifically to the overall kindergarten readiness scores provided by the DRDP testing tool. The next section looks at each sub-research question individually and considers the differences between the learning experiences students may have had while in the classroom.

Research Question 1a

The first sub-research question asked this: What are the differences in the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2018-2019** school year? Although the two schools differed in size and sample using the data provided, the researcher chose to conduct a chi-square test. The analysis of the test provided there was a statistically significant association with the results of Pearson Chi-square = 10.26, $df = 1$, $p = .001$. The phi coefficient, $\varphi = -0.1$, provided information that the association was weak between technology use and DRDP scores, thus rejecting the null hypothesis that there will be no statistically significant difference between the **kindergarten readiness scores** measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2018-2019** school year (Laerd Statistics, n.d.). However, the association was too weak to draw a strong inference (Laerd Statistics, n.d.). Because this was the earliest of the 3 years the technology may have been different in the next 2 years. Additional research should be conducted to compare these differences further.

Research Question 1b

The second sub-research question asked this: What are the differences in the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2019-2020** school year? The analysis of the second test provided there was no statistically significant association with

the results of Pearson Chi-square = .630, $df = 1$, $p = .428$. The phi coefficient, $\varphi = -0.038$, suggested there was no meaningful difference between technology use and DRDP scores. These results support the null hypothesis that there will be no statistically significant difference between the **kindergarten readiness scores** measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2019-2020** school year (Laerd Statistics, n.d.). Further research is needed to fully understand why this was different than the first sub-research question.

Research Question 1c

For the third year in the study the researcher asked this: What are the differences in the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2020-2021** school year? The third test showed there was a statistically significant association with the results of Pearson Chi-square = 342.91, $df = 1$, $p < .001$. The phi coefficient, $\varphi = -0.93$, suggested there was a strong negative association between technology use and DRDP scores. These results support rejecting the null hypothesis that there will be no statistically significant difference between the **kindergarten readiness scores** measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the **2020-2021** school year (Laerd Statistics, n.d.).

Discussion

Data were collected from two rural school districts in Missouri using the Desired Results Developmental Profile (DRDP). The data from the 3 years varied slightly. The researcher summarized that the differences in these results might be due to the response to the COVID-19 pandemic in schools. Further research should be conducted to determine if the data differed due to the change in educational practices during the COVID-19 pandemic. The 2018-2019 school year was prior to the pandemic and the results of the data from this year were treated and analyzed with the realization the year was a typical school year. Data starting in 2019-2020 were analyzed by the researcher with the realization that many schools changed their educational practices during this time to continue providing education during isolation. Also, during this time schools began to use different tools for kindergarten screening than the recommended DRDP in the state of Missouri. For the 2020-2021 school year, the two districts that participated in the study were in session, however, with state recommendations and practices for safe distancing, illness, and virtual learning being available, students had a different classroom experience than students in the classroom for the 2018-2019 school year.

To look closer at Bronfenbrenner's (1981), theory and how the use of technology in the preschool classroom might affect the physical development of children, the research questions for this study identified two areas that may have an association and compared them for the years 2018-2019, 2019-2020, and 2020-2021. During these 3 years it would have been easy to assume the same test should be conducted using previous years, however the constant change in the advancement of technology would make the data less valuable than data collected using the most recent technology

available (Kardeş, 2020). Bronfenbrenner's theory would agree that the introduction of technology into a child's microsystem, such as a classroom, would ultimately affect the child's development. By implementing the use of technology, children's interaction with their environment would be changed. Screens and technology change the way children receive information (Annarumma et al., 2020; Hadders-Algra, 2021; Hauck & Felzer-Kim, 2019; Ly, 2018; Martins et al., 2021; Tolocka et al., 2019). This was evident in the results of the tests run for RQ1a. It should be noted that this school year preceded the Covid-19 pandemic and should be considered through the lens of an average school year. Children who took the DRDP this year had an average interaction like any other public school across the state. This microsystem experienced extraordinarily little change over the past few years even with the advancement of technology (Dooley, 2018). Although in the previous year of study there was a very weak association between DRDP scores and technology use in preschool, the 2019-2020 school year did not have enough evidence to support the null hypothesis. However the comparison between the two school years' data would suggest that the change in the microsystem according to Bronfenbrenner did have an impact though small enough to make that assumption further research is needed.

