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Exploring Technology Usage at Home and the Relationship to the Development of the Tripod Grasp in Kindergarten Age Students

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The Relationship Between Home Technology Usage and Tripod Grasp in Kindergarten Students

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Abstract

This research explored the development of the tripod/pincer grasp of 16 Kindergarten aged students and the activities these children engaged in when at home, with particular focus on fine motor and technology usage (both passive and interactive). This research used a mixed methods approach, using both classroom observations and a survey filled out by parents of participating students. This research fills a gap in existing research regarding the link between technology use and fine motor control in young children, as very little currently exists. The research found that fine motor activities at home helped facilitate the development of the tripod/pincer grasp at school, whereas large amounts of time spent engaging in passive technologies did not. The research also found that interactive technology was helpful only if the child utilized a stylus over their finger.

Keywords: fine motor, tripod grasp, technology

Introduction

Fine motor skills have been defined as the collective skills and activities that involve using the hands and fingers (Amundson & Weil, 2001). In other words, fine motor skills are those skills that require the small muscles of the hand to work together to perform precise and refined movements. Early childhood professionals, and curricula have long emphasized the importance of motor development and realized its importance to school readiness (Bredekamp & Copple, 1997). Fine motor skills have been hailed as one of the biggest predictors of school academic and social success (Cameron, Brock, Murrah, Bell, Worzalla, Grissmer, & Morrison, 2012).

Fine Motor Development and Theory

Fine motor skills such as the tripod grasp, the pincer grip, and precision or tip pinch grip are important to develop and aid in letter formation and the development of writing. Rule and Stewart (2002) defines the tripod or pincer grip as the pinching of an object between one or more fingers and the thumb. In other words, this is when a child stabilizes an object between the tips of the fingers and the thumb. Fine motor skills can be developed through a variety of activities such as coloring, drawing, writing, and cutting.

Crain (2011) discusses the work of several theorists who consider the paths children take in motor development. Maturational theorists such as Gesell developed theories that support that children go through sequences in development based on genetics. Maturational Theory of Child Development suggests that if a child does not have expected experiences at certain points of their life, the child may have developmental delays. This can be applied to Gesell's principal of growth known as Reciprocal Interweaving. Reciprocal Interweaving suggests that children go through a period where they explore hand dominance before finally settling on one hand. This could mean that if a child does not explore hand dominance, the child may have fine motor issues later on in life. Other theorists, such as Piaget, suggest instead that children go through stages of development based on cognitive capacity and not necessarily on genetics. There are also learning theorists (Pavlov, Skinner, and Werner) who suggest that children's development can be influenced heavily by external factors, such as teachers and other adults. These theorists suggest that modeling, reinforcement, and direct instruction from others is a large contributing factor in children's development (Crain, 2011). In terms of developmentally appropriate practices, knowledgeable adults play important roles in scaffolding young children's learning within the zone of proximal development. Scaffolding is defined as a process in which teachers model or demonstrate how to solve a problem, and then step back, offering support as needed. (Bredekamp & Copple, 1997). All of these theories and theorists need to be taken into consideration when researching fine motor skills in young children.

Technology Usage and Theory

The National Association for the Education of Young Children (2012) defines interactive technology as digital and analog materials, including soft- ware programs, applications (apps), broadcast and streaming media, some children's television programming, e-books, the Internet, and other forms of content designed to facilitate active and creative use by young children and to encourage social engagement with other children and adults. NAEYC also defines passive technology as forms of media that children do not actively engage with, such as watching television or videos on the Internet (NAEYC, 2012). The technologies most people think of are iPads, television, and the internet. Statistics show that the average child spends around 45 hours per week with media, while only 17 hours with parents and 30 hours in school (Common Sense Media, 2008). Further, it is estimated that 83% of children under six years old use some form of screen media (Kaiser Family Foundation, 2006). On average, children under the age of six spend two hours with a television and DVD player, 1 hour with video games, and 50 minutes with a computer. Overall, children under the age of six watch 4,000 hours of television before they enter kindergarten (Ernest, Causey, Newton, Sharkins, Summerlin & Albaiz 2014).

