1-1-2011

Preschoolers' Use of Technology in the Classroom

Re, Darlene M. Estes-Del Re
Walden University

Walden University

COLLEGE OF EDUCATION

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Darlene Estes-Del Re

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Chief Academic Officer

David Clinefelter, Ph.D.

Walden University
2011

Abstract

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by

Darlene M. Estes-Del Re

M.Ed., Trevecca Nazarene University, 1995

BS, Christian Heritage University, 1992

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Education

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Abstract

Almost from birth, children are immersed in a technologically rich world yet they often enter preschools that offer little to no use of technology. Preschool learning is tied to more traditional forms of reading and writing; this may be inconsistent with the ways children are learning at home and will learn in elementary school. Despite growing interest in creating learning environments that better mirror the technological experiences of the home, there is a significant gap in current research about how learning is affected in preschool environments designed with multiple forms of technology. This qualitative single case study was designed to explore children's preferred uses of technology for learning in a Montessori preschool. The study was supported by the New London Group's theory of multiliteracies and the model of the Montessori method. Data were collected using pre and post teacher interviews, observations, and student generated video and audio recordings of learning activities. Data were coded to form preliminary categories, and open coding was used to generate themes. The findings revealed that children preferred to use technology to express ideas, to write stories, and to visually document and share their learning experiences with others. When technology was made readily available for learning, children became confident, independent, and responsible users. The inclusion of technology also increased learning and encouraged children to socially interact through new media. Implications for social change include the implementation of learning tools that are more closely aligned with those used in future schooling which may result in higher achievement.

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ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 - 1346

Dedication

This dissertation is dedicated with love to my mom, Marilyn, who taught me to work hard and to dream big and to my husband, Joe, who reminded me that I could accomplish it. It's also dedicated to my beautiful children, Tristan and Jolene, who were understanding when mom had to study and write for hours and helped me with hugs and kisses every step of the way on this journey. I thank all of you for making my journey possible and for living my dream with me.

Acknowledgments

This journey would not have been possible without the continuous support, knowledge, and guidance that I received in pursuit of my doctorate degree from these wonderful people who I would like to personally acknowledge:

- Dr. Irmgard Gruber, for her plentiful cups of wisdom tea, encouragement, support, and dedication to my learning, which has made my experience at Walden University a joy. I could not have been given a more sincere, devoted mentor and dissertation Chairperson. Thank you for modeling how to be scholarly and committed to social change.
- Dr. Maryanne Longo for her time and guidance through my earlier KAM writing and for strengthening my research with her insights and passion for implementing technology in the early years.
- The children who participated in this study who allowed me to fully experience the ways they preferred to use technology for learning and for allowing me to share their preferences with others so that more children can benefit from the inclusion of technology in their classrooms.
- The teacher of the classroom in which I conducted my research who welcomed me as a colleague and allowed me to document the wonderful experiences children were enjoying in her classroom that was designed with multiple forms of technology. Without her support and dedication to the children in her care, none of this would have been possible.

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Chapter 1: Introduction to the Study

Background

Since the 1990s, the way people learn, communicate, and network has significantly changed with the integration of technology in both home and work environments (Yelland, Lee, O'Rourke, and Harrison, 2008; Coiro, Knobel, Lankshear, and Leu, 2009). Technology in all its forms—cells phones, MP3 players, DVD machines, computers, ipods, digital cameras, laptops, Internet, personal navigation systems, interactive toys and games--is a natural part of every day life and work. With so many available forms of technology, individuals can choose how and when to use certain technologies to complete tasks. Technology is both an accepted and expected part of leisure, work, and learning. The same is true for children growing up in today's technological society.

Children of the 21st century are immersed in a technologically rich world and are exposed to digital tools almost from birth. In the home, children grow and freely explore their digitized world. In a study of 0-6 year olds' use of electronic media, Rideout, Vandewater, and Wartella (2003), reported that 99% have a TV at home and 36% have one in their own bedroom. Nearly a half of their sample had a video game player and 63% lived in a home that had Internet access. Additionally, nearly half (48%) of children under the age of six used a computer and 30% played video games. Parent reports indicate that this group spent approximately two hours a day using screen media and that this was about the same as the amount of time that they spent playing outdoors and three times as much time as they spent reading (books) or being read to (Yelland, Lee,

O'Rourke, & Harrison, 2008, p.1). Children come to know how various technologies can be used to communicate and express spoken and written thoughts and have the freedom to explore possibilities the digital world affords. This is not the case when children enter preschool classrooms, which are often sparse in technology and teach literacy skills in traditional ways rather than through varied contexts, purposes, and uses of technology (Merchant, 2009; Yelland et al., 2008). Technology use is often restricted to turn rotations at the computer center or to teacher-directed activities which align with instructional goals. Personal preference for technology use is evident at home but not in the preschool environment.

There is a growing interest in creating learning environments which better mirror the technological experiences children know and prefer outside of school (Stevensen, 2008). Despite this interest, there is a significant gap in current research relating to how learning is impacted in environments designed with multiple forms of technology at the early childhood level. Studies related to multiliteracies and environmental designs at the elementary, middle school, high school, and collegiate level appear in scholarly journals, but similar studies related to early childhood students appear to be limited as will be discussed in more detail in chapter 2. This study generated knowledge pertaining to the ways preschoolers prefer to use technology for learning by exploring how 4-year-old children of a public Montessori preschool designed with multiple forms of technology located in a mid-South state prefer to use technology for learning at school.

Problem Statement

Preschool learning is often designed around more traditional forms of reading and writing activities and is teacher-directed rather than driven by the children themselves who naturally include technology in all its varied forms to learn and make meaning in their world (Lankshear & Knobel, 2003; Street, 1995; Warschauer & Ware, 2009; Dalton & Proctor, 2009). There is a need for research that studies children as subjects rather than objects to discover their preferred ways to use technology for learning at school. This study contributes to the body of literature pertaining to learning in preschool and the inclusion of technology in early childhood education by exploring how 4-year-old children of a public Montessori preschool designed with multiple forms of technology preferred to use technology for learning at school.

Nature of Study

This single qualitative case study allowed me to explore how 4-year-old children of a public Montessori preschool designed with multiple forms of technology located in a mid-South state preferred to use technology for learning at school. The uses of the digital camera, flip video camera, and SmartPen which are not generally used for learning or included as part of literacy development were observed in the classroom designed with multiple forms of technology for a 4-week period.

Multiple forms of data were collected before, during, and after the 4-week period. First, the classroom teacher was interviewed to determine her perceptions of multiliteracies learning. These interviews were audio-taped and transcribed. The teacher had the opportunity to verify the accuracy of transcribed interviews via email sent by

researcher. The teacher was asked questions that were used by the researcher to create an Excel spreadsheet yielding student data which was used for sampling purposes. Following the teacher interview session, the coded data received from the Excel Spreadsheet obtained from the teacher was entered into NVivo 9, a data analysis program, to determine which group of students made up *the case within the case* to be studied.

Once the targeted group was obtained, I began to conduct weekly two hour classroom observations of the selected participants during the morning work times to explore how and when child participants used classroom multilitercies strategies and tools within the Montessori environment designed with multiple forms of technology. Fieldnotes from these observations were transcribed for analysis. Prior to the start of the study, the classroom teacher had introduced technology into the classroom by giving students individual and small-group demonstrations of how to use the digital camera, flip video camera, and SmartPen in the same manner as children received lessons with the Montessori materials. Once children were confident using them, the technology tools were made available for children to use anytime during classroom work time. The Montessori Method, a method that encourages student freedom to determine learning interests, is fully addressed in the literature chapter.

During the first week of the study, I observed community group time in which the teacher goes over calendar activities, news of the day, reads stories, and invites children to sing. At the end of the community group time, I introduced the children to the study through a puppet show held during. Beginning in the first week, my only interaction with

the children was when I introduced them to the study through the puppet show. Thereafter, I did not interact with the children and assumed the role of observer as the children freely selected when and how they used multiple forms of technology for learning for the remaining four weeks of the study.

During the 4-week use of the multiple technology tools, children had the opportunity to share their experiences using the technology tools via created video journal clips, weekly postings to the secured classroom website, and picture journals created using the SmartPen. The classroom teacher was given the option of sharing the children's experiences via Skype with me during community group time led by the classroom teacher when I was not able to be physically in the classroom observing.

I conducted four 2-hour classroom observations. I observed children using the multiliteracies strategies and technology tools and described the ways children used the tools to complete learning activities on an observation form describing their usage (Appendix F). Field notes were taken using a SmartPen so that the pen's recording device picked up details that might have been missed by my handwritten notes alone. The SmartPen is a digital recording pen that simultaneously creates a visual and auditory recording of notes written and heard. Later the notes can be played back by tapping the handwritten notes on the page or by playing back the audiotaped version on a computer using Livescribe software program.

The flip camera recorder was used by the children to provide examples of how children chose to use technology tools to complete learning tasks in their preschool environment designed with multiple forms of technology. The flip-camera is a handheld

digital video recorder that is with a single click of a button and downloaded instantly to a computer with its flash drive connector. The camera features a large, red button that starts and stops the video recording. There are errors keys beside the large, red button for reviewing recorded videos. The simplicity of the flip-camera allowed children to create their own recording with one click.

In the final week, an audio-taped post interview was conducted with the classroom teacher to discuss the ways the preschool children preferred to use the various technology tools for learning and how the environment designed with multiple forms of technology fostered student interest in learning.

Since the children in the classroom had already been using the tools throughout the school year, and the study took place at the end of the school year, the proposed 4-week time to observe children was an adequate amount of time to observe. I was able to consistently describe the ways children preferred to use technology tools when completing learning tasks.

Collected data were entered into NVivo9, a qualitative data management software program. All data were read line by line to allow for codes to emerge and data to be analyzed. The data collection progress was on-going throughout the study.

The participants included five children of the 20 children making up one public, Montessori preschool classroom who met the specified criterion for the case and who were likely to provide me with the richest information for the single case study. The preschool classroom consisted of 20 children ages 3-6 and is academically comparable to classrooms of traditional students in preschool through kindergarten according to the

school district posted profile of the school. The Montessori environment was suitable for this study for several reasons. First, the children who participated in the study were allowed to freely choose work and could choose to use the multiple forms of technology to complete learning tasks; based on the premises of the Montessori instructional approach in place. Second, lessons in the Montessori classroom are individualized and sequential to allow for exploration and open-ended learning. Third, the multi-aged makeup of the classroom allowed for scaffolding of learning skills across age levels and subject areas.

Research Questions

The availability of multiple forms of technology is changing the way in which children learn and discover their world. Multiple technology tools, including digital cameras, Interactive White Boards, laptops, desktop computers, scanners, flip video cameras, and SmartPens can be added to the environment to extend learning opportunities for children beyond traditional reading and writing activities and provide daily opportunities for using technology to express learning in multiple forms. This qualitative single case study generated knowledge pertaining to learning in preschool and the inclusion of technology in early childhood education by exploring how 4-year-old children in a public Montessori preschool designed with multiple forms of technology located in a mid-South state preferred to use technology for learning at school. I sought to describe the ways the designed environment with multiple forms of technology fostered student interest in learning and what kinds of learning connections were made while using such tools as digital cameras, flip camera recorders, and SmartPens in the

classroom. My qualitative investigation added to the understanding of the ways technology shapes the learning of young children:

1. In what ways do children use technology to create meaning in an environment designed with multiple forms of technology?
2. What are the ways preschool children prefer to use technology for learning in an environment designed with multiple forms of technology?
3. What impact does an environment designed with multiple forms of technology have on student interest in learning activities?

These focus questions directed my single case study and influenced the research design of the study.

Purpose of Study

The purpose of my qualitative single case study was to explore how 4-year-old children in a public Montessori preschool designed with multiple forms of technology located in a mid-South state preferred to use technology for learning at school. I also sought to richly describe the ways the environment designed with multiple forms of technology fostered student interest in learning and what learning connections were made while using such tools as digital cameras, flip camera recorders, and SmartPens in the classroom.

In recent years, the wave of multiliteracies learning has been discussed, implemented, and researched at the elementary, middle school, high school, and college levels; however, little is known regarding the phenomenon of multiliteracies at the early childhood level. What is known is limited to adult perceptions of how and when

technology should be used by children in the preschool environment. The few studies conducted focused either on enhancing pre-existing curricula with technology or on the teaching of digital literacy skills. My study will contribute to the body of knowledge pertaining to the integration of multiple forms of technology tools and multiliteracies strategies at the early childhood level by exploring the ways children preferred to use technology on an everyday basis for learning in a preschool environment designed with multiple forms of technology. More importantly, my research serves as a vehicle for social change by providing a rich account of how young children preferred to use technology for learning in a preschool environment designed with multiple forms of technology which afforded them the freedom to choose when and how they used technology tools.

Conceptual Framework

My qualitative single case study was framed by the following two theories: the Montessori method and the multiliteracies approach of the New London Group (1996). The Montessori method provided a model of how to prepare an environment that not only met the developmental needs of the children but also allowed children the freedom to make their own choices and to pursue what interested them. The multiliteracies approach of the New London Group provided a framework for redefining what constitutes learning in the information age, or the digital age, as well as increase understanding of how meaning is constructed and reconstructed through the theory of design. The expanded definition of literacy proposed by the New London Group along with the guidelines Montessori offered for following the interest of the child within a prepared environment

provided the foundation for this study of the ways children preferred to use technology for learning at school.

Montessori (1966), a constructivist, believed that instruction should follow the child rather than be imposed by a teacher, and that learning environments should allow the child to explore and make meaningful connections of their world using materials representative of the time they live in. The method developed by Montessori is based on children's freedom to choose the work which best serves their interests and developmental needs (Montessori, 1966). Because the participants in my study were able to choose which multiple forms of technology tools and multiliteracies strategies they preferred for learning, the Montessori method provided the theoretical support for this decision.

The Montessori method aligns with the New London Group's new environment of literacy pedagogy (1996) based on the concept of design and the inclusion of multiliteracies (p. 11). According to the New London Group, teachers are responsible for designing learning processes and environments. Where language is concerned, the New London Group posited that the term *design* should be used to describe the forms of meaning. The 10 authors of the New London Group proposed that all language activities should incorporate the following three elements of design: available designs, designing, and the redesigned (New London Group, 1996, p. 11). This framework views literacy as a creative and iterative process which combines, transforms, and recreates conventions of language.

The New London Group's new environment of literacy pedagogy (1996) extended what is known and practiced in literacy by changing the way environments are designed to allow children to construct meaningful learning experiences through multiple forms of technology in the digital era and supports Montessori's (1948/1989) premise that tools give humans the ability to enhance their achievement beyond their physical and cognitive limitations. The new environment of literacy pedagogy also supports Montessori's assertion that students should be capable of using the tools of their time. The theories of Montessori and the New London Group supported the goals of my qualitative single case study which was to explore how 4-year-old children of a public Montessori preschool designed with multiple forms of technology located in a mid-South state preferred to use technology for learning at school. These theories are discussed in further detail in chapter 2.

Definition of Terms

Available Designs: the first element of design meaning which provides resources for design or meaning making (Cope & Kalantis, 2003, p. 20).

Designing: the second element of design meaning which involves re-presentation and re-contextualization. Reading, seeing, and listening are a part of the element of designing (Cope & Kalantis, 2003, p. 19).

Designs of meaning: processes of design which involve three elements: available designs, designing, and the redesigned which allow individuals to construct and reconstruct meaning (Cope & Kalantzis, 2003, p. 20).

Directress: refers to a teacher (guide) who facilitates learning in a Montessori classroom (Montessori, 1965, p. 11).

Flip video camera: a simple to use, video camera recorder that is compact with built in wireless capability that can be operated with just a click of a button and can store up to two hours of recorded videos (http://www.theflip.com/en-us).

Interactive White Board (IWB): is a board that resembles a dry erase wipe board only it is a large digital touch screen board that allows teachers to use the computer and Internet with small and large groups. Its advantage is that it can easily display Internet sites and open digital photos. Special pens are used to draw on the board and created work can be saved as image files to be used later (Wang et al., 2008, p. 50).

Montessori Method: a constructivist approach to learning and teaching based on the anthropologic work and child observations of Dr. Maria Montessori (Lillard, 2005, p. 18).

New environment of literacy pedagogy: proposed by the New London Group in 1996 to address what students need to learn regarding literacy. The new environment of literacy pedagogy is based on the concept of design and views "learning and productivity as the results of the designs of complex systems of people, environments, technology, beliefs, and texts" (New London Group, 1996, p. 11).