The next sub-research question looked closer at the 2019-2020 school year. The researcher noted that in the latter part of this school year, according to federal recommendations, both public and private schools were to be closed and students taught virtually. Many schools were ill-prepared to move from seated classes into solely virtual classrooms. Both schools that participated in this study were closed for a portion of this school year. Students who would normally have seated classroom time were now at home or in a day care program (Houp, 2021). Because of this, students who would normally be

sitting in a classroom setting may have had more physical play time or more sedentary time in front of a screen. However, because the school year for this year in the study began as a typical one, many students were able to receive an average education up until the middle part of the spring semester. The results of the chi-square test for this set of data varied from the previous data set in that the data that were observed were not significantly different from what one would expect if there was no real difference between the use of technology and the non-use of technology. The researcher noted that even though there was no significant statistical difference there still was not enough evidence to make an assumption.

The data for the third sub-research question had a drastic difference from the other 2 years for the study. In this year's data District 2 in this study had a notable difference in their 2021-year DRDP results in that none of the students tested with the DRDP were considered ready for kindergarten. Even as such, the Chi-square test resulted in a statically significant result that rejected the null hypothesis that there will be no statistically significant difference between the kindergarten readiness scores measured by the individual scores of the Desired Results Developmental Profile (DRDP) of Missouri kindergarteners who used touch screen technology in preschool and those who did not in the 2020-2021 school year. The results of this test also suggested there was a large negative impact on students who used technology as opposed to those who did not use technology in their preschool classroom. The researcher believes it should be taken into consideration that this year followed a year where schools had to severely modify their instructional practices due to COVID-19 recommendations by both the state and federal governments (Houp, 2021). In this study the school district who used technology most

likely would not have used it as heavily if COVID-19 had not created an environment in which it was necessary. This could have led to students not being as familiar with technology as the transition from in-person learning to virtual learning took place the previous year. Because of this information the researcher noted that Bronfenbrenner's (1981) theory stating that changes in the microsystem of a student such as adding technology in the classroom does impact the child's development. Here the data showed that there is a strong negative association between the addition of technology into preschool education and student performance on the DRDP as part of their entry into kindergarten.

Change in Research

When the researcher began this study, the focus was projected to highlight specifically the motor skill scores of the DRDP with regard to technology usage. As the researcher began collecting data from public schools across the state of Missouri, many administrators explained they either did not have access to the scores, they did not use the test in its entirety, or they no longer used the test. For this reason, the researcher began to look at the overall DRDP scores for kindergarten readiness to identify differences in students who used technology in preschool and those who did not use technology. Because Piaget's (1936) theory of cognitive development calls for physical interaction with the environment for healthy development, an overall look at how children learn in environments with technology compared to children without can be an important window into their development (Lin, 2019; Rowland, 2012). Because the 3 years chosen to study landed in the peak of the COVID-19 pandemic it should be noted many students' educational experience and microsystem, according to Bronfenbrenner (1981), would

have changed. The interactions students had with their environment in the year 2018-2019 changed drastically in 2019-2020 and should be recognized according to Piaget (1936) as having an impact on the development of young children (Dooley, 2018). This change also led to the modification of school practices including the method by which the DRDP was given, which this study did not investigate. Although the researcher made the change to look at overall readiness scores instead of the average motor skill scores provided by the DRDP it should be noted the DRDP in its whole does consider the physical development of children as part of their kindergarten readiness.