Theorists such as Urie Bronfenbrenner (1994) have well established theories discussing systems with which an individual interacts and the impact the system has on them that can be applied to children's usage of technology. Known as Ecological Systems Theory, Bronfenbrenner proposes that children are impacted by a series of five systems, from the Chronosystem to the Microsystem (indirect to direct impact). Recently with the introduction of technology into children's lives, the systems proposed have less solid lines, and frequently the systems become blurred, as children can access the world through the screen of a laptop or ipad. Another theorist (as stated in Crain, 2011) Vygotsky proposed a theory of socially mediated cognitive development. In this theory the development of cognitive concepts is conceptualized as resulting from interactions between maturation and instruction. From Vygotsky's perspective, mental functioning develops through mediated experience with cultural tools. In more modern times, computers are the physical and cultural tools that expand mental tools. Another theory of Vygotsky's, known as scaffolding, can be applied when discussing technology and you children. Researchers (Li, Atkins, and Stanton, 2006) hypothesize that computers programmed with developmentally appropriate, interactive software can serve as a mediating tool to scaffold cognitive performance and concept development among young children. Computers, by providing assistance to children's learning, will act as scaffolding agents and lead to increased cognitive development.

Early childhood professionals have concerns regarding the use of technology and young children' development. As children's use of technology is on the rise, there are concerns regarding how it's use may influence fine motor development. Research thus far has been mixed at best. Excessive amounts of technology can negatively impact a child's social development (NAEYC, 2012). Debates regarding content, amount, and type of media/technology exposure that children should be permitted to consume are pervasive. A review conducted by the Campaign for a Commercial-Free Childhood & Alliance for Childhood indicates that excessive screen time has been linked to childhood obesity, sleep disturbances, poor school performance, hindered peer relation- ships, and the undermining of learning (Campaign for a Commercial-Free Childhood & Alliance for Childhood, 2012). Other considerations of excessive screen time include the levels of violence to which young children are exposed, harmful commercialism, and the risk of addictive behavior (Ernest, Causey, Newton, Sharkins, Summerlin & Albaiz, 2014).

Research suggests technology may also have positive implications and impacts on children. House (2012) studied the effect of computer activities on fourth-grade children's science achievement in the United States and Japan. Students from both countries who used computers gained higher scores in science. In a study that Al- Abbadi (2005) conducted in Jordan regarding children's use of computers, the researcher found that instructional computer games helped to increase children's thinking skills. Technologies allow children to keep up with the fast-paced digital world and help them gain visual-reasoning skills. Video games can be emotionally, socially, and visually stimulating, which helps with attention to detail and hand-eye coordination (Hatch, 2011).

With so many negative and positive implications of technology to children's development, the question then becomes: does interactive and passive technology have an impact on the fine motor skills of children, and more specifically, does it impact their development of a standard tripod/pincer grasp? There is scant research examining the association between fine motor skills and achievement in typical school-age populations, and even less research on the relationship between fine motor skills and interactive technology.

It is clear that technology is here to stay, hence further research into how technology use impacts children's lives is critical. Knowing more about how interactive technologies impact children's fine motor development will assist parents and teachers and anyone working with children make more informed decisions regarding the usage of such technologies. Research is needed to better understand how young children use and learn with technology and interactive media and also to better understand any short and long term effects (NAEYC, 2012). Use of new media by kids is rising dramatically, and future studies need to focus on this new media, so that we improve our understanding of their impact on kids (Common Sense Media, 2008). This study will look into children's use of fine motor activities at home, as well as technology use, and will attempt to answer question: is there a relationship between the development of the tripod grasp and home technology (passive and interactive) usage?

Literature Review

The purpose of this review is to shed light on preexisting research surrounding the topics of fine motor development in young children and technology usage for young children. Further, this review also examines the scant studies that examine how technology impacts the fine motor development of young children. The importance of fine motor skills is well documented. Within the last ten years, several studies have been conducted to reiterate the importance of young children having the experiences required to develop their fine motor skills. Also, within the last ten years, there has been an increasing number of studies that explore both positive and negative implications of technology and its impact on young children. These studies will be discussed below. The goal of the literature review is to examine past research involving children's fine motor development and the impact technology has on children's development overall. The review also hopes to shed light on any prior studies that examine the link between fine motor and technology.

Fine Motor Development in Young Children

There is a substantial body of research to suggest that children who have developmental motor problems early in life tend to have a degree of motor, educational and social difficulties as they get older. Grissmer, Grimm, Aiyer, Murrah, and Steele (2010) provide evidence that fine motor skills at kindergarten entrance predict later achievement as well as teacher-reported attention span.