Multiliteracies: literacy practices which extend beyond traditional literacies to include screen-based reading and writing; the teaching of multiple languages through multimodal learning which generally include computers, iPods, mobile phones, laptops,

digital cameras, flip camera recorders, DVD players, MP3 players, SmartPens, the Internet, emails, and more (Cope & Kalantzis, 2003, p. 3).

SmartPen: a computer embedded in a pen that captures handwriting and simultaneously records audio, synchronizing it to the writing. To replay what was recorded while writing a specific word, users simply tap on the word. The interactive notes can be saved and shared to the computer (http://www.livescribe.com/en-us).

The Redesigned: is the third element of design founded on historically and culturally received patterns of meaning. In essence, the redesigned resource becomes a new available design, a new meaning-making resource (Cope & Kalantis, 2003, p. 3).

Traditional literacies: literacy practices based on print-based reading and writing; the teaching and learning of the national language which generally include paper, pencil, book, blackboards, and overhead projectors (Yelland, Lee, O'Rourke, and Harrison, 2008, p. 29).

Assumptions

This study was conducted with the following assumptions: (a) participants had the freedom to choose when and how to use multiple forms of technology tools for accomplishing learning tasks at school, (b) participants voluntarily participated in all aspects of the study, (c) the classroom studied was designed with multiple forms of technology before the study, (d) participants provided honest reflections pertaining to the use of multiple forms of technology tools on a video clip, and (e) teacher participant provided honest responses to interview questions. It was also assumed that the child

participants were self-directed enough to choose the technology tool preferred to accomplish learning tasks.

Scope

This qualitative single case study was confined to one public, Montessori preschool designed with multiple forms of technology. I did not attempt to categorize students or their reading and writing based academic abilities. I did not predict the future successes or failures of students utilizing multiple forms of technology or multiliteracies strategies.

Limitations

This study was limited to five preschool students enrolled in one public mid-South Montessori school. Consequently, it was not the goal of my case study to generalize results obtained to other Montessori or traditional preschool classrooms. Instead, my goal was to provide particularization of a specific case. Purposive sampling was used to inform the understanding of the research problem. As is typical with nonrandom sampling, the participants were selected based on shared characteristics including age range, years in Montessori program, home use of technology, typical cognitive and physical development, and method of instructional delivery (Johnson & Christensen, 2004).

As with all qualitative case studies, my study was limited to both my sensitivity and integrity as the researcher since I was the primary instrument of data collection and analysis (Merriam, 1988, p. 42). My level of experience and training in observation and interviewing significantly impacted the strength of the case study. I had extensive

training in observation as a Montessori teacher of 16 years. I had not been formerly trained in the art of conducting interviews. To compensate, I researched methods of interviewing and practiced interviewing on willing candidates who were not part of the study.

Another concern that arises with case study research is what Guba and Lincoln (1981) referred to as "unusual problems of ethics in which an unethical case writer could so select from among available data that virtually anything he wished could be illustrated" (p. 378). To avoid this situation, I remained constantly aware of my own biases with the use of memoing during data analyses to keep separate what occurred and how I interpreted it.

Further limitations involve the issues of reliability, validity, and generalizability (Merriam, 1988). Issues of reliability and validity can be resolved with careful attention to how data is collected, analyzed, interpreted, and reported. It was my intention as the researcher to increase reliability and validity of the case study by making these data processes as transparent as possible to the reader with the use of NVivo 9. The data analysis program allowed me to code data while maintaining the original text. At any time, surrounding text could be accessed from the click of a coded piece of text to ensure that interpretation of the text was accurate. Connections between coded data could also be retrieved at any time. Internal validity was enhanced through triangulation. Triangulation was accomplished through the use of multiple sources of data, member checks, extended observations at the research site, and clarification of my biases at the outset of my study (Denzin, 1970; Merriam & Simpson, 1995).

Reliability in quantitative research refers to whether or not the findings can be replicated and yield the same results; however, in qualitative research, reliability is a question of whether "the results are consistent with the data collected" (Merriam, 1988, p. 206). Dependability of results was accomplished through the use of multiple methods of data collection and analysis (triangulation) as well as the creation of an audit trail (researcher's log with NVivo9) that accounted in detail how data were collected, coded by categories, and interpreted.

The number of participants for my study was justifiable because the goal of case study research is to provide a rich account of a phenomenon that will yield the most significant information on the topic being studied (Goodwin & Goodwin, 1996; Merriam, 1988) rather than to provide results that can be generalized to larger populations. A larger sample than three to five participating children would not allow for the desired depth of inquiry that is necessary to fully describe the ways children prefer to use technology for learning at school. A smaller sample than three to five participants would not provide the desired holistic perspective of the learning preferences of the specified group of children and would not allow for the desired depth of study that is necessary to fully describe the multiple ways 4-year-old children prefer to use technology for learning at school.

Despite the limitations of my study, the results provided a rich account of how 4-year-old preschool children preferred to use technology for learning at school and how the environment designed with multiple forms of technology impacted student interest in learning activities. The results also provided school leaders, particularly the local Steering Committee made up of 20 Montessori school directors impacting approximately

915 students and families, with insight into how 4-year-old children use technology tools such as the digital camera, flip camera recorder, and SmartPen to extend preschool learning opportunities beyond those experiences tied to traditional reading and writing activities, allowing children to cultivate 21st century learning skills

Delimitations

My qualitative single case study was limited to the study of 4-year-old preschoolers of one public preschool Montessori classroom of 20 children ranged in age from 3-6. The program provides instruction via the Montessori method to students pre-K through 4th grade and is a magnet school option for students. The preschool students range in age from 3-6. As typical of Montessori environments, the students are grouped in multi-aged classes. The classroom is taught by one full-time, trained Montessori directress who is also a state certified teacher holding a Masters of Education degree. The Montessori directress is supported by a second adult who is neither Montessori trained or state certified

Significance of Study

Multiliteracies Approach

Multiliteracies is an emergent and integrated approach to literacy that has been implemented in early childhood education on a limited basis in the United States. Due to the extensive number of preschoolers using technologies and interactive toys at home for learning and play, researchers are increasingly interested in the inclusion of such devices in educational environments and the impact that the various forms of technologies may have on how children learn and what tools interest them the most for learning. Despite

this interest, there is a significant gap in current research relating to how environments designed with multiple forms of technology shapes learning at the early childhood level. Studies related to multiliteracies and environmental designs at the elementary, middle school, high school, and collegiate level appear in scholarly journals, but similar studies related to early childhood students are limited. My study generated knowledge pertaining to: how 4-year-old children responded to an environment designed with multiple forms of technology, what technology tools and multiliteracies strategies children selected to accomplish learning tasks, and how children used the various technology tools to make and remake meaning.

Professional Application

Emerging technologies continue to challenge the way educators teach and design classrooms for learning. Educators face the challenge of preparing students for life and learning in the 21st century. Teachers are pressured to teach students new skills deemed necessary for success in the contemporary work force. This pressure has now trickled down to early childhood. Early childhood educators must rethink how they teach and how they design learning environments in order to prepare preschoolers with the skills that extend beyond traditional reading and writing print-based skills. Knowledge generated from my study provided early childhood educators with a model for transforming preschool environments to include multiple forms of technology which affords children the freedom to choose when and how to use technology tools

Social Change Implications

Early childhood environments designed with multiple forms of technology and learning led by the children has the potential to bridge the technological gap children experience between their home and preschool worlds. With many preschools limiting the use of technology by students during the regular school day (Yelland et al., 2008), my study helps to create a social awareness of the innovative and iterative learning experiences that the environment designed with multiliteracies provided children. Designing preschool environments to mirror most home environments that naturally integrate technology allowed children to experience learning in a more familiar way through technology.

Summary

A review of the current literature demonstrates an increasing interest among educators in the United States regarding integration of technology tools and multiliteracies in the classroom (A. Luke & Freebody, 1999; New London Group, 1996; Neumann, 2006; Mayer, 2009; Harrison, 2009; Yelland et al., 2008), but only a limited body of scholarly research has been conducted related to environments designed with multiple forms of technology at the early childhood level. Searches of educational literature via various online databases have not revealed any scholarly research studies regarding environments designed with multiliteracies at the early childhood level.

This chapter introduced the concepts of multiliteracies and the integration of technology into learning environments and identified the need for research of the preferred ways young children use technology for learning at school in an environment

designed with multiple forms of technology. It suggested that a single case study of 4-year-old children of a public Montessori preschool designed with multiple forms of technology located in a mid-South state might increase understanding of the ways preschool children prefer to use technology for learning that extends beyond traditional reading and writing activities. The problem addressed in my single case study was the lack of understanding regarding the phenomenon of multiliteracies learning through multiple forms of technology at the early childhood level. The purpose of my qualitative single case study was to explore how 4-year-old children in a public Montessori preschool designed with multiple forms of technology located in a mid-South state preferred to use technology for learning at school. The significance of conducting my research was to bridge the technological gap children experience between their home and preschool worlds and to provide a model design for preschool environments that mirror home environments that naturally integrate technology so that children can experience learning in a more familiar and preferred way at preschool through technology.

In chapter 2, an analysis of the Montessori method and The New London Group's design theory incorporating multiliteracies, which provide the conceptual framework of this study, is presented. The existing literature related to the digital world of preschoolers is reviewed, as is literature pertaining to teachers' and children's perceptions of multiliteracies, 21st century skills, and learning experiences of children with the use of technology tools. The qualitative single case study selected for my study was analyzed, along with methods that were considered and rejected.

Chapter 3 provided details of the research design and explained the procedures that were utilized to answer the research questions. My role as the researcher is defined, the context of the study is explained, and decisions regarding the selection of the population and sample are justified. Chapter 3 includes a discussion of how participants were ethically protected. Finally, a detailed explanation of the data collection and data analysis is provided, along with a description of how validity and reliability was established.

Chapter 2: Literature Review

Introduction

The review of literature is organized into three main sections. In the first section, the theories that provide the conceptual framework of this study—the Montessori method, and The New London Group's theory of multiliteracies and redesign—are presented. In the second section, the digital generation is described and characteristics unique to children growing up in a digital world are identified. This section also reviews the literature related to children's attitudes and perceptions regarding multiliteracies learning and the inclusion of technology and 21st century skills in the preschool environment, the benefits and limitations of environments which include technology, and construction of language and behaviors that are made possible with the inclusion of multiliteracies in preschool environments. The final section is a review and justification for the use of the single case study method in researching the complex, developing phenomenon of multiliteracies learning in early childhood education.

Throughout the literature reviewed, multiliteracies or new literacies was found interchangeably to describe skills and strategies necessary for children to be considered literate in a digital world of learning, communicating, and connecting. This study adopted Coiro, Knobel, Lankshear, and Leu's (2009) definition of literacy as a "rapid and continuous process of change in the ways we read, write, view, listen, compose, and communicate information" (p. 5) as it examined learning for new times in early childhood education. This definition of literacy is fitting since there will likely be more new technologies emerging and changing the ways one is literate; thus making it more

important that that literate persons know *how* and *when* to choose applicable forms of technologies to support one's purposes (p. 5). Particular attention is paid to the way preschool environment designs include various technologies to help preschoolers choose the tools which best support their language and social purposes. The term multiliteracies was originally coined by the New London Group (1996) to describe the changing landscape of literacy in the new knowledge era that is associated with "changes in social and cultural ways of doing things, ways of being, ways of viewing the world" (Coiro, Knobel, Lankshear, and Leu, 2009, p. 7) and in this study is used to describe the multiple ways to become literate.

An exhaustive search of the literature was conducted using resources from several libraries including the Walden University Library, the Hendersonville Public Library, and the Belmont University Library. The following databases were searched: Academic Search Premier, Computers & Applied Science, Education Research Complete, ERIC, ProQuest, and Sage full-text database. The following key words were used to perform the search: *technology and children, digital literacy, new literacies, emergent literacy, computers and children, child participation in research, designs of social futures, digital cameras, technology integration and preschool, emergent multiliteracies, multimodal learning, visual literacy, emergent writing, Montessori and technology, learning environment designs, multimodal literacy, writing development and children,* and *social development and technology*.

Conceptual Framework

The New London Group and Multiliteracies

Recognizing the need to examine literacy in light of technological advancements, a group of scholars, later named the New London Group (1996), came together from various parts of the world to discuss the changing landscape of literacy. Together this group considered whether literacy practices should be kept the same or whether they should be transformed to reflect the changes observed in the everyday social literacy practices of the changed world. The New London Group began an open dialogue about the changes technology has brought to the world young children are growing up in.

The New London Group (1996) discussed in depth the changed world of preschoolers. They agreed with other researchers of the field that the world of preschoolers is immersed in technology (Hasebrink, Livingstone, Haddon, & Olafsson, 2009; Marsh, 2005; McPake, Stephen, & Plowman, 2007; Pew Research Center, 2009; Roberts & Foehr, 2008; Shuler, 2009; Stephen, McPake, Plowman, & Berch-Heyman, 2008; Vandewater et al., 2007) and has ushered in multiliteracies which go beyond basic reading and writing practices and include varied forms of communication made available through technology tools. Having grown up with technology, children naturally accept the tools of technology as part of every day social practice as they observe the multiple ways adults, teens, and peers communicate through text messages, tweets, emails, instant messages, blogs, and more. Whether at the mall, grocery store, library, zoo, bus station, or home, technology is used to communicate with others and to carry out various daily tasks. The same cannot be said of the preschool environment where technology is largely

confined to a single computer station equipped to reinforce phonemic awareness through skill and drill programs. There are a few preschool programs which allow children to create pictures and stories on the computer when it is tied to teacher instruction. Children often rotate turns at the computer averaging 20 to 30 minutes of computer time a week (Cuban, 2001; Madden, Ford, Miller, & Levy, 2005). Otherwise, early literacy skills are encouraged through traditional forms of paper, pencil, chalkboard, crayon, markers, and books. This is largely due to the enormous pressure teachers face to fulfill the academic milestones set by the *No Child Left Behind* legislation which is rooted in traditional print-based reading skills and less focused on writing and social aspects of literacy (Coiro, Knobel, Lankshear, and Leu, 2009, p. 9). The New London Group (1996) agreed that these methods alone neglect additional social literacy skills children need to acquire to ensure their success as readers and writers in a time when the world is going paperless and social networking has become the preferred way to communicate and exchange ideas.

Following their week long discussions of the current literacy practices employed in schools, the New London Group (1996) recognized the need to transform these literacy practices. They focused on the plurality of literacy rather than on literacy that is focused on language only. After a week of dialogue, the New London Group (1996) summarized their discussions and agreed to adopt the term *multiliteracies* to describe the new direction for literacy learning and the design of social futures. This term more accurately describes how a diverse society made up of many cultures and languages are able to communicate and create social networks across the world despite their differences. This

kind of social communication is not possible with literacy that is bound by systematic teaching aimed at mastering a single language in a specified way. Instead, multiliteracies pedagogy focuses on multiple modes of meaning-making that take into account diverse cultures and context.

According to Cope and Kalantzis (2000), multiliteracies "create a different kind of pedagogy: one in which language and other modes of meaning are dynamic representational resources, constantly being remade by their users as they work to achieve their various cultural purposes" (p. 5). The difference in instruction rests in the open-ended approach to literacy that allows for learners to create and recreate meaning for varied purposes. In a world shaped by new communications media, teaching must consider text that is visual, audio, spatial, behavioral, and more. Instruction in one set of standards or skills cannot constitute literacy in a world that requires plural literacies (p. 6).

The next challenge faced by the New London Group (1996) was developing a design that would make possible the transformation of current literacy practices. They discussed *how* social change experienced through technological advances could reshape literacy practices (Cope & Kalantzis, 2000). Discussions were focused on redefining what literacy entails. The group embraced the concept of *design*, in which "we are both inheritors of patterns and conventions of meaning while at the same time active designers of meaning. And as designers of meaning, we are designers of social futures—workplace futures, public futures, and community futures" (p. 7). Together the group generated a theory to translate the *what* of literacy into the *how* of literacy. The *what* of literacy

includes the following six design elements in the meaning-making process: "Linguistic Meaning, Visual Meaning, Audio Meaning, Gestural Meaning, Spatial Meaning, and the Multimodal patterns of meaning that relate the first five modes of meaning to each other" (p. 7). The *how* of literacy was narrowed to four components of teaching and learning:

1. Situated Practice which draws on the experience of meaning-making in lifeworlds, the public realm, and workplaces;
2. Overt Instruction through which students develop an explicit metalanguage of Design;
3. Critical Framing, which interprets the social context and purpose of designs of meaning; and
4. Transformed Practice, in which students, as meaning-makers, become designers of social futures. (p. 7)

Once the New London Group (1996) agreed on the *how* and *what* of literacy design and practice, they committed to researching their theory through the development of the International Multiliteracies Project. The intent of the project was to set up research experiments to "test, exemplify, extend, and rework the ideas explored in their dialogues together in New London" (p. 7).