As the literature review in this study noted the conflicting results of studies surrounding young children's physical development and technology, the researcher set out to create data that would clarify the conflicting findings. However, due to the nature of the study and the hurdles the researcher encountered collecting data from the DRDP there is further research needed to continue to clarify previous studies. Both Piaget (1936) and Bronfenbrenner's (1981) theories support a more physical environment where children interact and are engaged in their surroundings. Bronfenbrenner's ecological systems theory emphasizes the importance of understanding individuals within the context of their environments, including the immediate setting in which they interact as well as broader systems like community and society. These multiple systems interact with one another and in complex ways. In the context of this study, the results suggest that there is a weak to significant negative association between the DRDP scores and their use of touch technology in the preschool classroom. This finding could be interpreted as evidence of the impact of technology usage within the classroom environment. However, Bronfenbrenner's ecological systems theory highlights the

importance of considering multiple systems that interact with one another, and the potential influences of these systems on individuals. The importance of this theory does not go unnoticed in education today, however as technology advances researchers and educators need to be aware of how advancing technology can and does impact the physical development of children (Dooley, 2018).

Implications

The implications of this study on the differences in motor skills for students using touch technology and students who did not are important to educators today. As technology continues to grow and develop, the exposure young students have to these technologies will only expand (de Oliveira et al., 2020;Ly, 2018; Rideout & Robb, 2020). From an educational perspective, findings from this study may inform teaching practice and the method by which the curriculum is taught. The process of teaching the development of early childhood education includes raising awareness of the potential impact of touch screen technology used on children's motor skills. Curriculum designers and educators may need to look at balancing the benefits of using technology to enhance learning outcomes with potential risks to the development of motor skills. For instance, more hands-on manipulative activities may need to be introduced to facilitate proper motor skill development (Hinkley & McCann, 2018; Nobre et al., 2020).

This study may also have clinical implications such as informing the assessment and intervention of motor skill delays in young children (American Academy of Pediatrics, 2018). Physicians and therapists may utilize this information to facilitate studies that screen for excessive touch screen technology use and its potential impact on motor development. These recommendations may filter into early childhood development

practices and education. Further research in this field may help bridge the gap between education and healthcare on a timely and important issue of childhood development.

Lastly, parents may benefit from the implications of this study. Children develop motor skills through their physical interactions with the environment around them (Piaget, 1936; Zukowski & Dickson, 1990). Some implications for parents might be expanding their awareness of the potential impact touch screen technology has on their child(ren)'s development. Some may choose to select a different education program based on touch screen usage or limit exposure in other ways. Parents might become more involved with monitoring their child(ren)'s use of touch screen technology and choose to have their child(ren) participate in more physical games or activities involving manipulatives. The study also provides information that might help parents implement early intervention if they see a change in their child(ren)'s motor skill development (Ly, 2018).

Overall, the implications of this study can assist educators, parents, and even physicians in better understanding how technology continues to impact the development of students and younger children (Annarumma et al., 2020; Hadders-Algra, 2021; Hauck & Felzer-Kim, 2019; Martins et al., 2021; Tolocka et al., 2019; Tsai, 2019). With technology increasing across all ages this type of research is continuing to be both valid and necessary. However, even with preparations this study proved to have several limitations when collecting and processing the data.

The study sought to clear the confusion surrounding conflicting literature that supports student use of touch technology as having a positive impact on student motor function and the literature that disproves this (Ackermann et al., 2020; Hatzigianni &

Kalaitzidis, 2018; Kuzmiakova, 2020; Lauricella & Cingel, 2020; Lin, 2019; Ly, 2018; Reardon & Leonard, 2019; Rojas-Barahona et al., 2021). The limitations of this study were found to be substantial as the researcher attempted to obtain data from public schools. An important consideration for this study was the size of the study. Due to time and resource constraints, it was not possible to include a larger and more diverse sample of participants. After the researcher contacted schools across the state of Missouri with little to no response, the DESE provided a condensed list of schools that utilized the recommended DRDP for the years 2018-2019, 2019-2020, and 2020-2021. This list provided the researcher with an insight as to how many schools used the DRDP as recommended by the state of Missouri as part of their kindergarten screening. Even so, some of the schools that utilized the DRDP did not report scores using the recommendations provided by the tool. Many schools utilized a pass/fail function rather than a percentage score for each category of the DRDP tests. Other districts reported the use of a different Kindergarten Entry Assessment (KEA) tool. Ultimately, the direct contact of individual administrators and staff from these schools resulted in the small collection of data for this study.