The first study conducted by Brown (2010) researched the impact of the Primary Movement program (an intervention technique) and fine motor skills. The Primary Movement program involves the daily repetition of a short sequence of movements and includes specific exercises to stimulate the major motor parts of the brain. A large part of the program is presented in a child-friendly format using actions, songs, and rhythms. The study involved 65 children, ages four and five. A majority of the children were from low income families, and there was a large percentage of male students. Past research conducted by McPhillips & Jordan-Black (2007) has shown these students have more difficulty with fine motor tasks. The children participating in the Brown study were assessed using the standardized British Ability Scales II (BAS II) fine motor subtest called Copying. This assessment was given twice by the author of the study. The results of the study show that the Primary Movement program had a positive impact on further developing fine motor skills in their experimental group. This information was gathered after analyzing the data and noting that the experimental group received a higher score than the control group. This study suggests that fine motor skills can be built through intervention and practice of skills to help support their development (Brown, 2010).

A second research study conducted by Cameron, Brock, Murrah, Bell, Worzalla, Grissmer, and Morrison (2012) examined the relationship of executive functioning and fine motor skills to academic achievement. Data was gathered from three sources: a parent questionnaire, child assessments during a home visit, and individual child assessments at school. This study's results highlight motor development as a contributor to kindergarten entry performance and children's learning over the year in a variety of domains. Fine motor skills are a prominent part of what kindergarten teachers ask children to do, but wide variation has been observed in students' experiences with motor activities (Marr, Cermak, Cohn, & Henderson, 2003). Furthermore, gaps in motor skill can be traced to sociodemographic factors such as gender, ethnicity, and socioeconomic status, and indicate that although some children enter the kindergarten classroom well prepared to do motor tasks, others do not (Grissmer & Eiseman, 2008). Increasing children's opportunities for fine motor learning experiences with elements of design copy may be one direction for curriculum supplements in early childhood, which has been identified as the most economically efficient period of human development for intervention (Heckman et al., 2006). This study (Cameron, et al., 2012) supports the findings of the previously discussed research by Brown (2010).

A third study by Stewart, Rule, and Giordano (2007) examined the effect of fine motor skill activities on the development of attention in kindergarteners. Five classrooms participated in the study, and there was a control and an experimental group. This study specifically researched the pincer grip. Children in the experimental group were given supplemental fine motor activities in which children used tongs, tweezers, and spoons to move small items. After analyzing data through several attention assessments, including a subtest of the Cognitive Assessment System (CAS), it was discovered that females responded more positively to the supplementary activities. The research suggests further studies exploring effective materials for males and factors such as student choice and interest are needed.

Technology Use, Young Children, and Their Development

Studies into the impact of technology on young children has begun only in recent years. The National Association for the Education of Young Children (NAEYC) position statement in 2012 states that technology can be a very useful tool, and one that can be used to supplement the educational experiences of children. NAEYC further states that adults working with children need to be careful with the amount of time young children interact with technology.

The first study by Bittman, Rutherford, Brown and Unsworth (2011) used data from the Longitudinal Study of Australian Children (LSAC) to study the development of vocabulary and traditional literacy in children aged from zero to eight years. It also examined the access young children have to digital devices, parental mediation practices, children's use of digital devices as recorded in time diaries, and, finally, the association between patterns of media use and family contexts on children's learning. The results of the study show that exposure to television is not inherently harmful to children's learning. The analysis also shows that parents are the most important factor with children's vocabulary development. Finally, the study shows that computer usage is associated with more developed language skills (not necessarily the use of games).

A second study by Li, Atkins, and Stanton (2006) examined the effect of school and home computer use has on children enrolled in a Head Start program. 122 children, ages ranging from 38 to 61 months, participated in the study (the majority from low income families) and two groups were formed: the control group who received standard Head Start curriculum, and the experimental group who received traditional Head Start curriculum supplemented with a period of 15-20 minutes daily on a computer with age appropriate software. The children were assessed with four standardized tests to assess their school readiness, visual motor skills, gross motor skills, and cognitive development. They found that the experimental group outperformed the control group on the school readiness test, and that home computer use enhanced these results, but the data was inconclusive with regard to the motor assessment. The researchers posit that the results were inconclusive due to two main factors: the short amount of time the researchers conducted the study, and the software programs utilized in the study. More time and a wider array of software must be made available to study the effects more.