The work of the New London Group opened dialogue on literacy learning and the design of social futures among policy-makers and educators. As a result, changes in practice have been noticed and researched at the elementary, high school, and college level; however, preschool practice remains focused on traditional teachings of literacy and include technology to reinforce traditionally taught skills. There is limited research

on multiliteracies practice in the early years. Of the few studies conducted by (Becker, 2000; Burnett, Dickinson, Myers, and Merchant, 2006; Cohen, 2006; Facer, Furlong, and Sutherland, 2003; Good, 2009; Harrison et al., 2009; Liebermann, Bates, and So, 2009; Plowman & Stephen, 2003, 2008), the focus was on how to fit technology into pre-existing literacy practices rather than on how to transform literacy altogether with the inclusion of multiple forms of texts. As a result, technology tools are used sparingly to supplement traditional ideas rather than made readily available for children to choose which tools to use when and for what purpose.

The problem is that policy makers heard the message of the New London Group (1996) and saw technology as a way to narrow the achievement gap. In haste, computers were placed in preschool programs with no total effect in mind. There were no guidelines or standards in place for how to integrate the computers in the preschool curriculum. There was no consideration of redefining literacy practices. Teachers were not trained in how to use the computer or in how to select appropriate software. As a result, teachers either chose to use the computer as a supplement to reinforce traditional skills or chose not to use it at all. Literacy practices continue to be stuck in past traditions and are not preparing preschoolers for their social futures.

While some research supports positive learning outcomes from computer exposure and use (Clements, 1999; Papert 1998; Yelland 2002, 2007), other critics (Armstrong & Casement, 2001; Cordes & Miller, 2000; Healy, 1998) are against young children using computers arguing that technologies take away valuable learning from play and socialization. These same critics are also concerned with potential dangers that

may arise from exposure to unsuitable material and predators on the Internet (Cordes & Miller, 2000). Technology has made considerable advances since the publication of these arguments. Internet safeguards that are parent-controlled and child-safe have made Internet use safe and suitable for children. New interactive interface technologies have opened the way for play and socialization in a digital world. The mobility of technology allows children to be on the move rather than stationary when using new tools. These advancements have made it more possible to move past print-based traditions and provide more opportunities for children to develop multiliteracies and be better prepared for their social futures (Coiro, Knobel, Lankshear, & Leu, 2008).

Yelland et al. (2008) embraced the possibilities of mobile technologies and child-protected Internet use and developed an action research project which extended the work of the New London Group (1996) by researching how multiliteracies could be implemented in preschool environments. The project entailed consultation with 36 teachers to identify effective strategies teachers could employ to use technology in ways that would build on their existing curricula skills. Their work was instrumental in challenging educators to rethink literacy practices in the early years to include technology. However, their studies did not embrace the vision of multiliteracies described by the New London Group (1996), which viewed learners as active agents in the meaning-making process. Instead, Yelland et al. (2008), extended traditional literacy to include other forms as related to themes of study and which was teacher selected and guided. The goal of their collaborative research project was to create pedagogy for multiliteracies that early childhood teachers could use as a guide for how best to include

technology to prepare preschoolers for a technology rich future (p. 14). The emphasis again was on how technology could be added to existing curricula as a way to include digital literacy rather than on transforming literacy practices altogether. The project neglected to address the cultural and social purposes offered by technologies that create meaning for the children. To employ multiliteracies in preschool, there is a need for a method of instruction that is child-driven and specifically designed to allow for open-ended expression and communication through varied forms of technology.

Montessori Method

Though not a new method of instruction for children, the Montessori method could make the transformation of literacy practices in preschool possible by helping teachers design learning environments that are child-driven and specifically designed to include multiliteracies envisioned by the New London Group (1996) and foster the social aspects of writing described by the New Zealand Ministry of Education (1992). The following discussion will elaborate on the components Montessori considered essential for preparing learning environments for young children which can also be applied when designing preschool environments with multiliteracies.

Montessori drew upon her knowledge and experiences with medicine, anthropology, and neurology when she designed the specific didactic materials to include in early learning environments. Montessori studied the behaviors and interactions of children and discovered that children possessed universal human tendencies of exploration, orientation, order, communication, ability to make abstractions, preference for work with the hands, repetition, correction of own errors, work towards self-

perfection, and development of a mathematical mind. These same tendencies can be applied when deciding how to integrate technology and multiliteracies in early childhood education.

Human Tendencies and the MultiLiteracies Environment

Like the original materials designed by Montessori, multiliteracies materials should be based on extended observations of children to determine what needs exist for the language and social construction of children (Montessori, 1969). After needs are documented and analyzed, the multiliteracies environment can be prepared to suit the developing needs of young children ages three through six. Such an environment should mirror the child's home setting that naturally and practically integrates tools of society including technology. The environment should also provide many opportunities for the child to explore the real world and to assimilate factual knowledge (Montessori, 1969). Since fantasy is difficult for this age child, encounters with technology should be connected to real things and people. Learning with multiliteracies should be hands-on, open-ended, and allow for lots of movement. Children should be able to design their own uses for materials and also be allowed to move about with the materials. Mobile technologies today have made this more possible today than ever before (Yelland et al., 2008).

Following the Child

As described above, the Montessori method was based on human tendencies found universal in children. This section focuses on the implementation of the method that is driven by the child and provides a model for child-directed learning. Montessori's

work began by observing and following the child's interests and developmental tendencies. She discovered what worked and what did not for the children as well as the way which each child worked. Maria Montessori did not have any pre-conceived notions because she was not trained as a teacher. Her approach was scientific in nature and artistic in expression. It was Montessori's belief that if teachers provide an environment that meets the needs of the children and these needs are determined by keen observation, then the children will develop normally.

According to Montessori, children need opportunities to work with their hands and choose their own activities which further their cognitive, physical, social, and emotional development. If lessons are designed for successful and independent use by the child, then the teacher will be able to guide children in the use of materials and then let them on their own to choose which materials interest them in their construction of language and social behaviors. When the curriculum is driven by the child's interests and needs, allowances for self-discovery and social collaboration are naturally included. The role of the teacher (guide) is to prepare the environment with the essential tools of the time and to guide children towards their independence with the tools of the environment.

According to Montessori, the teacher must design the environment so that it meets both the psychological and physical needs of the child. Furnishings and materials should be child-sized and successfully manipulated by the independent child. Montessori stressed the importance of making tools available at all times for the child's use which isolated one skill at a time and were specifically placed in the environment according to the sequence of the curriculum. Following Montessori's model, multiliteracies

environments should include materials that are adapted to the size and capabilities of the young child. Speech to text word processing programs are an example of this as well as taking digital pictures of an event with one simple click of the Flip Camera recorder. In both cases, the child can successfully accomplish the tasks independently.

The Montessori environment is orderly, sequenced, structured, functional, and predictable to support the child's strong need for order and his desire for independence, freedom of movement, and freedom for choice (Montessori, 1967). One of the primary goals of a Montessori prepared environment is to support the child developing independence from the adult, "that is, it is a place where he can do things for himself—live his own life—without the immediate help of adults" (Standing, 1957, p. 267). Independence of the child is helped with a sequence of materials in each curriculum area that are arranged from easiest to most difficult and from concrete to abstract (Lillard, 1972). Materials were made concrete to enable children to maximize learning through work with their hands. Likewise, transformed preschool environments should be orderly and present new literacies materials in a way that allows the child to build knowledge of the new materials from concrete foundations to greater integration of literacies. Emphasis is placed on the work a tool allows one to do rather than on learning how the tool itself was developed. The same emphasis should be applied with technology—it is more important for the child to learn how and when to use various technologies rather than to be skilled in identifying computer components and operational functions.

As discussed, the Montessori method is based on human tendencies of children and instruction that follows the child can help teachers thoughtfully and appropriately

transform preschool environments to make available many forms of technologies for children to construct language and social behaviors. Like Montessori, The New London Group (1996) was not interested in adding new tools to update or enhance current learning practices which were not meeting the needs of children for their time. Instead, The New London Group was interested in transforming environments and practices to ensure that the early years were properly preparing children for their social futures.

A few recent case studies have attempted to research the appropriate use of new literacy tools such as email, digital cameras, twitter, and computers in preschool environments (Stevensen, 2008; Wang et al., 2008). These case studies found that children responded positively to technology experiences. While these studies attempted to explore the appropriateness of a specific technology tool added to the curriculum, none of the studies examined the impact of many multiliteracies tools on the writing development of young children. None of these studies directly looked at the social process of writing that develops as children use multiliteracies to interact with one another. Children were studied as objects of study rather than as subjects of study. Studies were not focused on how and when preschoolers chose to use technology.

Any tools to be considered suitable for preschool environments should allow for safe use by the child that is not teacher-dependent and allow for open-ending exploration and learning rather than specified learning tasks. The tools should be logically placed and sequenced in the curricula rather than just randomly placed. There are other tools less explored with children that might also be considered appropriate to include in preschool environments. These include the SmartPen, Flip-Camera, and Dragon Naturally Speaking

Software. A study is needed that would explore in-depth the social writing behaviors and interactions that emerge as children engage with multiliteracies in the preschool environment.

Enhancement or Transformation

A review of the literature shows that much has been theorized about transforming school curriculum to reflect the influence of new technology (Bawden, 2001; Cope & Kalantzis, 2000; Marsh, 2005; Harrison et al., 2009; Herring, 2004; Hisrich & Blanchard, 2009); but very few studies have actually researched how such a transformation would take place in classrooms. As a result, classroom practitioners have favored an approach that views technology as *enrichment* (Burnett, Dickinson, Myers, and Merchant, 2006; McPake, Stephen, and Plowman, 2007; Merchant, 2003; Parette, Hourcade, Dinelli, and Boeckmann, 2009; Plowman & Stephen, 2006; Shuler, 2009; Stephen & Plowman, 2008). Such practitioners embrace this enrichment view because it is easier to add to what is already being taught rather than completely change what and how they teach (Stephen & Plowman, 2008; Karachmer, Mallette, and Leu, 2003).

A project entitled, *Interplay: Play, Learning and ICT in Pre-school Settings* explored the ways teachers used technology to supplement play areas. Learning was supported through the use of guided interaction in which the teacher was readily available to intervene and assist with technological challenges as needed. Interestingly, there were few examples reported of adults observing, recording, and assessing children's progress with ICT (p. 638). Results of the project implemented by Stephen and Plowman indicated that children were able to successfully manipulate technology in the playroom with the

guidance and support of the adult since pre-school children cannot read instructions about the process of the activity. A limitation of the project was in how to practically make this model work for all students at all times since the teacher could only work with a few children at a time. Children who waited for teacher help often in their frustration aborted the activity instead of waiting for the teacher to come over to them. While enhancement appears to be the easier approach, in practice it poses classroom management issues.

In response to the need for studies on the practical inclusion of technology in preschool settings, a study conducted by Burnett, Dickinson, Myers, and Merchant (2006) explored the ways peer-to-peer digital communication could transform classroom practice rather than just enhance it. The researchers set up a project between two primary schools who agreed to allow students to communicate with one another through email. Specifically, the study looked at processes children utilized when engaging with onscreen communication. Data were also collected to increase understanding of how children perceived the use of digital communication in the classroom. The views and interests of participants were initially established through a shoebox containing gathered artifacts that were meaningful to the participants. Each child took digital photos of the gathered items and attached those to an initial email sent to their assigned peer. These photos served as a starting point for their interaction. Receivers of email then asked questions regarding the photos. Children used onscreen alias and each had individual email accounts. The focus of the study was on how children used digital literacy rather than on how effective the project was. As a result, rich, descriptive data on the writing processes and products were

obtained by Burnett et al. (2006), thus contributing to the limited research available on digital writing (Nixon, 2003; Lankshear & Knobel, 2003).

Further findings from Burnett et al.'s investigation (2006) described how the writing process was transformed through the use of keyboards and mouse devices. Students responded positively to the perfectly formed letters the screen produced and to ease of editing. Children experienced with the standard keyboard featuring the letters Q, W, E, R, T, Y as the first six letters confidently composed emails whereas others who were less experience were frustrated when they had to hunt and peck for letters on the keyboard. They expressed a preference for an alphabetized keyboard. Burnett et al. (2006) study raised important issues about the relationship between composition and transcription in children's writing (p. 18). Communicating on screen requires less focus on physical maneuvering of a pencil and extended practice in penmanship. The manipulation of the mouse as a pointing device required different dexterity altogether. Overall with on screen communication, the participants were able to compose and edit their writing simultaneously. Data also suggested that writers actually paid more attention to their writing errors when they could see what they had written appear on the screen. When composing with pencil and paper, students have a tendency to just keep writing rather than to stop, reread, and edit. Participants also relied on peers as a source of knowledge when seeking help in how to navigate technology. Students and teachers shared roles of teaching and learning (p. 19).

The study conducted by Burnett et al. (2006) not only evidenced a transformation in the writing processes, but also found that written products transformed into new kinds

of text. An analysis of the created text showed similarities to writing styles often seen in text messages composed by teenagers (Merchant, 2003). Abbreviations and acronyms were prevalent. The use of such coding is not a new phenomenon to written form. Short hand and private codes have been used in communication and is accepted as an alternative form of the intended word (Herring, 2004).

When working towards a completed project such as the creation of PowerPoint slides to be shared with a targeted audience, Burnett et al. (2006) found that the children were highly interested in creating multimodal texts which included "their own drawings, digital photographs and images from the internet cartoons and clipart" (p. 20). Particular attention was also given to the ways children went about choosing which images they wanted to use and to what new meaning was attached to the selected images (p. 21). Similarly, an ethnographic study conducted by Pellettier, Reeve, and Halewood (2006) found that computers could support kindergarten children in building knowledge rather than just using computers to express pre-existing knowledge in story writing activities. Scardamalia and Bereiter (2003) believed that online environments with initial adult guidance could offer opportunities for collaboration and problem solving for young children.

Children's Perceptions of Digital Texts

The qualitative study conducted by Brunett et al. (2006) informally interviewed children and found that the communicative uses of both email and PowerPoint were considered as literacy since the specified curriculum did not incorporate these mediums. The children expressed increased confidence in their ability to use the computer and

found that it was easier to create texts for purposeful communication with an audience that would respond (p. 25). Another study by Stevensen (2008) found that children preferred to use text messaging over other writing mediums when communicating with friends. Digital texts allow children to communicate freely without concern for grammar and spelling.

Direction for Future Literacy Research

While the study conducted by Brunett et al. (2006) added to the literature rich descriptions of how new technology transformed practices in two primary classrooms of older children, there is still an urgent need of further exploration with younger students. Brunett et al. (2006) suggest that research should focus on "the physical demands of onscreen writing, the writing process in relation to the production of digital texts, and the combination of verbal and visual material in onscreen writing" (p. 25). Brunett et al. (2006) also argued that "there is a need to incorporate new literacies into classroom life and that this involves changing views of text production and consumption and, in fact, the very nature of literacy" (p. 25). The research findings of Brunett et al. (2006) suggested that email partnerships are valuable because they provide an experience in purposeful exchange of ideas and thoughts. With email exchanges, children were motivated to communicate and were willing to perfect written text produced for their intended audience (p. 25). As mentioned earlier in chapter 1, these technology skills and understanding are often ignored in both literacy policy and practice, thus confining the role of ICT to a typing tool to produce traditional literacy skills (Andrews, 2004).

The findings of Brunett et al., (2006) confirm the need for "rethinking literacy in ways that accommodate the new ways in which meaning is created and understood" (p. 26). It is not enough just to give a new definition to literacy; the very nature of teaching and learning must also transform. New environments for learning and opportunities to communicate must be offered to students. The new environments should address the need to accommodate the wide distribution of technology skills such as typing, onscreen navigation, and the use of pointing devices (Facer et al., 2003; Tyner, 2003). There is a need to "ensure that all children acquire such basic skills so that none are to be excluded from the new opportunities offered by changes in the technology of writing" (Brunett et al., 2006, p. 26). Stephen & Plowman (2008) contend that learning with ICT should "involve three interacting components: the child, the technology, and the practitioner" (p. 639). Such a model allows the children to be active agents in learning bringing their own learning styles, preferences, and interests to their experiences (Stephen, 2003). Definitions of ICT should also include technologies which cater to the preschooler's needs such as digital cameras, video cameras, dance mats, electronic keyboards, mobile phones, and interactive toys (Plowman & Stephen, 2006).