The second limitation occurred because of DESE (2023) expanding the recommended tool for kindergarten screening, the KEA, to include the Kindergarten Observation Form and the Brigance Inventory of Early Development III Standardized Assessment, which uses 55 measures and multiple methods for assessing children's skills. Because of this recommendation many schools in the state of Missouri had already begun to shift to using the KEA prior to 2021. Conversations the researcher had with

districts who did not have DRDP scores to submit centered around the district moving to other forms of screening per DESE's recommendation starting in 2021.

The next limitation was the reliance of self-reported data from the administrators who participated in the survey to observe any delimitations for this study. Although measures were taken to ensure the accuracy and validity of the data, self-reported data are subject to biases and errors that could affect the findings. Administrators and teachers who filled out the survey may have different opinions of how often or how long they utilized touch screen technologies in the classroom. Another bias may be when deciding what touch screen technology is, such as one teacher's use of a tablet versus another's use of a touch screen projector system.

Additionally, this study focused on the skills of preschool students preparing for kindergarten and the age level of students and did not account for other demographic or contextual factors that may influence technology use and motor skill proficiency. The study also did not account for length of time in the classroom or whether the interaction with touch screens was individual or whole class oriented. Further research is needed to explore the role of these factors in shaping these relationships. This is especially true as technology advances.

Finally, this study was conducted in Missouri and included only two school districts, which included eight buildings located within the state. This geographic location has a particular cultural context, and the findings may not be generalizable to other regions or settings. Another part of this limitation is that in 2021 the state of Missouri moved away from the recommendation of the DRDP as its preferred testing model for kindergarten screening. Because this move was coming, many schools preemptively

moved away from the DRDP in preparation for the state's change in recommendations. For future studies, the replication of this study in different contexts or populations would create a more robust transference of the findings.

By highlighting these limitations, the researcher demonstrated a commitment to transparency and accuracy in reporting the results. They also demonstrated an awareness of potential weakness of the research and created avenues for future research with ways to enhance the methodological rigor and validity of the research in the future. Using these limitations the researcher developed recommendations for future research in this field.

Recommendations for Further Research

Preschool education plays a critical role in shaping children's cognitive, social, and physical development (Kaur et al., 2023). The recent advances in technology provide new opportunities for enhancing preschool curriculum. However, the impact of technology on early childhood students' motor skills remains unclear and controversial. To address this issue future studies like this are needed to explore the effect of different types, frequencies, and durations of technology use on various aspects of motor development in young children. This study took place during the 2019-2022 COVID-19 pandemic. Schools during this time were faced with a situation many had not seen in their lifetime. Even before the pandemic, schools were continually changing in response to new learning standards and practices, however the push for at-home learning and virtual education during the pandemic caused many schools to integrate technology for the first time. Many of these schools have continued to use that technology in some way in the classroom. Both state and federal funding has become available following the pandemic that made it easier for schools and administrators to expand technology in the classroom.

Technology has also become more accepted as a means of acquiring education. At home learning using computers and tablets has become for some families the preferred method of learning. Parents have also found ways to use these technologies to work from home, creating a new viewpoint of the importance of technology. Technology has increased in the home from 8% in 1984 to 95% of families having touch screens in the home in 2017 for school aged children (Caramia et al., 2020; Sonnenschein et al., 2023). Because this study took place during the years of the pandemic a future study may include a comparison study looking at years before, during, and after the pandemic.