A third study conducted by Hsin, Li, and Tsai (2014) examined 87 peer-reviewed articles published between 2003 and 2013 regarding technology use and young children. Twenty three of the studies were from 2003 to 2007 and 64 were from 2008 to 2013. A large percentage of studies examined literacy development and/or cognitive development. Each study's results had both positive and negative implications, with time on technology being one factor that could be either positive or negative. There was an overwhelming amount of studies that discovered positive implications for social development. Several studies suggested that it was not necessarily the technology itself that had a negative impact, but rather the way children utilized the technology that was. Shimizu, Yoon and McDonough (2010) developed a training program that was found to be effective in reinforcing developmentally-delayed preschoolers' point-and-click skills with a mouse and their eye-hand coordination. Donker and Reitsma (2007) compared two ways of using a mouse, drag-and-drop versus click-move-click, and found that the former resulted in fewer interaction errors and was more appropriate for kindergarteners and first graders (Hsin, Li, & Tsai, 2014).

Researchers agree that more studies need to be conducted with regard to fine motor skills and technology usage and children. Although many research studies exists examining fine motor skills and their development in children, research into the field of technology and young children is in its infancy, and is as likely to change as the technologies themselves change. There has been little study of the longitudinal effects of children's new media use on language acquisition, motor skills, literacy and school performance but there is a voluminous literature on older screen and page media (television and reading) on children's learning. Regardless of the development of technology there will always be one unchanging factor: the children and their developmental needs. Newer, fresher research is needed to fully examine the relationship between fine motor skills and technology in young children. This research study will examine specifically fine motor activities at home as well as home technology usage (both passive and interactive) and the development of the tripod/pincer grasp at school.

Methods

This research used a mixed methods approach. The research was gathered from both qualitative and quantitative means. Qualitatively, the researcher observed a group of Kindergarten students in their regular education classroom a total of ten times (five times in November and five times in March). The researcher focused on students' pencil grasp, and analyzed whether the child exhibited a tripod/pincer grasp, or another form of pencil grasp. Quantitatively, the researcher sent a survey home to the same set of students' families that examined both fine motor and technology activities their child completed at home in an average school week. The researcher then examined the results to see if there are any relationships between students' pencil grasp and home activities, the focus being on fine motor, passive technology usage, and interactive technology usage. Due to the fact that observations were required in conjunction with the survey, a mixed methods approach was the best fit for this research project.

Setting and Participants

A rural public elementary school located in the eastern United States served as the setting. All children from one Kindergarten classroom were selected to participate in the study. There were 20 children currently enrolled in the classroom. All students were Caucasian. The students ranged in age from five years five months to six years six months. There were 14 males and six females in the classroom. Writing is a scheduled daily activity in the classroom, and occurred in the classroom since early October. Students ranged in academic ability and family socioeconomic status, with half of the students in the classroom qualifying for free and reduced lunch. Out of the 16 students whom participated, 13 came from a family where both parents were present in the home, while 3 were being raised by a single parent (mom in all 3 instances). Four students are on individualized behavior plans, and an additional one recently was picked up for academic special services.

Data Collection

Before any research began the proposed research was approved by the Institutional Review Board at the local University. Once approved, consent was gained from all participants following the NIH protocol. First, a consent form was given and signed by the research site's administrator. Next, consent forms were sent home to participants. 100% of the families consented to having their child observed, and a total of 16 families consented to filling out the form to complete the survey (80%). For families who completed the survey, the child received a small token of appreciation (a sticker, pencil, eraser, or candy).

in-class observation protocol. For the qualitative portion of this study, the researcher observed students during their scheduled writing time. The researcher had a checklist with student's names on the right-hand side in alphabetical order, and with 10 rows along the top stating the order of observations 1st to 10th (see Appendix A for a copy of the form). The researcher examined the students five times in two different months (November and then again in March) for a total of ten times. The November observations correspond to the 1st to 5th on the observation checklist, and the March dates correspond to the 6th to the 10th. The researcher observed each child for a brief period of time as they wrote for a total of 15 to 20 minutes in the classroom and put a check in the box if they exhibited the tripod/pincer grasp and crossed the box out if they did not. After observing each child the initial time in November, the researcher marked out the names and assigned each child a number (again, going in numerical order, just as it had been alphabetical order). From that moment on, all data pertaining to each child was assigned the same number.