Growing Up Digital

In 1997, Don Tapscott described youth growing up digital in his book at a time when the Web had only just arrived meaning that there was no Google, Facebook, Twitter, or the like. Eleven years later high speed internet and mobile technologies changed the world again for children. Tapscott (2009) extended his earlier study of the

youth growing up digital with his newest book describing what it was like for those children aged 20 years or younger to grow up digital.

Tapscott (2009) contends that "for the first time in history, children (the net generation) are more comfortable, knowledgeable, and literate than their parents with an innovation central to society" (p. 2). Critics of the net generation are concerned with the loss of social skills and interest in healthy habits to hours spent on the internet (Bauerlein, 2001; Bly, 1997). They are equally concerned with the online bullying and preference for violent content media. Between 2006 and 2008, Tapscott (2009) conducted a $4 million dollar study of the net generation to explore what is the truth about this unique generation of youth who has grown up digital.

With the help of his company, Tapscott interviewed 6,000 Net Generation youths from around the world. In addition, leadership persons in education, science, business, and government contributed their views of the net generation. The study found that the net generation valued both freedom to work and freedom of choice in how to carry out the work. The net generation is more interested in customizing things and collaborating ideas through open dialogues rather than lectures. The net generation will question everything and insist on integrity. They are accustomed to speed and want work and school to be challenging in a fun way (Tapscott, 2009, pp. 6-7). The Net Generation often understands new technologies better than their parents and educators. Tapscott (2009) believes that understanding rather than scrutinizing the ways of the Net Generation holds the key to unlocking futures in both education and business.

The Net Generation by instinct turns to the Internet to "communicate, understand, learn, find, and do many things" (Tapscott, 2009, p. 9). According to Tapscott, the net generation not only uses technology differently, but also behaves differently. They prefer to text message rather than email one another. In fact, teenagers and other members of the Net Generation prefer to text one another rather than carry on a conversation in the presence of others. The Net Generation assimilates technology whereas adults must accommodate it (p. 18). Alan Kay (2009) argued that technology is only considered technology for those people who are born before it was invented (p. 19). Overall, the Net Generation embraces technology for what it enables them to do differently. They are not concerned with how it all works—they are just interested in using it.

Stevensen (2008) conducted a qualitative study which explored interest and the everyday uses of technologies at home and school. Her study was focused on the practices of technology rather than on equitable access. Findings revealed that children's time spent using technology at school was sparse and less interesting than technology use at home. ICT use at school was generally work-related and teacher directed.

What about the generation of younger children growing up digital? What can be said of their preferences for communicating, understanding, learning, and doing things? How do they construct their language and behaviors when given the opportunity to freely explore new literacies forms? The research is limited and there is a need to observe children in an environment designed with multiliteracies that are readily accessible and offer open-ended possibilities.

Multiliteracies: Concepts, Policies, and Practices

Digital literacy has only recently been viewed in its plural form of multiliteracies in the literature (Anderson & Henderson, 2004; Ba, Tally, & Tiskalas, 2002; Bawden, 2001; Doering et al., 2007; Myers, 2006; Snyder, 1999; Thomas, 2004). Lankshear and Knobel (2008) support the plural view of multiliteracies since there are many of them and they are significantly diverse in form and context (p. 2). Paul Gister (1997) argued that digital literacy was more about the mastering of concepts than keystrokes. Lanham (1995) offered an operational definition of literacy that went beyond the ability to read and write to include the ability to understand information presented in varied forms (p. 198). Operational definitions are concerned with specific skills and demonstrations that are deemed necessary to be considered digitally literate. The No Child Left Behind's "Enhancing Education Through Technology Act" (2001) is based on an operational definition of literacy and created standards by which all children must achieve by the 8th grade to be considered digitally literate. From a socio-cultural perspective, literacy is situated in social practices (Gee, Hull & Lankshear, 1996, p. 1).

Child Attitudes and Perceptions of Multiliteracies

Many decisions regarding the inclusion and implementation of ICT are made based on adult conceptualizations rather than the attitudes and perceptions of the children who are directly impacted by decisions made (Facer, 2002). Few studies have considered what technology means to the individual child. A study conducted by Stevensen (2008) interviewed children in-depth to explore their everyday use and perceptions of ICT. Children expressed the desire to use technology more at school than they were allowed.

They also wanted more opportunity to use technology to explore their own ideas and to create their own publications rather than just completing teacher-dictated assignments. Children also compared their home and school experiences with ICT. At home, the children could choose when and how they wanted to engage with technology. Social networking and sharing of projects were a part of their home experience with ICT. The same was not true with the school experience. For this reason, some students preferred not to use the computer at school so that they could participate in other activities that allowed them to share with friends.

The interviews conducted with the children by Stevensen (2008) also revealed that children preferred to communicate with one another through text messaging rather than email since their friends instantly respond to a received text message and rarely check personal emails. The children of this study were purposefully selected from privileged homes well equipped with technology to focus on the practices of ICT. The establishment of equal access allowed the study to explore how the children chose to use or not use the technology. It was found that ICT use at home was shaped by meanings attached socially (Bingham, Valentine, and Holloway, 1999).

Stevensen's study (2008) found that individuals with access to technology only perceived it useful when it was made relevant to them. There are times during the day that they choose not to use technology when it does not serve their need (p. 127). This study showed that children with ready access to technology will only choose technology when it is made relevant or allows them to socially connect to others. These findings challenge the assumption that children as digital natives naturally will choose to use

technology when provided access to it and raise questions to the benefits and limitations of multiliteracies environments (Selwyn, 2006). Again, research on relevant technology use for young children is limited. Research supports that the early years is a time when social development progresses through play. Can the same be said of technology? Is technology only relevant to the young child when the activity is play-oriented or socially networked? What are the benefits and limitations of technology use in environments of young children?

Benefits and Limitations of Multiliteracies Environments for Young Children

Some early childhood educators and advocates are concerned with how technology impacts traditional literacy development and opportunities to learn through imaginative play (Lankshear & Knobel, 2002; Christensen & Kelly, 2003; Miller, 2005). There is concern that children are less interested in paper and pencil literacy activities and interacting socially with others when technology is offered as a choice in the learning environment.

Jane Healy (1998) voiced concern with the advantages and disadvantages of computer use on the healthy and creative development of young children. She cautioned parents and teachers alike to consider the effects of screen-based learning rather than blindly trust the message put out by political and commercial advocates of technology that "technology will improve the quality of learning and prepare our young for the future" (p. 18). Healy (1998) advocated the development of a technology plan for computer use in the early years which addresses many issues early childhood advocates have with children using technology. The biggest concerns are with the age when

children should start using computers and how they should use them. Since children are still developing their skills the types of support needed to support learning endeavors with technology raise questions among parents and teachers. Then there is concern with choosing age appropriate programs which are best for children and do not have a harmful affect on children's social, physical, emotional, creative, or physical development in any way.

A longitudinal study conducted by Straker, Polluck, Zubrick, and Kurinczuks (2006) analyzed health risks associated with computer use and found that only 1% of the children using computers experienced musculoskeletal and vision problems. Results also showed that the availability of computers and their given sedentary nature still constitutes public health concern and the need to continue to monitor children's use of computers (p. 343). Many of these studies mentioned were not based on newer technologies available which allow children to be mobile when in use and which foster creativity, problem-solving, and social interactions through interactive interfaces.

Policy-makers, educators, and parents continue to debate whether or not new technologies should change the way children are being educated. They agree that education should prepare children for life and learning in an unpredictable future (Healy, 1998, pp. 18-19). Based on the discussed concerns, Healy (1998) expressed the need for objective, long-term research based on the personal and cultural implications of new technologies that will offer developmentally appropriate guidelines for the integration of technologies (p. 27).

Since Healy (1998) first published her concerns with technology in the early years in her book, *Failure to Connect,* technology advancements have made computer usage more user-friendly and affordable. Adaptations in the size of computer screens and mouse devices are evidences of the way new technology advancements have addressed prior concerns with the physical discomfort children initially experienced with technologies designed for adult use. Touch screen innovations have accommodated the younger child by eliminating keyboard navigational skills. While all of these adaptations have been beneficial, Yelland (1999) argued that it is the adult imposing limitations on the effectiveness of a child's play with the computer. Adults need to rethink their views of the computer-child relationship to maximize learning through play with technology. The same is true for those concerned with child development keeping pace with technological advancements. Children accept the emerging technologies as natural changes in their environments and adapt accordingly; whereas, the adults are more reluctant (Gibbons, 2007). However, objective research is still lacking to provide evidence of the advantages technologies offered in the early years have on successful learning in later years.

More recently, Gibbons (2007) critically explored the child's relationship to new technologies. He contended that technology is as much about the tools available as it is about the modes of thinking the tools allow the child to explore. Early childhood education was heavily influenced by Froebel (1886) who saw the purpose of education as an opportunity for children to explore the relationships and uses of objects in the material world (p. 69). Exploration was described as child's play and early childhood education

became marked by the importance of learning through play (Marsh, 2002; Mergen, 1982; Sutton-Smith, 1997). Gibbons (2007) took into consideration the historical views of the importance of play that began with Froebel (1886) when examining the impact of new technologies on the child's early educational experiences (p. 19). In the same way that the printing press impacted child's play and oral traditions of learning by making possible for oral instruction to be recorded and read in print form new technologies have changed forms of learning from paper to screen (p. 25). Fewer educators today raise question of the inclusion of books and writing tools in play-based instruction, yet many continue to debate the inclusion of play-oriented technologies (p. 25).

The inclusion of technology in the preschool environment also raises concern among advocates for developmentally appropriate practice. Eliason and Jenkins (1999) argue that "programs need to adopt teaching practices that adjust to the way young children learn and to appropriate ways of assessing their learning and growth" (p. 2). The individual needs of the developing child must be reflected in instructional decisions and materials included in early childhood education (Eliason & Jenkins, 1999; Bers et al., 2004; Bowman & Beyer, 1994).

In order to address the voiced concerns of early childhood advocates regarding technology and the developing preschool child, it is necessary to move past the idea of simply adding a computer to the classroom (Cohen, 2005). Instead, technology must be used creatively to develop multiliteracies and make available opportunities for collaboration and knowledge building that is not otherwise possible with traditional preschool materials (Plowman & Stephen, 2003; Yelland et. al, 2008). In fact, Papert

(1993) believed that the computer would better prepare the preschool child for school than print-based learning could.

Papert (1993) contended that technologies now can offer "children a transition between preschool learning and true literacy in a way that is more personal, more negotiational, more gradual, and so less precarious than the abrupt transition we now ask children to make as they move from learning through direct experience to using the printed word as the source of important information" (p. 11). In this light, the computer has become developmentally appropriate for educating young children as well as essential for early education (Gibbons, 2007). The computer now can become a learning partner for the child that is open-ended and available at all times. Future research is needed to investigate how computers contribute to thinking about thinking for children as they go about constructing their language and behaviors.

Cognitive Abilities of Preschoolers in the Digital Age

The 4-year-old preschooler seeks to be independent in what he wants to do and in how he wants to do it (Lowe, 2009). Advancements in technology have allowed preschoolers to have more control over their own learning than ever before (Sprenger, 2008, Lowe, 2009). With the initial guidance of a parent, teacher, or experienced peer, preschoolers gradually become independent users of technology and are able to think about choices to be made (Lowe, 2009).

Some early childhood practitioners question the ability of young children to understand and use technology and prefer that the preschool child only play with traditional resources such as sand, water, and blocks" (Lowe, 2009, p. 26). To address

these expressed concerns, Lowe (2009) describes how she and her team incorporated technology into the learning environments at Homerton Children's Center. The first step involved preparing learning environments that fostered independent use of technology and successful use by individual learners. Access to tools and materials were carefully considered and planned. Technology tools were added to various learning areas of the classroom to support independence. The following multiliteracies tools were easily accessible by children and were made available for everyday use:

1. computer and printer/scanner
2. webcam and microphone
3. carefully chosen software
4. Internet access
5. interactive whiteboard
6. digital camera
7. digital movie maker
8. talking photo albums and cards
9. metal detectors
10. programmable toys and remote controls
11. cassette recorder
12. CD player (Lowe, 2009, p. 27).

This range of technology allowed children to "discover the place and purpose for the use of technology in their everyday lives" (p. 27). The skill of independence was achieved

when children were given choices and allowed to use technology tools that matched their own levels of understanding (p. 30).

Lowe (2009) and her team also found that preschoolers felt a sense of accomplishment when they actually printed out a picture created on the computer or a photo taken with the digital camera (p. 31). The addition of technology in role-play areas allowed children to develop play further by imitating adult careers which utilize various forms of technology. Interactive Whiteboards which are set up to be accessed and used by children allow children to create larger digital pictures requiring larger ranges of motion and catering to the young child's need for movement. Digital cameras that were child-sized with one-step button functions were found to be the easiest technology tools for preschoolers to operate and to become independent users of (p. 33).

The children studied by Lowe and her team especially enjoyed creating their own digital movies of friends at play that were later shared with the whole class during group learning (p. 33). The digital movie maker allowed the preschool child to "reflect on their own play and learning" (Lowe, 2009, p. 33). Lowe (2009) also found that children by age four were able to independently use digital cameras, download them to the computer, and print their own photos. Pictures and videos taken by the children themselves can provide insight into their perspectives and preferences (p. 33). Lowe's (2009) study found that children "who were given control over technology, had a deeper understanding of its uses and allowed them to naturally incorporate technology in their play to support other areas of learning in a meaningful way" (p. 37).

Some studies have found that newer technologies have afforded the younger child to grasp more abstract concepts that were previously considered too advanced for them (Yelland, 2005; Resnick, 1998). With technology available today, the young child can reason, engage in collaborative learning, and problem-solve (Liebermann, Bates, and So, 2009). Digital manipulatives are being used to teach advanced concepts through hands-on learning. Studies conducted of young children engaged in open-ended uses of technology found that the children were more motivated to learn and reflective of their own learning than other children who were engaged in more structured computer instruction that offered little user control (McCarrick & Li, 2007; Liebermann, Bates, and So, 2009). Other researchers examining cognitive skills of preschoolers found that children exposed to open-ended learning with multiliteracies tools exhibited skills of abstract thinking, reflective thinking, analyzing and evaluating information (Liebermann, Bates, and So, 2009; Klein, Nir-Gal, & Darom, 2000; Nir-Gal & Klein, 2004; Shute & Miksad, 1997).

Construction of Language and Behaviors

Policy makers have recognized the preschool years as foundational for reading and writing success in later years (Mayer & Ryan, 2007; Adams, Treiman, & Pressley, 1998; Dickinson & Tabors, 2001; Snow, Burns, & Griffin, 1998). They have set standards at state and national levels to support early experiences with print for literacy development. As a result, research has been conducted to increase understanding of literacy development in preschool. Literacy involves both reading and writing; yet the research has focused more on reading readiness than on the early writing experiences of young children (Mayer & Ryan, 2007).

Theorists from the few studies conducted on writing development agree that young children express ideas and prefer to communicate through scribbles and drawings (Freeman & Sanders 1989; McGee & Purcell-Gates 1997). Research findings show that writing development can vary across age spans and that the greatest growth occurs between the ages of three and five when opportunities and resources are provided to cultivate writing (Barnhart & Sulzby 1986; Fox & Saracho 1990; Burns & Casbergue 1992; Whitehurst & Lonigan 1998; Bus et al. 2001). Despite these findings, greater emphasis continues to be placed on reading development rather than writing development in the preschool years. Limited writing experiences are mostly focused on letter formations and letter-sound relationships. From the earliest of times, people communicated through gestures, stories, and drawings. Yet, preschool writing is focused on the conventions of writing rather than the social connection made through the written exchange of ideas. Equally concerning is that writing has not been valued in the same way by parents or teachers. There is a need for research documenting the writing behaviors and development of children to ensure that preschoolers are prepared to become successful writers as well as communicators in a world that is socially networked (Clay, 2001).