As such, the first recommendation for further research would be to conduct this study again in 3 years using the more universally accepted testing tool for the state of Missouri. According to DESE the researcher found KEAs can be an assortment of tools. One of the tools recommended by the state of Missouri is the DRDP, however more schools are adopting the Kindergarten Observation Form (KOF) or the Brigance Inventory of Early Development III Standardized (IED III Standardized) assessment, which uses 55 measures and multiple methods for assessing children's skills. By modifying the tool and expanding the results, future researchers will have more information to analyze if administrators agree to participate (DESE, 2023). The researcher acknowledged that the DRDP was slowly being dropped as the preferred method of testing, however through information provided by DESE decided enough data existed to conduct the study. Another path would be to expand the results into other states that used the DRDP tool. States such as California still utilize the DRDP. A future study may be to replicate this study in that state.

An expansion of this research may include a qualitative study on why some districts choose to use or not to use technology. The two school districts where the samples were taken from for this research included one larger and one smaller district. In the future researchers may ask the question why some schools choose to use technology in younger classrooms, and some do not. The perceptions of teachers and administrators teaching in smaller districts may differ from those in larger districts impacting their use of technology or maybe funding may impact a school's use of technology. Bronfenbrenner's (1981) theory also extends into systems that reach farther than the immediate classroom and home life. His theory suggests that the immediate setting, such as the quality and quantity of touch technology access, the classroom environment, teacher-child interactions, and the nature of curriculum and instruction, are all potential factors that may shape students' developmental outcomes. Additionally, the broader societal context, such as cultural values around technology use and economic inequalities, may also play a role (Dooley, 2018). By framing a study utilizing different phases of Bronfenbrenner's theory, future researchers may dive deeper into the ecological systems theory.

A final recommendation would be to expand this research into other grade levels and physical assessment tests. A longitudinal study might be an option to track the motor development of preschoolers who use touchscreens for different durations and frequencies, compared to those who did not use or had a limited exposure to touch technologies. The research could also be expanded to study the impact of the physical environment and design of a preschool classroom and its effect on early childhood motor skills when paired with touch technology.

Future researchers may use this study and change the method of data collection to a qualitative form. In place of DRDP scores, future studies might focus on survey data and the perceptions of educators on preschoolers' motor skill development because of using or not using technology in the classroom. With the increased use of technology, studies such as this will be more useful in deciding what best fits children's needs and development. It is not difficult for any administrator or educator to agree technology has a place in the classroom. The important task educators have is conducting and analyzing appropriate research regarding the effects of technology on children's physical development.

Conclusion

As technology continues to advance, schools will continue to find its use in the classroom (Dashti & Habeeb, 2020; Elmali et al., 2020). The narrative of this study began as clarifying conflicting research and was designed to help close a gap in research directed toward young children and the effects these advancing technologies can have on their physical development (Ackermann et al., 2020; Lin, 2019; Ly, 2018). Research surrounding younger students typically surrounds the development of social skills and the effects of sedentary activity in young children. These are the children developing their fine motor, gross motor, and gross locomotor skills, which can impact their physical activities later in their lives (Hadders-Algra, 2021; Hauck & Felzer-Kim, 2019; Martins et al., 2021). There was a limited amount of research on the effects touch technology and screen time have on children under the age of 6, which was the age group studied in this research (Kracht et al., 2020).

Bronfenbrenner's (1981) ecological systems theory created the framework for this study. His theory suggests there are five systems of contact that influence social and physical development. For participants of this study the researcher looked through the lens of the microsystem, which includes the home and school environments (Dooley, 2018). This system is made up of the individual's immediate surroundings such as where the individual lives, school, family, friends, and religious institution. Children entering schools through their preschool program are exposed to a different microsystem than other preschool students if their exposure to technology differs. It is important to note that movement and interactions with the environment satisfy basic needs children have (Piaget, 1936). Social, physical, symbolic, and cultural characteristics of an environment can permit, invite, or inhibit a mutual interaction between a child's engagement in motor behavior and their immediate environment (McLinden, 2017). Bronfenbrenner knew the environment with which children interacted would impact their growth and development. His theory identified different levels of environment and how they could impact how children developed as a result (Bronfenbrenner, 1981). The results of this study, over the period of 3 years, showed supporting evidence for this theory as technology was or was not used in the classroom. Using statistical analysis of those 3 years, 2 out of the 3 years not only showed a significant association between technology use and DRDP scores, but also the results showed a negative association. Because the DRDP test analyzes a child's physical growth, specifically their motor skills, it can be assumed their interaction with technology does in some way impact their physical development or motor skills. Because students spend time in school as part of their microsystem, educators need to be aware

that the choice to use or not use technology can impact the development of children's physical abilities such as motor skills.