The observation protocol was valid and reliable because only one person collected all data, thus negating any possible bias that may have existed from researcher to researcher. The same form was used for all observations, and the same protocol existed for each observation. The same children were observed, and for the same time frame, as well as during the same time of day.

parent survey. A survey with 27 questions was sent home in the form of a survey to families asking them to circle a number that relayed the information of how frequently their child participated in a range of activities in an average school week. The numbers ranged from 1-5, with 1 being never, 2 being rarely, 3 being sometimes, 4 being frequently, and 5 being always. Activities included fine motor, gross motor, and technology activities (fine motor being activities that required the use of hands, gross motor being activities that required the use of the whole body). For fine motor the following were included: coloring and/or drawing, writing, doing craft, helping with chores, helping with cooking, does puzzles, plays with toys, reads, plays with Playdoh or other similar putty or clay, or plays with Legos or other similar building block materials. There were two forms of technology included: passive and interactive. For passive technology the following were included: watching television, watching videos on the iPad or other tablet devices, and video watching on smart phones. For the interactive technology portion, the following were included: games/activities on the iPad or other tablet devices, playing games/activities on a smartphone, playing video games on a game console (such as Xbox, Playstation, etc), doing activities on a laptop computer with a trackpad, or doing activities on a desktop computer with a mouse. With regards to the iPad or tablet usage, there was a 1-5 scale for how often their child used their fingers or a stylus. As surveys came back in, the researcher marked out names and assigned the survey the same number as the child's number during the observations. A copy of the survey can be found in Appendix B.

The survey was reliable and valid because all surveys were sent home at the same time and each activity was described to eliminate confusion (for example, an explanation for stylus was included). Survey participants had the same time frame to complete the form, and were allowed to fill the form out in their homes and not in an unfamiliar environment. Directions were also restated at the top of the second page to eliminate confusion. Surveys were sent home on a Monday because this is a day when parents know to look for forms to come from school to be signed (field trips/fund raisers etc…).

Analysis

For the in class observation portion, the researcher took all data notes from the observations of each child and decided what the child's pencil grasp was based on the amount of tripod/pincer grasp checks they received or did not receive. For example, if a child received four checks for tripod/pincer grasp in the month of November, the researcher assigned that child as having the tripod/pincer grasp. At the end of the observational period in March, the researcher coded the child's grasp as 3=no tripod/pincer grasp, 2=changed from no tripod/pincer grasp to tripod/pincer grasp, 1=always had tripod/pincer grasp

For the survey portion, the data was gathered and put into a spreadsheet. The researcher reassigned students whose parents completed the surveys and their child's observation notes on the spreadsheet based on the child's score of 1-3 for grasp. The child's grasp was also noted as a column before any survey data was entered. again using the 1-3 scale mentioned above. Thus, the researcher reassigned numbers based on the fact that only 16 out of the 20 children could be included on the spreadsheet (from both observations and survey data collected), as well as the child's score on the 1-3 grasp scale. The researcher than began typing in the 1-5 ratings for each child. Each individual fine motor, passive technology, and interactive technology task got their own column. From there there were three major categories created for data: passive technology (television and watching videos on smartphones and tablets), interactive technology (video games and games or other interactive media on smartphones and tablets), and fine motor tasks. The researcher averaged the scores for all the tasks from each of the three main categories for each child, and then again for each 1-3 grasp score. This way the researcher was able to clearly see the average score for fine motor activities, passive technology usage, or interact technology usage for the students who scored a 1 on the grasp scale, the students who scored a 2, and the students who scored a 3. The researcher also averaged the scores for the 1-3 grasp scale with regards to whether children utilized their fingers or a stylus when playing games on the iPad or other tablet devices.

Results

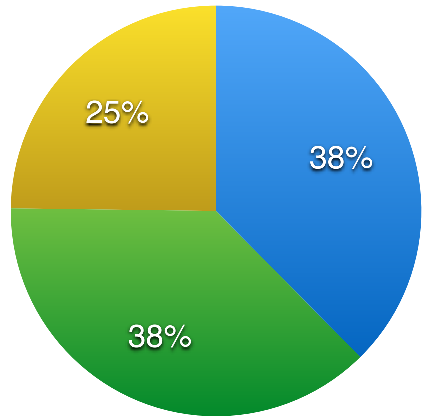
The results of this study include several findings. Once qualitative observations were complete, 6 students consistently had tripod/pincer grasp, 6 went from not having the tripod/pincer grasp in November to having it in March, and 4 students never gained the tripod/pincer grasp. Once survey results were in and tabulated, the students who consistently had the tripod/pincer grasp demonstrated a high usage of fine motor tasks at home, and a lower usage of technology at home. Those who moved from not having the tripod/pincer grasp to having the grasp also scored higher in fine motor tasks at home, and lower in technologies. Finally, those who never gained the tripod/pincer grasp had a lower usage of fine motor tasks at home and a higher amount of technology usage at home. These results will be discussed further below.