Characteristics of Emergent Writers

Walk into any preschool and evidence of pre-reading is everywhere. Environments are labeled with printed signs to encourage the recognition of familiar words. There are reading corners and reading centers with activities focused on building phonemic awareness. Teachers carefully document individual reading benchmarks of the

children to ensure that no child is left behind in reading. There are art materials available for creating books in the writing centers of some classrooms. These materials allow for expression of ideas through drawings and practice with letter formations, but opportunities for writing for social connections beyond this are not evident (Mayer & Ryan 2007).

The majority of preschool instruction is focused on developing book concepts and awareness that printed materials can be read. Children are engaged in whole class readings of enlarged books so that they can interact with the large print of the book as it is read by the teacher. Less time is devoted to whole class or individual instruction in writing. The same is true with the integration of computers in preschool. Computers have been placed in the classroom to support reading development with an emphasis on phonics through skill and drill types of programs rather than for opportunities to express ideas and to connect with others (Barker & Torgeson, 1995; Foster, Erickson, Foster, Brinkman, & Torgeson, 1994; Jones, Torgeson, & Sexton, 1987; Roth & Beck, 1987). These emergent reading activities will continue to take precedence over activities aimed at developing writing as a social process in preschool if there continues to be a gap in the research between early reading development and early writing development.

In an attempt to promote writing development in the early years, a handful of researchers have worked to develop writing skill inventories to inform teachers and parents of the skills young children should acquire before entering kindergarten (Chapman, 1996; Freeman & Sanders, 1989; Fox & Saracho, 1990). Most of these

developed inventories have focused on letter recognition and formation of letters which come much later in emergent writing.

Emergent writing is much more than the ability to correctly form letters and to string them together to form words (Papert 1993; Mayer & Ryan 2007). According to Mayer and Ryan (2007), *emergent writing* means "children begin to understand that writing is a form of communication and their marks on paper convey a message" (p. 35). Papert (1993) went so far as to describe the learning of alphabetic relationships and letter symbols as *letteracy* rather than literacy. He suggested that literacy involved the ability to obtain information and share ideas through the varied forms of communication available to a culture. The emphasis here is on the opportunity and capability for a child to communicate an idea through print rather than an attempt to form letters correctly as practice for later writing.

Learning to write is a social process and writing is developed through the children's observations and interactions with more advanced peers in writing (Teale 1995; Chapman 1996; McGee & Purcell-Gates 1997; Morrow & Sharkey 1999; Schickedanz 1999). This includes communication through technology such as emails, text messaging, instant messaging, tweeting on twitter, and the like. Such opportunities for social writing are sparse in preschool settings with the continued emphasis on reading development and emergent writing checklists that are focused on the conventions of writing rather than on the social characteristics of an emergent writer.

Unlike emergent writing checklists focused on the skills emergent writers possess, The New Zealand Ministry of Education (1992) developed a descriptive list of the

characteristics of emergent writers which focused more on the social process of writing as children develop attitudes towards writing, understandings about writing, and writer behaviors. Though each of these areas of writing development occurs simultaneously; for purposes of clarity, each of the areas will be discussed in isolation.

Children's attitudes toward writing evolve from a playful interest in writing to meaningful expression in own writing to purposeful experiences as a writer. Children's motivation to write is often based on recurring satisfying experiences with their own writing. Confidence is built as children discover that they can share their personal experiences by writing them down for others to see. As emergent writers, children expect writing to be enjoyable and find writing to be rewarding (Matteson & Freeman, 2007).

Like children's attitudes, their understandings about writing also take shape over time. Initially, children come to know and understand that print holds meaning. They observe displayed print in their immediate environment and become aware of how print is interpreted and used by others. Soon after, children make the discovery that both speech and stories can be written down. When others read back their written stories or speech, the children develop an understanding that writing can be read over and over again. Through more exposure and modeling of writing provided by others, children begin to understand that thoughts can be written down without being spoken first. Children realize that thoughts which are written can be shared immediately or at a later time by others. This leads to another new revelation that books are the written thoughts of others that are shared with others. Around this time in writing development, the children are moving from dependency on others to help them write texts to using their own

spelling conventions to create original writings. In advanced stages of writing, children begin to realize that words are always spelled the same.

All while children are developing their attitudes and understandings of writing, they are also developing behaviors as writers (Matteson & Freeman, 2007). The first noticeable writing behavior exhibited in children is their orientation of the page they begin to write. Children begin to develop a preference for the position of the paper. Knowledge of directionality begins to develop and is depicted by the use of spaces between words and writing from left to write across the page while writing flows from the top to the bottom of the page.

Around this same time in their development, children primarily use their own experiences for writing. Topics tend to be egocentric and focused on their own interpretations and feelings of the world. Once children have a sense of directionality and topics of interest for writing, they combine drawings with scribbles to generate and express ideas (Matteson & Freeman, 2007). Children at this stage of writing are able to rally recount their created picture stories and will readily correct others who incorrectly read back their stories. Children are able to answer questions asked by others about their story as well as ask questions about others' stories. This new found ability demonstrates an understanding of the importance of including details in a story. Following a question and answer time about their story, children are likely to refine their writing by adding details. Up to this point children are expressing themselves largely through drawings and scribbles.

With continued modeling of writing and opportunities to explore letter formations, children begin to experiment with letter shapes. They enjoy forming the letters with a variety of mediums. In time, children are able to consistently form letters. During this latter stage of emergent writing, children still begin stories with a picture of what they are interested in writing about. The difference now is that they are able to string familiar letters together to form phonetically spelled words. Children at this stage are not concerned with conventional spelling. Later, they are introduced to the rules of spelling and the conventions of grammar. This is the way children have traditionally experienced literacy before greater emphasis was placed on reading development and before advancements in technology took place and completely transformed the way the world communicates, operates, and learns. There is a need to explore how the social writing characteristics of children have been impacted by advances in information, technology, and communication and meaning-making possibilities.

Multiliteracies and Meaning-Making Possibilities

Early childhood educators no longer question the necessity of expanding literacy to include new literacies but question instead how to adapt and integrate multiple literacies in a way that promotes social development and creates meaning-making possibilities for young children. Research on the full integration of technologies is lacking in early childhood. One of the few studies available, conducted by Wang et al. (2008) explored technology integration and use in a classroom at a university lab school for four and five year old children in a southeastern United States city.

The children of Wang et al. ‘s (2008) studied classroom remained with their two teachers for two years and were supported by two graduate students who assisted in the classroom. The environment was embedded with the following technologies: digital camera, two laptops, desktop computer, digital microscopes, recorders, microphones, and headphones (p. 48). Technology integration was extended beyond the walls of the classroom in order to enhance communication with parents. The class created a Web site which only allowed access to families. Teachers sent emails along with weekly newsletters to keep parents informed and involved. The teachers provided guided interaction to students as students moved from center to center in the classroom. Teachers would guide and assist students with technology or content needs as they arose. Digital cameras were used to document bones discovered in the sand play area. The digital microscope allowed students to examine bone structures up close. Some students used the Kid Pix drawing software to document bones they found. In this example, students are given the choice of media to document their learning. In the multi-media book-making center, children are allowed to create four kinds of books: traditional paper-and-pencil books with drawings and handwritten text; multimedia books containing scanned images of children’s drawings and audio files of the child telling the story; computer printouts of stories typed by the teacher from children’s dictation; and blended stories featuring a combination of child-written text and dictated text written by a teacher on printed digital photographs taken by the child (Wang et al., 2008, p. 49). Children are able to choose the kind of book they prefer to make. In the research center, students use books and the Internet to explore dinosaurs more extensively. The Interactive White Board (IWB)

allows all students interested to engage in the research. Digital cameras were used by teachers of the classroom to document student learning.

Wang et al.'s (2008) study provided an example of how teachers could embed a variety of technologies into the classroom. Findings showed that purposeful learning with technology resulted when technologies encourage "engagement, active learning, creativity, and social interaction" (p. 50). It was also evident that choice of technology was determined by its appropriateness for task and its alignment with teacher's intentional instructional plans. The activities of this Wang et al.'s study were clearly teacher driven and based on a specific theme, thus limiting children from pursuing their own interests and social needs. There remains a need for a study of an environment embedded with technology that allows children to choose how and when to use various forms of technology.

Qualitative Single Case Study Research

This exhaustive literature review supported the need for a study of how children choose to use technology for learning in a prepared environment designed with multiliteracies and that allows the children to freely explore and choose how and when to engage with available technologies. Since my goal was to explore technology integration from the perspective of children, quantitative research designs were ruled out. Qualitative research designs including grounded theory, narrative study, phenomenology, ethnography, and case study (Creswell, 2007, p. 53; Merriam, 2002) were researched and carefully considered for their suitability for answering the research question: how do 4-

year-old children of a public, Montessori preschool designed with multiple forms of technology prefer to use technology for learning.

Grounded theory is conducted when "the researcher attempts to derive a general, abstract theory of process, action, or interaction grounded in the view of participants in a study" (Creswell, 2003). The purpose of this research approach is to generate a theory (Creswell, 2007). Data are constantly reviewed and examined for repeated occurrences eventually leading to the development of a theory (Hatch, 2002). I did not seek to generate a theory based on the findings in the data. For this reason, the grounded theory was not considered appropriate for my study.

A narrative study enables a researcher to tell the chronological life story of a person and relates it to his/her own life experiences (Creswell, 2007). This approach uses stories to describe the experience (Merriam, 2002). Usually, a narrative research design is used to tell the story of one or two individuals. Because I sought to gain the perspectives of three to five children of a public Montessori preschool, the narrative approach was not ideal.

A phenomenological approach was also considered for my study. This approach is appropriate when the research is concerned with describing the human experience of a phenomenon. According to Merriam (2002), the focus of phenomenology studies is "on the essence or structure of an experience" (p. 7). The phenomenology design seeks to describe the lived experience of a whole group of people rather than just an individual or two as in narrative designs (Creswell, 2007; Merriam, 2002). My study involves the study of a current phenomenon. Since the focus of my study is on how children prefer to use

technology for learning rather than on just describing the children's experiences with technology, a phenomenological approach was rejected for my study.

Whenever a study seeks to identify the shared patterns of behavior, beliefs, and language among an entire cultural group, an ethnography study approach is appropriate (Creswell, 2007). Its main purpose is to study human society over an extended period of time yielding findings that inform readers how to behave when they are present in the culture of study (Merriam, 2002). Ethnographic studies utilize multiple techniques such as participant observation, field notes, interviews, and artifacts to describe the shared culture of a group (Creswell, 2007; Hatch, 2002). Since I intended to look at a smaller group within the larger group during a bounded time frame, the ethnographic research design was rejected.

A case study approach also utilizes similar ethnographic techniques but its emphasis is on how a contemporary phenomenon is perceived by a particular group. Since I sought to explore specifically how 4-year-old children of a Montessori preschool designed with technology prefer to use technology for learning, a qualitative single case study is the preferred approach for this study.

A case study approach best suits this study since it allows me to study a phenomenon within a bounded system (Creswell, 2007; Merriam, 2002; Yin, 2009). I investigated a bounded system, a preschool Montessori classroom in a specific location during a specific time frame with specifically selected participants who meet specified criterion (Yin, 2009; Merriam, 1988). My case study focused on the contemporary sides of the phenomenon regarding the integration of multiliteracies in preschool

environments. The case study research method is a strategic qualitative research methodology. The case studies research method is often criticized for its lack of scientific rigor and its inability to generalize its findings; however, the use of multiple data collection strategies establishes triangulation and strengthens and confirms case study results (Noor, 2008). More recently, researchers are recognizing the appropriateness of the case study research method when dealing with a "process or a complex real-life activities in great-depth" (p. 1602). Based on the nature of my study which was to provide a rich account of the preferred ways 4-year-old preschool children in a public, Montessori classroom designed with multiple forms of technology preferred to use technology for learning, the case study research method was selected.

Summary of Literature Review

The list of social characteristics of emergent writers generated by The New Zealand Ministry of Education (1992) combined with the new literacies framework developed by The New London Group (1996) and the Montessori method (1972) will provide a lens for a study of how young children prefer to use technology for learning in an environment designed with multiple forms of technology. By design and practice, the Montessori classroom will provide an ideal model for ethnographic research of the writing behaviors and interactions of children in an environment designed with multiliteracies. The prepared Montessori environment would include only the technology tools which align with the human tendencies and sensitive periods described earlier which would aide writing as a social process.

The research design that best suits a study of a phenomenon shared by a particular group of people bounded by time and space is a qualitative single case study (Creswell, 2007; Maxwell, 2008; Merriam, 1988, Yin, 2009; Stake, 1995). A single case study will extend the previously discussed existing studies on literacy development and the inclusion of technology in preschool by providing an in-depth description of the ways 4-year-old preschool children of a public Montessori preschool designed with multiple forms of technology located in a mid-South state prefer to use technology for learning. Chapter 3 which follows describes in-depth this qualitative single case study including descriptions of data collection and analysis.

Chapter 3: Research Method

Research Method

The work of the New London Group opened dialogue on learning through multiple forms of technology and the design of social futures among policy-makers and educators. As a result, changes in practice have been noticed and researched at the elementary, high school, and college levels; however, preschool practice remains focused on traditional teachings of literacy and include technology to reinforce traditionally taught skills. There is limited research on multiliteracies practice and the use of multiple technology tools in the early years. The few researchers examining this area (Burnett, Dickinson, Myers, and Merchant, 2006; McPake, Stephen, and Plowman, 2007; Merchant, 2003; Parette, Hourcade, Dinelli, and Boeckmann, 2009; Plowman & Stephen, 2006; Shuler, 2009; Stephen & Plowman, 2008), have focused on how to fit technology into pre-existing literacy practices rather than on how to transform learning altogether with the inclusion of multiple forms of technology. As a result, technology tools are used sparingly to supplement traditional ideas rather than made readily available for children to choose which tools to use when and for what purpose.

This chapter describes the methods that were used to gather and analyze data in my qualitative single case study that addressed the need for research that studies children in-depth as subjects rather than objects to richly describe their preferred uses for technology for learning at school. This selected method of study extended existing studies on preschool learning and the inclusion of technology in early childhood

education by providing a detailed account of the ways 4-year-old children in a public Montessori preschool designed with multiple forms of technology located in a mid-South state preferred to use technology for learning at school. A group of 4-year-old children in a single public Montessori preschool classroom of twenty children represented *the case within the case* for this single case study to allow for deeper understanding of how this specific group of children preferred to use technology.

Field observations allowed me to focus more closely on the environmental design itself and how it allows children to access various forms of technology to express learning and to make new meanings. The environment designed with multiple forms of technology was closely observed as it provided multiple ways for children to learn in a Montessori classroom. Classroom observations of the ways children chose to use technology tools for learning was analyzed to determine how interest in learning activities was shaped by the design of the environment over the specified 4-week time frame of the study. Actual conversations between children and self-talk by children while working were audio taped with the use of the SmartPen as children wrote in their journals using the SmartPen. The SmartPen actually records each word spoken with each stroke the child makes with the pen. The participant observation method allowed for the inclusion of multiple research methods including: teacher interviews, observations, field notes, video recordings, digital pictures, and student artifacts (Yin, 2009; Murchison, 2010).

The qualitative single case study research method supported my study's purpose to explore how 4-year-old children in a public Montessori preschool designed with

multiple forms of technology located in a mid-South state prefer to use technology for learning at school. The single case study method allowed me to richly describe the ways the designed environment with multiple forms of technology fostered student interest in the use of multiple technology tools such as digital cameras, flip camera recorders, and SmartPens through observations, video recordings, multiliteracies tools observation chart, and analysis of artifacts generated during the study period. Generated artifacts from the study included visual representations and descriptions of learning experiences between the 4-year-old participants and other children of the bounded classroom including digital photos, story exchanges while writing in SmartPen journals, and student-created videos. The flip-camera provided an authentic source of video documentation controlled by the child that was instrumental documenting the technology preferences of the children (Yelland, Lee, O'Rourke, and Harrison, 2008).

Finally, multiple sources of data were used throughout the research design to allow for triangulation of the data and to strengthen the validity of this study (Creswell, 2007; Yin, 2009; Merriam, 1988).