By conducting this study and comparing literature on the topic, the researcher was able to compare the differences of students using and not using technology while in a critical part of their growth and development (Ackerman, 2020; Lauricella & Cingel, 2020; Ly, 2018). With the American Association of Pediatrics recommendation of no more than 2 hours of screen-based interaction a day, it is critical school districts have access to knowledge on the effect of touch technology on their students' development (Hatzigianni & Kalaitzidis, 2018). Studies such as this one should be conducted in more classrooms, states, and countries to mitigate any detrimental use of technologies on students' development, specifically motor scores. Students today are faced with the ever-growing use of technology and following the COVID-19 pandemic the use of technology as part of regular education has grown as a result for education outside of the traditional classroom. This is even more prevalent as funds specifically for technology integration become more available to schools (Flynn, 202; Houp, 2021; Müller et al., 2021; Szente, 2020).

This study provided a small window into the effects of technology on the development of children, specifically those in the early childhood years of school. Although the data of this study varied it should be considered a starting point for future research as the microsystem in which young students find themselves is changing and adapting to the ever-growing technology being provided to schools. Future researchers should take note of the proposed research by this researcher to begin the exploration of how a technology-diverse environment affects the physical development of young

children attending public schools. This research will be pertinent to the foundations of learning being provided by early childhood programs and should be expanded on as time and technology advances.

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APPENDICES

Appendix A

Good Morning!

I am a doctoral student at Southwest Baptist University and an alumnus of Strafford High School.
The reason for my email is I am inviting you to take part in a short study. Before you decide, I would like you to understand why the research is being done and what it would involve for you. I am therefore providing you with the following information. Please take time to read it carefully and discuss it with your team or employees if you wish.

Purpose of Study
The purpose of this quantitative causal-comparative study is to test Bronfenbrenner's Ecological Systems Theory by comparing kindergarteners who used touch screen technology in preschool and kindergarteners who did not use touch screen technology in preschool, based on student scores on the Desired Results Developmental Profile (DRDP) in Missouri public schools (Sutter, et al., 2017).

This information could be utilized by preschool teachers and parents of young children to better facilitate their learning and development of fine motor, gross motor, and gross locomotor skills. In most educators' experience, teachers believe touch screen technology has a negative effect on children's development of fine motor skills, but do not know to what extent (Hatzigianni & Kalaitzidis, 2018; Kaur et al., 2021; Leonard, 2013).

Though studies have been conducted on how technology such as tablets, computers, and touch screens impact children's development, many studies provide conflicting information (Ackermann et al., 2020; Hatzigianni & Kalaitzidis, 2018; Kuzmiakova, 2020; Lauricella & Cingel, 2020; Lin, 2019; Ly, 2018; Reardon & Leonard, 2019; Rojas-Barahona et al., 2019). This study strives to add more clarity to the use of these technologies in younger classrooms.

What you can do?
After you have read this information you may take a few days to discuss if your district would like to participate. If you give consent you may complete the survey attached and send in your 2018-2019, 2019-2020, and 2020-2021 kindergarten groups' DRDP Physical Development - Health screening scores.

Why have I been chosen?
For this study, all public schools in the state of Missouri are being contacted to ensure a large population for research. You are being asked to participate because your district is a public school district in Missouri.

Do I have to take part?
It is up to you to decide whether or not to take part. If you do decide to take part you will be asked to give consent by your completion of the survey. To do this you may access the attached link and complete the form. Participation in this study is entirely voluntary and you are free to refuse to take part or to withdraw from the study at any time without having to give a reason.