Overall Trends in Children's Grip During the School Year

Trends in children's acquisition of the tripod grip from November to March were tracked. Based on how children performed during the five observations students were placed into the 3 categories (1-always had tripod/pincer, 2-gained tripod/pincer grasp from November to March, and 3-never gained tripod/pincer grasp). Out of the six students who scored a 1, four were male and two were female. Out of the six students who scored a 2, four were male and two were female. Out of the four students who scored a 3, four were male and zero were female. All 16 students who participated in the study fell exactly into one of these three categories. Figure 1 shows the percentage of children in the sample who changed or maintained their grip from November to March.

Figure 1

Student Grasp Score

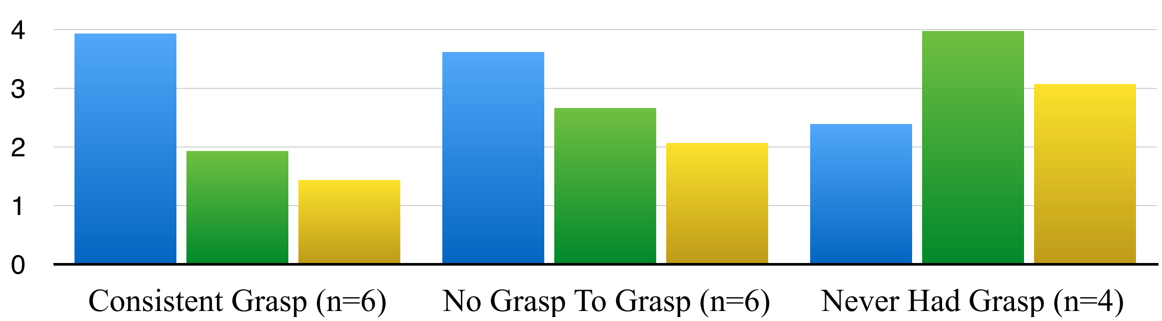


Trends in Grip Pattern by Activities at Home

In order to see the relationship between grip pattern and home activities, average scores for items related to fine motor tasks, interactive technology tasks, and the passive technology tasks were calculated for children receiving a 1, 2, and 3 on the grasp scale. As stated on Figure 2, students who consistently had the grasp participated in more fine motor activities than those who inconsistently had the grasp or never developed the grasp. The fine motor score decreased as students grasp score decreased. Students who never gained the grasp participated in more passive technology usage than those who gained the grasp or consistently had the grasp. Passive technology usage increased as student grasp score decreased. Finally, interactive technology usage increased as students grasp score decreased.