Research Design

The problem my study addressed was the need to better understand the impact of multiple forms of technology on the way preschool children preferred to learn at school. Several studies have been conducted on literacy practices and the inclusion of technology to improve traditional literacy skills at the elementary, middle school, high school, and collegiate levels; however, little is known regarding the phenomenon of environments designed with multiple forms of technology and multiliteracies strategies at the early

childhood level given that preschool learning is often designed around traditional forms of reading and writing and is teacher-directed rather than driven by the children themselves (Lankshear & Knobel, 2003; Street, 1995; Warschauer & Ware, 2009; Dalton & Proctor, 2009). Even fewer researchers have looked at children's preferred uses for technology in the early years. Most researchers have focused on integrating technology according to teacher preferences and curriculum instructional goals (Stevensen, 2008; Wang et al., 2008; Burnett, Dickinson, Myers, and Merchant, 2006; McPake, Stephen, and Plowman, 2007; Merchant, 2003; Parette, Hourcade, Dinelli, and Boeckmann, 2009; Plowman & Stephen, 2006; Shuler, 2009; Stephen & Plowman, 2008). My study addressed the need to research how 4-year-old children preferred to use technology for learning at school. This investigation contributed to the body of literature pertaining to learning in preschool and the inclusion of technology by richly describing how a specific group of 4-year-old preschool children preferred to use technology for learning at school and offered a model for designing preschool environments with multiple forms of technology that can be used in future studies of the ways children of the digital age learn at school.

I did not seek to quantify the changes in student learning or to establish a causal relationship between environments designed with multiple forms of technology and student learning, but rather my intent was to gain insight into the learning practices and preferences of children in an environment designed with multiple forms of technology. Therefore, quantitative research designs were not considered for my study. The inclusion of multiple forms of technology and multiliteracies strategies in preschool environments

is still in the formative stage and has yet to be explored in-depth in early childhood, necessitating a qualitative approach. (Creswell, 2007). Several qualitative research approaches were considered for my study including case phenomenology, narrative, grounded theory, ethnography, and case study (Creswell, 2007; Merriam, 2007). An ethnographic approach was initially considered but later rejected since my study is bounded by time, place, location, and people to explore the practices and behaviors of children with multiliteracies. My goal was not to describe the lived experience of a given culture, therefore a narrative study was not appropriate. Grounded theory was also ruled out for my study since I sought to study behaviors and interactions of children as they construct language rather than to develop a theory of language development. Usually, a narrative research design is used to tell the story of one or two individuals. Because I sought to describe in-depth the perspectives of a specific group of children of a public Montessori preschool, the narrative approach was not ideal.

A phenomenological approach was also considered for my study. This approach is appropriate when the research is concerned with describing the human experience of a phenomenon. According to Merriam (2002), the focus of phenomenology studies is "on the essence or structure of an experience" (p. 7). The phenomenology design seeks to describe the lived experience of a whole group of people rather than just an individual or two as in narrative designs (Creswell, 2007; Merriam, 2002). My study does study a current phenomenon. Since the focus of my study was on the ways a smaller, specified group of children prefer to use technology for learning rather than of the whole group of people using technology, a phenomenological approach was rejected for my study.

The case study research method is a strategic qualitative research methodology that specifically studies an isolated case to increase understanding of a contemporary phenomenon. More recently, researchers recognize the appropriateness of the case study research method when dealing with a "process or a complex real-life activities in great-depth" (p. 1602). Based on the nature of my study which was to provide a rich account of the ways 4-year-old preschool children in a Montessori classroom designed with multiple forms of technology preferred to use technology for learning, the case study research method was selected for my study.

I employed several sources of evidence including teacher interviews, observations, field notes, video recordings, and artifacts (Yin, 2009; Stake, 1995; Merriam, 1988). Interviews with the classroom teacher were conducted in person at the beginning and end of the study for comparison of her perceptions of how children preferred to use technology for learning and of how the designed environment with multiple forms of technology tools fostered student interest in learning activities. These interviews were audio-taped and transcribed using the SmartPen and NVivo 9 data analysis program. I conducted four 2-hour classroom observations of the group of 4-year-old children using multiple forms of technology tools. Fieldnotes were taken using a SmartPen during observations to ensure that details are not missed. Video-recordings with the Flip-camera and audiotaped recordings with the SmartPen created by the 4-year-old children helped to describe more accurately which technology tools were preferred by the children to accomplish learning tasks. Artifacts generated during the course of the 4-

week study were examined (Appendix G). These sources of data were used to answer the study's three research questions:

1. In what ways do children use technology to create meaning in an environment designed with multiple forms of technology?
2. What are the ways preschool children prefer to use technology for learning in an environment designed with multiple forms of technology?
3. What impact does an environment designed with multiple forms of technology have on student interest in learning activities?

Single Case Study Method

Qualitative single case study is a methodology that allowed me to see and observe the ways children learn directly (Stake, 1995; Merriam, 1988; Yin, 2009). I relied on myself as the primary research instrument and my fieldnotes as a primary source of data collection (Merriam, 1988). While in the field, I employed multiple fieldwork techniques to document the preferred uses of technology among participants. The exploration of how children prefer to use technology tools for learning in an environment designed with multiple forms of technology and multiliteracies strategies is still in the conceptual stage and is yet to be fully explored. While other qualitative research methods also employ case study techniques, the single case study approach was preferred for my study in order to gain new insight on learning with multiple forms of technology from the selected specific group of 4-year-old children and to gain a deeper understanding of the ways children prefer to learn with technology that otherwise would not be readily obtainable through relatively detached approaches such as surveys and observations (Yin, 2009; Merriam,

1988; Stake, 1995, Murchison, 2010). For this reason, my study was well suited for qualitative single case study research because I sought to view preschool learning with technology from the perspective of the 4-year-old children.

In order to create a detailed description of the case under study, I employed all of my senses during observations. I spent four weeks in one public Montessori preschool classroom personally collecting and recording data through teacher interviews, observations, student created video journals, and collected artifacts generated by the students during the 4-week study period. Throughout data collection, I examined the produced work of the children such as stories, paintings, videos, and digital photographs.

The purpose of this study was to provide an in-depth, detailed description of how 4-year-old children of a multi-age public Montessori preschool designed with multiple forms of technology located in a mid-South state preferred to use technology for learning at school. I also sought to richly describe the ways the designed environment with multiple forms of technology fostered student interest in learning and what learning connections were made while using such tools as the digital camera, flip camera recorder, and SmartPen in the classroom. The variety of data collected added depth to my investigation and added to the quality of the single case study (Creswell, 2007; Yin, 2009). I collected as much detailed information as possible from multiple sources of evidence to counterbalance questions of objectivity and validity in the research (Patton, 2002; Maxwell, 2005; Merriam, 1988). Data in my single case study were collected from multiple sources across specified times and dates and used member checking when possible to establish triangulation of analysis. Sources of evidence for my study included

face-to-face teacher interviews, observations, field notes, student-created video recordings, classroom website postings by child participants, and student generated artifacts.

The Role of the Researcher

As a case study researcher, I assumed the roles of teacher, observer, and interviewer in my study and gave emphasis to each role as was appropriate to richly describe the case (Stake, 1995). For the readers of my study, I served in the role of a teacher, trying to teach them about the case through a rich account of the phenomenon studied. A detailed description of the context of my study helped readers gain a sense of "being there" and increased their understanding of how and when children used technology in the preschool classroom. I observed and recorded the ways children chose to use technology to accomplish learning tasks to create a holistic picture of how and when children preferred to use technology. I conducted two open-ended interviews with the teacher participant to give her the opportunity to share her observations and thoughts regarding the children's preferences for technology use in the classroom. During the interviews, I took on the role of a listener and let the participant do most of the talking. Interview guides (Appendices H & I) were used to provide an overall plan for the interview sessions and to ensure topics of interest were covered.

Children are more likely to grant the researcher access to their feelings and interests if she befriends them first (Liewellyn, 1980; Knapp & Knapp, 1976). Although I did not interact with the students during the 4-week study, I needed to initially interact with the children in order to introduce them to the study and to explain my role as a

researcher in the classroom. A puppet show during the community group share time was utilized to introduce the children to the researcher and my study (Appendix E). Following the puppet show, I did not interact with the students; I simply observed. Through direct observation, I was able to create detailed field notes of the children's experiences with technology; allowing a more accurate interpretation of the account to be described in the case study.

Aside from assuming an observant role in the classroom, I was aware of my own biases and opinions that may have led to assumptions about the world of childhood. I am a certified Montessori Teacher who gained the trust of the children through my knowledge of the Montessori method and materials. Since very little research has been conducted with technology in Montessori primary classrooms, I brought no pre-conceived ideas on what the children will prefer. I did not assume that my social meanings were the same as the social meanings of the children (Fine & Sandstrom, 1988, p. 34). To avoid assumptions such as these, I used bracketing in my field notes to separate what the I understood the situation to be and what the situation actually meant for the children (p. 35).

Another important role that I took as a qualitative researcher was that of a knowledge expert in the topic of study. Knowing both Montessori and multiliteracies theories in-depth enabled me to make more accurate interpretations and identify contradictions regarding the evidence (Hatch, 2003, p. 61). For my study, I explored multiliteracies development as well as technology integration in early childhood education through a comprehensive literature review. As for the Montessori method

already used for instruction in the classroom to be studied, I was able to bring to the study my expertise in the Montessori method as a certified practicing Montessori teacher and a University Montessori Teacher trainer.

Lastly, and most importantly I was consciously aware of any potential biases that I might bring to the study that could impact the outcome of the study (Merriam, 2002; Hatch, 2002). I used the technique of memoing and bracketing in my field notes to track my own opinions and keep them separate from actual data. My bias included a genuine interest in multiple forms of technology and multiliteracies strategies applied to a Montessori environment that derived from my personal background in Montessori and my heightened interest in how technology can be used better in early childhood environments. I came to this case study with a sincere interest in learning how and when the young children prefer to use technology for learning at school and with a commitment to put aside any preconceived ideas or assumptions regarding the use of technology in the Montessori classroom or by children of this age. I was interested in gaining deeper insight into the preferred ways children use technology when granted freedom of choice and ready access to multiple technology tools.

Context of the Study

My study took place in one mid-South, public, multi-aged preschool Montessori classroom. The school was established in 1997 serving 474 students preschool through fourth grade in a spacious 78,100 square foot, two story brick building nestled on a hilly lot directly across from the neighborhood park and community center. Upstairs there are 11 elementary classrooms with multi-aged students first through third grade and three

classrooms of fourth grade students only. Downstairs, there are 12 primary classrooms with multi-aged preschool through kindergarten students. The primary classrooms have two adults who work with the children; a state certified teacher who is trained in the Montessori Method and an assistant who is neither state certified or Montessori trained. Additionally, there are special area teachers for art, library, physical education, reading, music, special education, math coach, school counselor, and strings.

Keeping with the Montessori curriculum, the primary classrooms offer instruction in Practical Life, Sensorial, Language, Mathematics, and Cultural areas. Practical Life activities enhance the development of task organization and cognitive order through care of self, care of the environment, exercises of grace and courtesies (manners), and coordination of movement. The Sensorial materials of the classroom enables the child to order, classify, and describe sensory impressions in relation to length, width, temperature, mass, and color. Language materials are made available to cultivate oral language and written expression. Writing is encouraged in early lessons which later lead to reading for the young child. The curriculum promotes writing before reading. Mathematic materials are concrete and move towards abstraction as children move from counting objects through manipulation to the internalization of mathematical operations. Cultural materials include geography maps and artifacts to explore from around the globe. There are also materials which provide the child open-ended opportunities to explore the arts and music.

In the Montessori preschool classroom, children are free to choose their own work daily during a 3-hour uninterrupted work cycle. During this time, children are allowed to work with any of the materials available in the classroom environment whenever they

like and for as long as they like following a formal lesson with the materials given by the classroom teacher. The teacher is both state certified and trained in the Montessori Method. The teacher assumes a role that guides rather than leads the learning of the children. Throughout the morning, she gives individual lessons to students with traditional Montessori materials and with technology tools while other students choose their own work. It is the prepared environment that offers the child endless opportunities for discovery and learning. A second adult is available to the children and only intervenes when asked for assistance by the children or the teacher; her main task is to prepare and maintain the environment. The tone of the classroom is one of peace and calmness. Children are taught to move carefully and respectfully through the environment. There is a quiet buzz of communication heard as the children freely go about their work and interact with one another.

The school day begins at 7:45 am and ends at 3:00 pm. Busing is not available for students attending a magnet school; therefore, parents must provide transportation to and from school for their child. Preschool students must be walked to the classroom and signed-in and out daily. Before care and aftercare school programs are available for families needing extended hours of care. Breakfast is provided for most students under the Title 1 program in place at the school. Over 60% of the student population qualifies to receive free lunch. Whether children are walked to the classroom by a parent or come to the classroom after eating breakfast in the cafeteria, their day begins with a 2 ½ hour uninterrupted work cycle. Around 10:35 am, the teacher softly rings a bell once and waits for all students to be still for her message. At this time, the teacher thanks the children for

their concentrated work and invites them to join her for community group time after putting their work away. Community group time usually lasts for 20 minutes and includes calendar activities, songs, science experiments, and big book stories. Children sit together in a circle and learning is teacher-directed during this group instructional time. A brief restroom break and opportunity to wash hands for lunch follows community time and is supervised by the classroom assistant.

The class walks to the cafeteria for lunch at 10:55 and eat with other classrooms in a spacious dining room from 10:55 to 11:25 am. When children return to the classroom, they prepare for outside play by changing into outside shoes and jackets and using the restroom if needed. During this transitional time, the teacher engages students in songs, flash-card sound activities, CD with books, or internet learning on the projector board. From 11:45 to 12:15 children enjoy outdoor recess on a playground located just outside the classroom. The outdoor environment includes slides, climbing structures, and outdoor flower boxes. Three primary classrooms share a recess time slot. Following recess, the preschool children use the restroom and carry their rest mats to the classroom next door for nap. The classroom assistant stays with them and supervises the napping room.

The kindergarten students come in from recess with the classroom teacher and begin a concentrated work time in reading and math until 1:00. From 1:00-2:00, kindergarten students leave the classroom for classes in art, music, physical education, library, and computers with specialty area teachers. During this hour, the classroom

teacher has an interrupted planning period. Kindergarten students return from specialty classes for a 45 minute work session.

At 2:45 preschool children return to the classroom and join the teacher and kindergarten students for closing circle. Closing circle time includes a review of morning learning, songs, and share time. Dismissal begins at 3:00. Some children are escorted to fun company by the classroom assistant. The classroom teacher remains with other students waiting for parents to come and sign-out children from the classroom.

My study included 4-year-old children enrolled in one of ten preschool classrooms at the public Montessori school. To conduct studies in the public school system, the following actions were required and were taken in order to obtain permission to conduct the study. First, the research coordinator for the public school system was contacted through an introduction letter describing the intent of the study which also included a copy of my approved proposal from Walden University. Upon approval from the research coordinator, a face-to-face meeting was set up with the principal and assistant principal of the school. During this meeting, the study was explained fully including how and when data would be collected and analyzed. Dialogue included a description of my role as a researcher and my intention to protect the rights of the participants.

With approval from the research coordinator and principal, a teacher consent letter including an introduction to the study and a detailed description of the what the study requires of the teacher was sent to the classroom teacher for her consideration to participate. Following the letter, a meeting was set up with the classroom teacher to

further explain the study and to obtain her permission to conduct the study in her classroom with her students. Documentations of permission to conduct the study granted by the public school research coordinator, principal of the school, and classroom teacher are included in the Appendix of my study.

To create a working relationship with the teacher of the classroom studied, I met one on one with the teacher to give the teacher opportunities to ask questions regarding multiliteracies and my study itself. To establish rapport with the parents of the child participants, I held an informational meeting allowing parents to ask any questions they had regarding my study. A home packet describing the study to parents and explaining how child participants will be selected and studied was sent home to parents who were not able to attend the parent informational meeting. Additionally, I created and posted a video clip explaining my study and my role as a researcher in the classroom to the secured classroom website for viewing by parents who could not attend the informational meeting and/or for those who wanted to hear the information again.

Population and Sample

Two levels of sampling were used in my case study. First *the case* was selected using purposeful sampling. I selected the public, multi-age Montessori preschool located in a mid-South state to make up the case of my study which provided the richest information on preferences of technology use by children. All students ranging in age from 3-6 of this selected preschool classroom made up the case of my study. Secondly, purposeful sampling occurred *within* the case to narrow the sample further to ensure participants selected and observed met the specified criterion for the case study: attended

a Montessori preschool for at least two years, typical in both cognitive and physical development, four years of age, and use technology at home. The names of all possible participants were obtained from a spreadsheet created by the classroom teacher based on her own student records kept, classroom observations conducted, and personal involvement in the subjects studied. The participant information obtained from the classroom teacher was downloaded, coded, and run through NVivo 9, a qualitative data analysis program, to determine the participants who met the study's criteria. The result provided me with five participants: Melvin, Adeline, Kyra, Ceiley, and Mia who met the study's criteria and who would best build the case under study.