Confidentiality
Any information collected during the study will be maintained on a confidential basis and access will be restricted to people conducting the study. Your name will not be disclosed, nor will details of your answers be given to anyone. The DRDP scores collected are to be group scores only. This report was chosen because no student names are visible and thus your students remain anonymous. With your permission, these scores will be averaged and used to conduct an independent samples *t* test. **All data collected will remain completely anonymous.**

Opportunity for you and your staff
Schools that choose to participate will have the chance of being selected for two of four $50 Amazon gift cards ($100 per district)

What are the benefits of taking part and what will happen to the results of the research study?
By participating in this study you and your school are aiding in the research of how our advancing technology might be impacting our students' development of motor skills. For your participation, you and your school will receive a copy of the results of this study.

Concerns or complaints about the research

If you have a concern about any aspect of this study, you should ask to speak to Lauren Wilson who will do her best to answer your questions.

To obtain further information

If you have any questions about this research, please contact me and I will be happy to discuss the study or answer any questions you may have.

To consent to study and participate please fill out the following survey and send a PDF copy of your DRDP Physical Development-Health Kindergarten screening Group scores for the 2018-2019, 2019-2020, and 2020-2021 school years to s810909@sbuniv.edu

SURVEY
https://forms.gle/cEbj6YaA3viToKj8A

Appendix B

Survey of Classroom Technology Use

Dear Participant,

You are cordially invited to participate in my quantitative narrative research to compare Desired Results Developmental Profile motor skills of kindergarteners who have used touch screen technology in their preschool programs and kindergarteners who did not. This research has been approved by the
Southwest Baptist University Research Review Board. You may contact Dr. Colleen Shuler , Chair of the Research Review Board at RRB@SBUniv.edu for any questions or concerns you may have related to this research. By participating in this research you have the opportunity to add to the research base related to understanding the perceptions of how technology can impact young students' physical development.
This form contains simple questions about your district's technology use to correctly determine in which category your district's DRDP scores belong.

Your participation in this study is completely voluntary and there are no foreseeable risks associated with this research. However,
you can decline to answer any question and you may withdraw from the interview at any point.

Your responses and kindergarten DRDP scores will be completely confidential. No student information will be collected beyond the class cohort
scores. Your information will be coded and your name will not be used. If you have any questions about the interview or your responses to the questions, you may contact Lauren Wilson at Lmawilson07@gmail.com.

By participating in this survey and sending your DRDP group scores you are demonstrating your agreement to allow me to use your interview responses and group DRDP scores for research purposes.

lmawilson07@gmail.com (not shared) Switch account

* Required

Please type your name: *

Your answer

Please type your school district name: *

Your answer

Do your preschool classrooms use touch screen technology, such as tablets or touch screen laptops in the classroom as part of regular student instruction? *

- ○ Yes
- ○ No

Next

Clear form

If you answered yes:

Do your preschool students use touch screen digital technology in the classroom? *

- ◯ Yes
- ◯ No

Would you say more than 5% of students are using a touch screen device as part of their IEP in the preschool? *

- ◯ Yes
- ◯ No

Has your preschool program been using touch screen technology for three years or more? *

- ◯ Yes
- ◯ No

Do your students have one-to-one touch screen technology for classroom use? *

- ◯ Yes
- ◯ No

Do your preschool classrooms use touch screen technology as part of their regular education? *

- ◯ Yes, students use their touch screen devices for educational lessons as individuals or small group
- ◯ No, but our students use them for recreational activities

Back | Submit | Clear form

If you answered no:

Would you say more than 5% of students are using a touch screen device as part of their IEP in the classroom? *

- ◯ Yes
- ◯ No

Back Submit Clear form

Thank you!

Thank you for your participation. Please send a PDF of your preschool's kindergarten screening DRDP group Physical Development-Health scores for the 2018-2019, 2019-2020, and 2020-2021school years to the email provided including school district name. **To ensure anonymity please ensure no forms have any student names.** Schools who participate will be entered into a drawing to win one of four $50.00 Amazon gift cards. Thank you again for your participation.

Back Submit Clear form