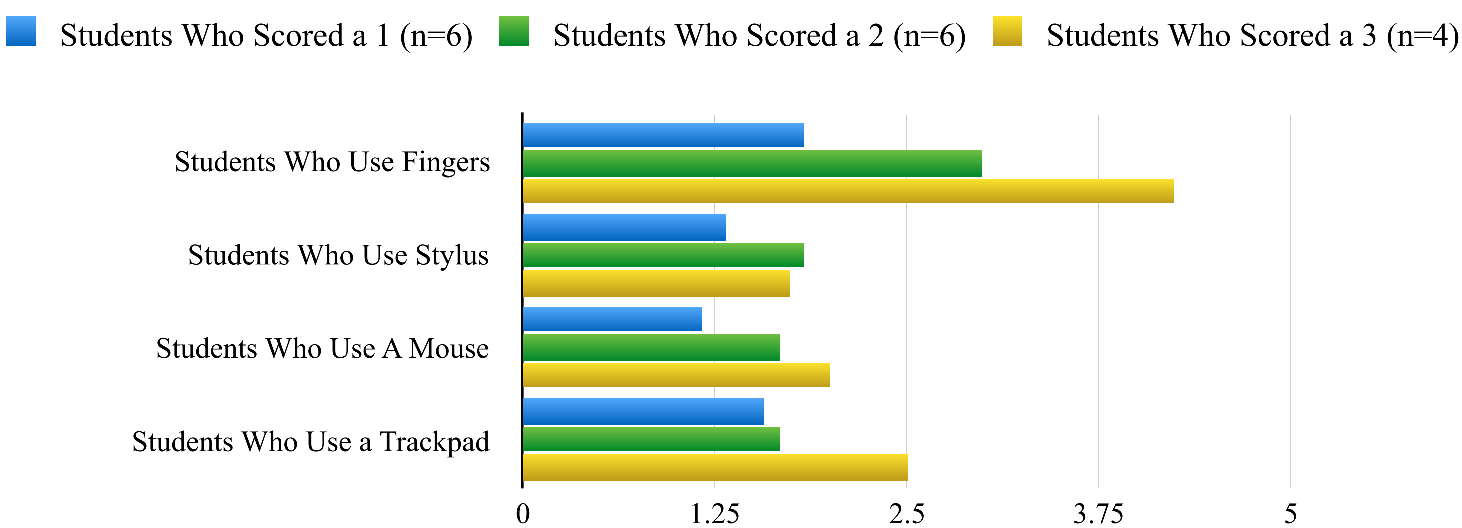
Figure 2

Differences in Activity by Grasp



Within the interactive technology portion of the survey parents were asked to answer how frequently students used a stylus or their fingers, as well as a mouse and a trackpad. Figure 3 shows that students who scored a 3 for never having the tripod/pincer grasp used their fingers over a stylus. Students who scored a 3 also used a trackpad more often than students who scored higher on the tripod/pincer grasp scale.

Figure 3
Students Usage of Fingers, Stylus, Mouse, and Trackpad



Discussion

This study revealed several trends regarding the role which technology and home activities play in developing kindergartener's fine motors skills, in particular, acquisition of the tripod grip. Results indicate that engaging in fine motor activities at home plays a critical role in helping to develop these skills at school. Students who engaged in various activities that are fine motor related at home were far more able to develop the tripod/pincer grasp at school. This conclusion supports the research conducted by Brown (2010) in that specific extra fine motor practice assisted students with fine motor tasks at school. This result also aligns with the research conducted by Stewart, Rule, and Giordano (2007) in that students who engage in activities utilizing the tripod/pincer grasp were more likely to maintain it at school.

Furthermore, students who frequently utilized passive technology at home were less likely to gain the tripod/pincer grasp, particularly if they engaged in fewer fine motor activities too. This result aligns with NAEYC's position statement (2012) that large amounts of time with passive technology has negative implications on a child's well-being. It also supports findings of a literature review conducted by the Campaign for a Commercial-Free Childhood & Alliance for Childhood (2012) which found that excessive passive screen time had negative consequences. However, other such as Bittman, Rutherford, Brown and Unsworth (2011) have not found that passive technology has a negative impact. In the context of the present study, the lack of fine motor engagement at home could be a contributing factor when paired with the higher amounts of passive technology; that is to say that it may not be entirely just the passive technology, but rather the pairing of higher amounts of passive technology and lower amounts of fine motor.

This study also found that as interactive technology usage rose, the likely-hood of acquiring the tripod/pincer grasp went down. Students who scored a 3 had the highest amount of interactive technology usage. Interactive technology has been posited to have positive influences on school readiness (Hsin, Li, & Tsai, 2014; Li, Atkins, & Stanton, 2006), but may perhaps have a negative impact as well. This is based on the fact that out of the two technologies studied, interactive technology usage increased more gradually than that of passive technology as the likely-hood of acquiring the tripod/pincer grasp went down. In this study students who scored low on the tripod/pincer grasp also relied heavily on their fingers and not a stylus. So a question that emerges from this study is: is interactive technology inherently harmful to students or is it the lack of use of a stylus that is harmful? Future studies may wish to investigate this further, particularly as interactive technology usage is increasing in usage with young children.

Implications and Recommendations

This study was important in that previous studies have examined fine motor and technology as separate entities. However, few have explored the connections and relationships between the two. Also, no studies have closely examined the relationship specifically to the tripod/pincer grasp and technology.

In considering whether or not there is a relationship between the development of the tripod grasp and home technology (passive and interactive) usage, the results of this study support that there is indeed a possible relationship between the two. Passive technology in particular appeared to have a negative impact on the development of the tripod grasp in students, particularly when paired with a lower level of fine motor activities being done in the home. Based on this finding, it is recommended that those with young children limit the amount of time children engage in the use of passive technology and instead encourage children to partake in more activities that have a fine motor focus (which was shown to be have a positive impact on the development of the tripod/pincer grasp). Activities such as coloring, drawing and cutting all use the many muscles in the fingers will will help support fine motor development. Engaging in more of these activities will in turn make the earlier development of the tripod/pincer grasp more likely.

Also, interactive technology appeared to have an impact on the development of the tripod/pincer, however this may be due to the fact that the majority of students who used interactive technology used their fingers and not a stylus. Based on this finding, it is recommended that children use a stylus whenever possible to help build finger muscles, and rely less on their fingers to manipulate the technology.