The sample *within* this case specifically focused on five 4-year-old students who exhibited typical cognitive and physical development (students without learning or physical disabilities) who were not in their first year of preschool and had experienced various technologies in the home. Purposeful sampling was used to select participants in order to "inform an understanding of the research problem and central phenomenon in the study" (Creswell, 2007, p. 125). Purposeful sampling was appropriate for my case study because representativeness is not a primary objective (Yin, 2009; Stake, 1995) and the site of this study was selected because of its likelihood to generate important data regarding language construction in an environment designed with multiple forms of technology. Another factor influencing the site selection for my study was the ease of access to do the research at the site.

This number of participants for my study (five children) was justifiable because the goal of case study research is to provide a rich account of a phenomenon that would

yield the most significant information on the topic being studied (Goodwin & Goodwin, 1996; Merriam, 1988) rather than to provide results that could be generalized to larger populations. A larger sample than three to five participating children would not have allowed for the desired depth of inquiry that was necessary to fully describe the ways children preferred to use technology for learning at school. A smaller sample than three to five participants would not have provided the desired holistic perspective of the learning preferences of the specified group of children and would not have allowed for the desired depth of study that was necessary to fully describe the multiple ways 4-year-old children preferred to use technology for learning at school.

Ethical Protection of Participants

As a qualitative researcher, I strategically planned for the ethical protection of participants. Extra precaution was exercised with my study that involved child participants who were an especially vulnerable population (Creswell, 2007, Hatch, 2002). The School District Research Team reviewed and approved my study following University Committee Approval. Prior to contacting potential participants or collecting data, I obtained approval from the Institutional Review Board (IRB) at Walden University to conduct my study (IRB Approval # 05-05-11-0136923).

To ensure the protection of the participants involved in my study, a principal consent form, a teacher consent form, a parental consent form was obtained following IRB approval. Both the principal and classroom teacher met separately with me to have the opportunity to ask specific questions and concerns with the study. Each were informed of the data collection period and of what would be expected of them during the

conducted study. A copy of consent forms obtained from the principal and the classroom teacher are included in the Appendix (A & C). A parent session was held for parents of the child participants prior to my study to explain the researcher's role in the classroom, the purpose of the study, procedures of my study, and the risks and benefits associated with the project will be explained. Parents were reassured that choosing to participate or not participate in my study would not put their child at any disadvantage from those who chose to participate. Parents were also reminded that participation in my study was voluntary and that they could withdraw from the study at any time. All names of participants were kept confidential. Parental consent allowed for artifacts produced by their child to be included in my study under a pseudonym. The parent session concluded with a request for the consenting parents to complete a consent form to be included in the Appendix (D) of my study.

For parents unable to talk in person with the researcher at the parent information session, home packets containing the same information along with a CD video recording of myself explaining my study was sent home with children the following day. In addition, the video clip describing the study and how to give consent for children to participate in my study was posted on the secured classroom website for parents to access.

Gaining consent from the University, school district officials, classroom teacher, and parents of participants are important research protocols for studies involving children. As a certified Montessori teacher gaining the assent of the children to conduct my single case study was paramount to me. The children were treated as competent social

actors rather than passive recipients in the research process. Their interest and willingness to participate or not to participate was honored. In this specific Montessori classroom, this is how students are already accustomed to learning so it was important that my study also allowed the children to pursue what interested them and to choose what activities to participate in (or not). Children were respected the same for assenting or declining to participate in the research activities throughout my study. Non-participating students had the same experience with the multiple technology tools already available in the classroom; I did not write about the learning experiences of any non-participating students.

After receiving School District approval, IRB approval from Walden University and consent from principal, teacher, and parents, I introduced myself and the study to the children through a puppet show (Appendix E) performed during community time in the classroom. During community time, children are gathered together for a special purpose. In this case, the special purpose was to inform the children about my study to be conducted in their classroom. Participation cards provided pictures of ways children would participate in the study to help "children comprehend exactly what their participation would mean" (Hatch, 2002, p. 67). I introduced students to my mail folder which contained envelopes with child participant's photos and names on the outside. Inside each participant's envelope was a participation card that allowed the child to mark which research activities (video journal, observation, and posting to class website) that they wished to participate in. Once participation cards were marked, the child sealed the card inside his or her envelope and placed the envelope back into my mail folder.

Voluntary participation in the study was explained further to the children by making it known that they could change their participation cards (status) at any time during the study. Any children not having permission to be in the study were not treated any differently than the other participating students and still had the same opportunities to engage with the multiple technology tools being offered in the environment as a regular part of their learning day choices.

Other ethical considerations of participants for my study included the selection of research site, time and length of classroom observations, and role of the researcher. This site was purposefully chosen because of its adherence to the Montessori philosophy that allows for the voluntary participation of children in learning situations (student-directed learning rather than teacher-directed) to allow for an in-depth study of the ways preschool children prefer to use technology for learning to be conducted without creating a potential conflict in the children's understanding of the notion of voluntary participation. Inherent in the Montessori approach is the understanding and compliance by all adults and children of the classroom is that "all are invited to participate; no one is expected." This honors the child's interest and will of those who wish to participate and those who prefer not to. Another premise of the Montessori philosophy is that opportunities of learning are presented to the child and then extended for the child to take part in whenever they desire to. This premise was adhered when collecting artifacts of student generated work. Children were shown where they could put work they would like shared in the research project.

Congruent with the Montessori instructional method, children were respected as agents of their own learning and rights. Their choice to participate in the study or not to participate was honored. Both participating and non-participating children went about learning in the same way; I documented only the learning practices and experiences of participating children in my field notes and analyzed video journals and web postings created only by child participants. The classroom teacher chose to share classroom learning experiences with me with in the morning before the children arrived and my observations began rather than via SKYPE when I was away from classroom. Permission to use child-safe internet sites had already been requested from parents by the classroom teacher at the start of the school year.

The frequency of observations also took into account ethical considerations for the child participants. I spent one morning a week during the free choice of activity session of the day for four weeks totaling 12 hours physically spent in the field. The 4-week period for my study aligned with the instructional time frames used in classrooms following the Montessori method and allowed children adequate time to demonstrate their preferred uses of how and when to use the multiple forms of technology to accomplish learning tasks. In multi-aged classrooms, the classroom teacher ensures that each student is instructed in the use of tools and materials before allowing the children to freely choose and explore the new tools on their own. Since the classroom teacher had already implemented many of the technology tools and multiliteracies strategies in the classroom, the 4-week period for my study allowed me to spend over 30 hours documenting the ways children preferred to use technology for learning.

My role as the researcher in this study took into account the ethical considerations involved when conducting research with young children. I am a Montessori trained teacher, and I honored and respected the already established classroom climate. Children were not pulled out or away from learning (Appendix M). I observed and described the learning activities of the children during the morning session that was designated for student choice lessons; the morning work cycle. Teacher Interviews were held during the teacher planning period so that no instructional time was lost. Student video journals were recorded by the students wishing to create video-journals (when I was not present) during the transition period before recess supervised by classroom assistant so that no instructional time was lost. On average, the participants engaged in research activities, aside from observations, 5-10 minutes daily and only during transition times.

Lastly, confidentiality was upheld by assigning different names to participants, classroom teacher, and not naming the school site or city of location.

Data Collection Methods

In case study research, data collection should be rooted in the research questions and what needs to be known (Stake, 1995). To protect the rights of the participants and the site, I had in place a protected data storage system before data were actually collected. Transparency of how I built the case added to the validity of my study. To accomplish this, I made use of a researcher's log available in NVivo9, data analysis program, which automatically dates the entries made and maintains an up-to-date record of the case under study. Data recorded and transcribed through interviews, observation, and video were managed through the use of NVivo9.

Most of the data collection occurred in the field and involved teacher interviewing using semi-structured questions, classroom observation during free work time, and artifacts generated by the participants during the timeframe my study was conducted. The choice of semi-structured rather than structured teacher interview was chosen because it offered different ways to ask the same questions of different respondents. The interviews were audio-taped using the SmartPen, which allowed me to write detailed and more accurate field notes with its audiotape feature which was a less intrusive instrument than a tape recorder. Following each teacher interview session, the audio recording was immediately down loaded to the NVivo 9 data analysis program installed on my password protected lap top computer. Direct observation was employed to gather information on the phenomenon of interest in the classroom environment which was not attainable from other methods (Noor, 2008). Such things as the physical setting and social environment of the classroom were best described through classroom observation. Observation greatly increased understanding of the phenomenon under study.

Data were gathered through teacher interviews, observations, video recordings, and artifacts generated during the time frame of my study to effectively portray the case. I followed protocols established by Walden University's IRB as well as the school district of the study site to gain access for data collection. Parental consent was obtained prior to the start of my case study.

Direct Observation

In case study research the focus is always on the case, therefore observations are conducted to increase the researcher's understanding of the case. The important issues

surrounding the case give direction to the observation (Stake, 1995). In my study, the case was a preschool environment designed with multiple forms of technology and the main issue was about the children's preferred uses of technology for learning at school. To become better acquainted with the case, I conducted all observations in the classroom under study. I attended carefully to what was being communicated verbally and nonverbally as well as attended to what was occurring. I recorded conversations verbatim in order to ensure accuracy in the write-up (Dewalt and Dewalt, 2002, p. 74). Writing detailed accounts of what I observed enabled me to see a familiar context with new eyes and to ensure that what was described accurately depicted the phenomenon (p. 75). Observation criteria is included in the Appendix (F).

Teacher Interviews

My goal as a case study researcher was to describe multiple perspectives of the case. The interview was employed to obtain descriptions and interpretation of the case from the teacher participant (Stake, 1995). During the interviews, I asked open-ended questions from an interview guide to allow the teacher participant to fully describe the case while making sure issues were being covered. I actively listened with the use of the SmartPen which allowed notes to be written while the interview was recorded. This allowed the interviewee to do most of the talking and ensured that details were not lost during the interview. The teacher participant was interviewed twice during my 4-week study. The length of the interviews were kept under 20 minutes to accommodate the length of the teacher planning time so that no instructional time was lost. Immediately following the interview session, the SmartPen was plugged into my laptop allowing for

an instant download of the written and audio recorded session. This tool ensured accuracy of transcription since there was no time lapse between interview session conducted and the written description of the interview. The audio recording provided the exact words used by participants to describe the case under study. Interview questions used are included in Appendices (H & I). Within the same week that the interviews were conducted, I emailed a complete transcription of the taped interview to the teacher that allowed the teacher to check for accuracy.

Artifacts from Participants

Artifacts generated from the participants were instrumental in describing the case. Children communicated through the work they created. A data collection box was setup in the classroom for participants to put artifacts created that the children wanted to share with me. These artifacts included child-created videos, written stories, books, drawings, digital photos and more. Electronic storage was made available via flash drives. Artifacts generated in my study by the children were collected and considered for their representation of the use of technology for learning and/or multiliteracies skills used by the children in the environment designed with multiple forms of technology. A list of criteria that was used to interpret the work samples generated by the children through the course of the study is included in the Appendix (G).

Fieldnotes

Fieldnotes were systematically written to describe what I observed and what was learned through my participation with the specified group of 4-year-old children (Emerson, Fretz, & Shaw, 1995; Merriam, 1988). The ways participants preferred to use

technology for learning was documented in field notes written and audio-taped with my personal SmartPen. The SmartPen allowed me to create a richer and more accurate description of the case by capturing conversations and interactions between participants verbatim. The playback feature of the SmartPen allowed me to look back at notes written while hearing the audio played; any missed details were quickly filled in. The field notes described in detail the ways the participants chose to use technology for learning. While observing, I was cognoscente of my own biases and made use of bracketing to note my own opinions and curiosities. A researcher journal was kept to log my personal thoughts and inquiries. Immediately following the observation sessions, I set my SmartPen recording device down on its docking pad which immediately launched its download on my laptop.

Field notes from all four observations were used to create a running account of observations and experiences in the field. The notes generated while in the field were more than just a factual account of what happened. They involved "active processes of interpretation and sense-making: noting and writing down some things as *significant*, noting but ignoring others as *not significant*, and even missing other possibly significant things altogether" (Emerson, Fretz, & Shaw, 1995, p. 8). In this way, my field notes were more like a snapshot of the learning activities that happened in the moment that could be read and revisited time and time again (Geertz, 1973, p. 19). Conceptual memos were written at regular intervals during the taking of my notes "to record generic but pertinent information in three sections that follow: problems and setbacks; overview of hours in

field and primary sources of data; and patterns, insights, and breakthroughs" (Heath & Street, 2008, p. 80).

Videotape Recordings

Videotapes created by the children (when I was not present) using the flip-camera allowed children to demonstrate their use of multiple forms of technology and how they preferred to use technology for learning in the environment designed with multiple forms of technology. These video recordings were optional for children to create. A list of criteria that was used to evaluate video recordings of learning experiences is included in the Appendix (0). Evaluative criteria included time, date, length, participants, and type of learning activity recorded in the videos.

Prior to data collection, I obtained an Excel spreadsheet of student information including criterion that was used for participant sampling: years in Montessori school, age, typical cognitive and physical development, and technology use at home from the classroom teacher. I conducted an interview with the classroom teacher to gain insight into how she designed the environment with multiliteracies strategies and multiple forms of technology tools including: the digital camera, flip-camera recorder, SmartPen, computers with email access, the projection board for Internet learning. In addition to the multiple forms of technology tools, I asked the teacher to explain the procedures in place to introduce kid safe internet sites that could be used for obtaining information on topics of interest expressed by the children. During this same interview session, I collected contextual information about the school site and classroom. During the four week study, I took on the role of an observer paying close attention to how and when children used

technology tools to for learning and to create meaning. Attention was also given to the timing and manner of how the classroom teacher introduced the children to any new materials placed in the environment.

To ensure the quality of my single case study, data were collected from multiple sources across specified times and dates over the course of four weeks using the method of direct observation and techniques characteristic of case study fieldwork. In the interest of objectivity, I "accounted for the processes through which they have learned (Malinowski, 1922/1961, pp. 2-3). I made my learning of the case transparent through reflexive writing that not only described what was learned about the phenomenon under study but also described my experience of learning as a participant observer using the researcher log available with the NVivo 9 data analysis program (Merriam, 1988; Stake, 1995; Wolcott, 1990; Sanjek, 1990). Data included teacher interviews, observations, parent home surveys, field notes, video tapes, and artifacts generated by students during the study. Data were collected and analyzed simultaneously throughout the 4-week case study.

Data Analysis

Data analysis began almost immediately when I described the context of my study and began to give meaning to my first impressions (Stake, 1995). In analysis, all data collected were broke down to uncover what is important and increased understanding of the case. The objective was to see how the parts related to each other and made up the case as a whole. Like data collection, analysis was ongoing throughout my case study to allow me to reach new meanings about the case. Data were analyzed to see emerging

patterns and themes. Data analysis was conducted as data were collected to prevent a vast accumulation of data to be analyzed at once at the end of the study. Ongoing analysis maintained the desired focus of my case study by eliminating repetitious data that were not needed in the process of analyses rather than weeding through data at the end of the study. The qualitative data analysis program, NVivo 9, allowed me to put in all collected data—written, audio, and video—and code for meaning. The program allowed for rigorous queries to be made of the coded data. The goal in my case study research was particularization rather than generalization. The idea in case study analysis is to focus intently on the way a particular group of people interact in a specific situation or place during a given time and then create a holistic view of the situation (Shaw, 1978; Merriam, 1988).

Analyses in case study research must be rigorous and ongoing. I constantly questioned whether I was accurately describing the case (Stake, 1995). Discrepancies in the case were considered and accounted for. I was ready to give alternative explanations where discrepancies existed. This kind of rigorous clarification was necessary to establish triangulation and accuracy of description (Stake, 1995). Data source triangulation allowed me to check whether what I observed about the phenomenon changed or stayed the same under different circumstances (p. 112). Member checking was another way to validate descriptions and interpretations. The teacher participant under study examined the written description and had the opportunity to clarify my description of the case.

Data were analyzed in its entirety in order to present a holistic perspective of the group of children under study (Goodwin & Goodwin, 1996). The strength of my single

case study was in its ability to richly describe the total experience and perspective of the children rather than isolated occurrences and opinions (p. 109). I considered data as it existed and evolved in its natural state (Robson, 1993). I strived to create a *noninterventionist tone* for my study that allowed the children and their experiences to speak for themselves (Goodwin & Goodwin, 1996, p. 110). Maintaining a noninterventionist tone required sensitivity to the contextual features of the phenomenon being studied (p. 110).