Limitations

There are several limitations to this study. The first is that the data collected was from a small sample in a rural area. A larger sample from a variety of urban and rural areas would give a more clear picture than from just the one town used. The participating students were predominantly male, which could potentially have skewed the data in that the genders were not represented equally. The strategies for collecting data may have influenced study findings. Issues regarding in class observations and parent survey are considered further.

In Class Observation

A large influx of students into the Kindergarten classroom, as well as the departure of other students, is a possible limitation. While none of these students were included in the study and do not directly affect the data, their presence or absence impacted the overall classroom atmosphere and the amount of time their regular classroom teacher had to spend catching new students up to the rest of the classroom. Snow days also impacted the observation data in that two of the days observations were scheduled, school was either cancelled or dismissed early. This also impacted sample size for data collection, as some students were unable to come due to the amount of snow. Due to the amount of snow days the participating school accrued, the final two observation dates were closer together than the other previous eight.

There were several strengths to these observations. One such strength is that the observed class was not the researcher's own classroom, thus preventing any personal bias. Also, that fact that clear expectations and specific criteria was established prior to observing makes the data more valid and reliable. Finally, having a specific time of the day that was consistent allowed the researcher to see the same activity (writing) occurring at the same time of day, and students became accustomed to seeing the researcher in the room at that time of day.

Parent Survey

A possible limitation for the survey is that the first time the survey went home, a plethora of other paperwork was also sent home from the school. This, combined with snow days that week, may have led to less parents participating in the survey. This may have been because the survey simply got lost in the shuffle of paperwork, or because of the snow days, the survey got forgotten. The amount of snow days also impacted the amount of time parents had to fill the survey out. Parents had extra time the second time the survey got sent out because of a snow day the Monday if was due to be collected. A few parents contacted the head of the study and requested a definition for a stylus, so the second time the survey went out the definition was included on the survey. All participating parents answered all questions, with no questions being left blank.

Future Directions

Th present study opened up possibilities for other researchers to explore. What specific facet of interactive technology creates the most impact on a child? Is it the technology itself, or is the use of a stylus/lack thereof? Is passive technology inherently harmful, as suggested by previous studies, or is it only when paired with a lower engagement in other tasks, such as fine motor? Much more research is needed to begin to unpack the specifics as to how technology impacts the fine motor development of young children. Future researchers exploring this area further will help shed light on a very complicated topic.

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Appendix

A Observation Form

Check means tripod/pincer grasp exhibited, and crossed out means not exhibited

Student Name/ Number	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th

B Parent Survey

Please use the following scale when answering the questions below. Circle the **number** that best matches.

In an *average* school week, how often does your child participate in these activities?

	1	2	3	4	5
	never	**rarely**	**occasionally**	**frequently**	**always**

writes words or sentences	1	2	3	4	5
rolls down hill or slides in winter	1	2	3	4	5
hops or skips	1	2	3	4	5
watches t.v.	1	2	3	4	5
jump ropes	1	2	3	4	5
listens to music	1	2	3	4	5
colors and/or draws	1	2	3	4	5
completes puzzles	1	2	3	4	5
plays with toys (action figures, dolls, cars, etc…)	1	2	3	4	5
does games on an ipad	1	2	3	4	5
watches shows or videos on the iPad	1	2	3	4	5
uses their fingers on the ipad	1	2	3	4	5
uses a stylus (pencil-like device) on the ipad	1	2	3	4	5

In an *average* school week, how often does your child participate in these activities?

	1	2	3	4	5
	never	**rarely**	**occasionally**	**frequently**	**always**
plays video games on a console (Xbox, Playstation, etc..)	1	2	3	4	5
reads books or magazines	1	2	3	4	5
is on a desktop computer with a mouse	1	2	3	4	5
is on a laptop computer with a trackpad	1	2	3	4	5
plays with playdoh	1	2	3	4	5
plays sports (T-ball, soccer, etc…)	1	2	3	4	5
Plays games on a smartphone	1	2	3	4	5
watches videos or movies on a smartphone	1	2	3	4	5
participates in other physical activities (karate, yoga, zumba, etc…)	1	2	3	4	5
swims	1	2	3	4	5
builds with legos, blocks, and other building toys	1	2	3	4	5
does crafts (cutting, pasting, glueing, etc…)	1	2	3	4	5
helps with cooking	1	2	3	4	5
helps with chores	1	2	3	4	5