Data were organized into various categories and sub-categories throughout the study using the data software program of NVivo9. Throughout the data collection and analysis process, I employed analytic induction and constant comparison to ensure that discrepant cases were considered and accounted for (LeCompte & Preissle, 1993; Bogdan & Biklen, 1992; Glaser, 1978). At every stage, learning was defined and explained in light of the collected data. Modifications of learning descriptions were made when the data called for it (Bogdan & Biklen, 1992). All pertinent data were used to describe in detail how children preferred to use technology for learning at school.

After each session in the field, I carefully logged digital recordings noting time, place, key speakers, and the primary artifacts before I began any transcribing (Heath & Street, 2008, p. 84) in my researcher's log created with NVivo 9 data analysis program. In these initial loggings, I emphasized what seemed *ordinary* and what seemed *non-ordinary* in language, behaviors, and context (p. 84) so that in later analysis I was better able to distinguish common events from rare ones.

In all qualitative research, concerns regarding reliability and validity must be carefully considered (Goodwin & Goodwin, 1996; Creswell, 2007). Unlike quantitative research that measures reliability and validity, credibility in qualitative research is dependent on a detailed study design which incorporates internal checks such as inter-raters and member checking.

Chapter 4: Results

This chapter describes the generated, gathered, recorded, and analyzed data for my case study of ways children use technology for learning in an environment designed with multiple forms of technology. The collected data include audio-taped, pre- and post-study interviews of classroom teacher, home surveys of technology use, video journals created voluntarily by the children, website postings by the children to a secured classroom website, digital artifacts generated by the children, and observations of the child participants during classroom work time. These multiple sources of data generated in the natural classroom environment across varied times and days over the course of the 4-week study made the triangulation of data possible. All sources of data were cross referenced to establish patterns, relationships, and themes through the use of the qualitative data software program, NVivo 9. This triangulation of data supported the findings presented later in this chapter and provided a rich account of the case being examined.

The purpose of my qualitative single case study was to explore how 4-year-old children of a public Montessori preschool designed with multiple forms of technology located in a mid-South state preferred to use technology for learning at school. I also sought to richly describe the ways the environment designed with multiple forms of technology fostered student interest in learning and what learning connections were made while using such tools as digital cameras, flip camera recorders, and SmartPens in the classroom. My qualitative investigation sought to add to the understanding of the ways technology shapes the learning of young children:

1. In what ways do children use technology to create meaning in an environment designed with multiple forms of technology?
2. What are the ways preschool children prefer to use technology for learning in an environment designed with multiple forms of technology?
3. What impact does an environment designed with multiple forms of technology have on student interest in learning activities?

These focus questions directed my investigation of the ways 4-year-old children of a public Montessori preschool designed with multiple forms of technology preferred to use technology for learning and influenced the ways data were generated, gathered, reported, and analyzed. Two main themes surfaced throughout the data collection and analysis process: *communicative* and *explorative* preferred uses for technology. Multiple sources of data revealed that when various forms of technology were made available in the learning environment, and the children were allowed to choose when and how they wanted to use the tools for learning, technology was used by the children to document, record, and share learning as well as to digitally explore and experience the people and objects of their preschool environment in ways not possible with print-based media alone. It was also found that the design of the preschool environment that included multiple forms of technology increased both student interest in learning and teacher instructional time.

Organization

In this chapter, I organize the findings of my study into four distinct sections for discussion. The first section describes the process by which data were generated,

gathered, recorded, and analyzed. This section also provides a description of the demographics of the participants and the context of the setting. The second section for discussion describes how data were managed and analyzed throughout my study. The third section of this discussion presents the findings of this investigation as they relate to the research questions. This section of the chapter details the patterns, relationships, and themes that emerged from the data as well as presents one discrepant case and the non-confirming data uncovered. Finally, to account for the accuracy of the data, the chapter concludes with a discussion on the quality of the evidence.

Data Collection

To address the need for an increased understanding regarding the phenomenon of technology integration in preschool years, multiple forms of data were collected. The data gathered included audio-taped pre and post study interviews of the classroom teacher, home surveys of technology use at home, video journal entries made by the child participants, participants' postings to the secured classroom website, digital artifacts generated by participants, and four observations conducted by the researcher of the ways participants chose to use technology during morning work sessions. The data were collected at various times and dates over a 4-week period.

In order to obtain the classroom teacher's views toward multiliteracies and the inclusion of technology in preschool, interviews were conducted with the classroom teacher before and after the study. Both interviews were semi-structured and conducted face-to-face between the classroom teacher and me in the teacher's private office adjacent to her classroom during the teacher's planning time. The wording of the interview

questions was intentional to generate open-ended responses to the research questions tied to the study (Appendices H & J). Follow-up questions were purposefully designed for each interview question to allow me to illicit additional details needed to help answer the study's specific research questions. The interviews were audio-taped using a SmartPen which simultaneously recorded my handwritten notes and oral responses to questions given during the interviews.

The SmartPen recording device allowed for the immediate verification of the accuracy of the interview as the pen could tap on any section of the written notes taken and play back the selected segment for both teacher and me to hear. During playback, additional details could be added to any responses given simply by tapping again on the record button if the teacher wished to edit any of her responses. During both of the playback sessions immediately following the interview sessions, the teacher was satisfied with her given responses and chose not to edit. With each of the teacher's verifications, I set the SmartPen down on its docking pad which immediately launched its download on my laptop. Later in the same hour, I downloaded the recorded interview session into NVivo 9 software program. For both interviews conducted, I transcribed the interviews and emailed them within 48 hours to the teacher so she could verify the accuracy of the transcribed interviews. The SmartPen recording device has a four hour charge and was tested for accuracy of operation prior to both interview sessions and an additional SmartPen was available and ready for use in the event the first pen stopped working during either of the interviews.

Because I sought to increase understanding of the ways children preferred to create meaning in an environment designed with multiple forms of technology, it was imperative to consider how the participants used technology first in their home environments to create meaning and make sense of their world. Upon consent for child to participate in the study, parents were asked to complete an open-ended survey to describe the ways the children used technology in the home (Appendix J). Information obtained from parent surveys administered prior to the study revealed the varied ways the participants experienced technology in their home environments. Table 1 depicts which technologies tools were available and how they were commonly used by the participants in the home (see Table 1).

Table 1

Technology Tools Explored and Commonly Used by Participants in the Home

Child	Technology	Ways Used at Home
Adeline	computer	educational websites for learning a topic
	Digital camera	take pictures of environment
	DVD player	watch movies
Ceiley	laptop/desktop computers	logs onto laptop to do reading activities
		Internet/Google information she wants to know
		Googles images she wants to see
	Nintendo DS Lite	play video games, take pictures
Kyra	computer/laptop	play games; internet to look up information
	Digital camera	to take pictures
	Play Station/Wii	play video games
	Cell phone/Smart phone	talk
Melvin	computer	play games; internet to look up Information; play reading games
	iPod	to hear music and dance
	Cell phone	makes calls, takes pictures, talks
	Electronic games	play educational games and other games
	Electronic books	read and listen to stories
Mia	desktop computer	play educational games; Internet to look Up information
	Vetch electronic games	play educational games; MOBIGO games
	DVD player	watch movies in her room
	Cell phone	make calls, take pictures, talk

Note. Pseudonyms have been used to protect the identity of the participants. *N*=5

All of the participants used computers for looking up information and for playing educational games. The majority of the participants used cell phones for making calls, taking pictures, and talking. Adeline and Kyra were the only participants who had home experience using the digital camera. Mia and Adeline operated DVD players for watching movies. Of all of the participants, Melvin experienced the most variety of technology tools in the home. This information obtained from the a semi-structured parent survey conducted prior to the study helped increase understanding of the technological world the participants were accustomed to before coming to school. The opportunity to explore technologies in the home by the participants may also explain why the children were so comfortable exploring ways the technologies could be used in the school environment.

On the first day of my study, the children were introduced to me, the researcher, and the purpose of my research through a brief puppet show (Appendix E). The children positively responded to the puppet and listened intently to the questions asked by the puppet regarding my role as a researcher in their classroom, how my study will work, and the voluntary nature of my study. They were given the opportunity to ask questions. The children were particularly interested in what constitutes data and what the work of a researcher is really like. At the close of the presentation, I placed a data box on the language shelf to collect artifacts during my study. As I placed the data box, I heard positive murmurs from the children such as, “I’m gonna make some data for the box” and “I’m going to color, make pictures, and put some work in the data box”. The participation

folder was also made accessible for participants to access and to indicate which research activities they wanted to participate in.

During the 4-week study period, participants were observed for two hours on four separate occasions for a total of eight hours working with technology tools already placed in the classroom prior to my study. The technology was already integrated and introduced to the children; the ways children preferred to use the technology for learning had not been fully explored or documented. These four observations conducted weekly in the classroom allowed me to experience with all my senses the ways participants preferred to use technology for learning. Children of this classroom were accustomed to observers and went about their daily work with little regard of my presence. The children went about choosing their own work and tools to work with as they would normally do. Technology was naturally included in the environment and accessible daily to the children. Children could use the technology whenever they desired. Its inclusion simply offered more tools. The ways participants preferred to use technology for learning was documented in field notes written and audio-taped with my personal SmartPen.

In addition to my conducted observations, participants were given the option to create video journals with the flip-camera to describe in their own words the ways they prefer to use technology for learning. Participants were shown by the classroom teacher how to create a video journal that described the ways they like to learn and the materials they like to work with in the classroom. Following the teacher's demonstration, participants were allowed to create video journals whenever they wanted to talk about the things they like to work with. Once a week, the classroom assistant reminded participants

of their option to create a video journal. With the flip-camera, participants could talk and visually record the work they like to do. With the simplicity of the recording device, participants could easily review their own video. If children wanted to change the video they could redo it.

Using a password-protected secured classroom website created by the teacher prior to the study, participants were given the option to post to the website any of their created videos that they wanted to share with their parents and the school principal to help them better understand the ways children preferred to use technology for learning. The classroom teacher offered participants assistance in posting their videos once a week throughout my 4-week study. Parents could view the videos on the website and could post their own comments. During my 4-week study, I was granted access to the secured classroom website so that I could review postings made by the participants.

The final data collection source came from digital artifacts generated by the participants throughout my 4-week study. Digital artifacts collected included stories written and recorded with the SmartPen, digital photos taken with the digital camera of the participants' own work, and videos created with the flip-camera capturing classroom learning as well as individual learning. Stories created with the SmartPen were physically stored in the classroom data box and digitally stored on my password-protected laptop. Photos taken with the digital camera were downloaded daily and stored on an external flash drive accessible only to myself. Videos created with the flip-camera were downloaded weekly using Flipshare software and stored on my password-protected laptop.

Setting and Participants

The site for my case study was a large, public Montessori school located in a mid-South state which offers a magnet school option for students residing in the school district for children ages 3 through 10. The school selected for my study serves 474 students and applies the method and curriculum developed by Dr. Maria Montessori known as the Montessori method. The preschool classrooms have two adults who work with the children; a state certified teacher who is trained in the Montessori method and an assistant who is neither state certified or Montessori trained.

Keeping with the Montessori curriculum, the preschool classroom of my study cultivates oral language and written expression by allowing children to work with hands-on language materials. Writing is encouraged in early lessons which later lead to reading for the young child. The curriculum promotes writing before reading. Children are free to choose their own work daily during a three-hour uninterrupted work cycle. The teacher assumes a role that guides rather than leads the learning of the children. Throughout the morning, she gives individual lessons to students with traditional Montessori materials and with technology tools while other students choose their own work. It is the prepared environment that offers the child endless opportunities for discovery and learning. A second adult is available to the children and only intervenes when asked for assistance by the children or the teacher; her main task is to prepare and maintain the environment. The tone of the classroom is one of peace and calmness.

The preschool classroom of five 3-year-olds, ten 4-year olds, five kindergarteners made up the case for my study. Five of the 10 four-year-old preschool students made up

the case within a case sample for my study. Table 2 provides criterion selection for the student participants.

Table 2

Descriptive Characteristics: Student Participants

Student	Gender	Age	Years in program	Technology in home
Melvin	M	4	2	yes
Adeline	F	4	2	yes
Mia	F	4	2	yes
Ceiley	F	4	2	yes
Kyra	F	4	2	yes

Note. Pseudonyms have been used to protect the identity of the participants. *N=5.*

Data Management and Analysis

Data Management Procedures

The data gathered for my investigation included audio-taped pre and post study interviews of the classroom teacher, parent survey of home use of technology, optional video journal entries made by the child participants, optional participants' postings to the secured classroom website, digital artifacts generated by participants, four observations, and a researcher's log of personal thoughts and inquiries that emerged with the data. All of the collected data were imported into NVivo 9, a qualitative software program and stored together in a project folder within the program.

Interviews. The pre-study interview was conducted with the classroom teacher four days prior to my 4-week study. She was asked to define literacy and learning in

regard to technological advances of the 21st century. The post-study interview was conducted five days following my 4-week study. This session allowed Mrs. Nelson to reflect back on her earlier responses and gave her an opportunity to modify her definition of literacy and the ways children were using technology to create meaning in her preschool classroom. During both interviews, I simultaneously wrote notes and digitally recorded the sessions using a SmartPen recording device. Immediately following each interview, I played back the audio for the teacher to hear her responses giving the teacher an opportunity to make any desired changes to her responses before the session was downloaded into Livescribe on my password-protected laptop.

From Livescribe, the digital recorded interviews were exported as a Wav file and imported directly into NVivio 9. Once imported into NVivo 9 as an Internal Source, the interviews could be opened and transcribed within NVivo. In the transcription mode, NVivo 9 the text can be typed directly during playback mode. The playback features allowed me to hear back the audio as many times as necessary with its rewind and fast forward options. With these features of NVivo I was able to create accurately transcribed accounts for each of the teacher interviews. The transcripts were copied to word processing documents and attached to emails sent to the teacher for her verification of their accuracy. After the transcripts were sent, the audios and transcriptions of the interviews were saved in the project folder created for this research study in NVivo 9 on my password protected laptop as well as saved onto an external hard drive and flash drive. When not in use, both the external hard drive and flash drive were stored in my keyless, locked file box stored in my home office. The teacher verified the accuracy of the two interview transcriptions formally by email as well as face-to-face to me.

Parent Surveys. Consenting parents were asked to complete an open-ended survey that described the types of technology that was available to children in the home as well as the experiences the children had with it. Completed surveys were turned in to the classroom teacher and given to me, the researcher, before observations of the classroom were conducted. Information obtained from parent surveys was gathered and synthesized into a table for comparison (Table 1).

Video Journal entries. Participants were given the option to create weekly video journals with the flip-camera. The teacher initially demonstrated to students how to create a video journal entry to be watched only by myself that describes the materials they like to work with when learning in their classroom. To ensure the privacy of their recorded entries, children were asked to bring the flip-camera to me after all of the child participants who wanted to create a video journal had the opportunity to do so. At that time (during the children's lunch period), I immediately downloaded the video journal entries into a video project file with FlipShare on my password-protected laptop. The download took less than five minutes to complete and secure.

The video journal entries were exported as Wav files and imported and saved into the already created research project file for my study in NVivo 9 on my password-protected laptop. A separate file was set-up for video journals; separate sub-files for each participant were created for easy access and cross-referencing purposes. In the transcription mode, NVivo 9 the videos can be transcribed directly during playback mode using a text box. The playback features allowed me to hear back the videos as many times as necessary with its rewind and fast forward options. With these features of NVivo I was able to create accurately transcribed accounts for each of the video journals created

by the participants. Once the video journal entries were entered into NVivo 9 and saved both in the project file and on external hard drive and flash drive, I deleted the entries from the flip-camera.

Website postings. Participants were given the option to weekly post created videos on the flip-camera to the secured classroom website with the help of the classroom teacher. Once a week, the teacher asked the child participants if there were any videos that they created that they would like her to post on the classroom website. The teacher posted the videos to the website at the request of the participants. I was granted access to the classroom website for my 4-week study. I logged in daily to check for postings made.

Observations. Following each observation, I set my SmartPen recording device down on its docking pad which immediately launched its download on my laptop to save the digitally recorded fieldnotes. The fieldnotes were typed in entirety and saved as four separate word documents; a document for each of the four observations conducted. A word document file was created on my password-protected laptop to store and save the word documents containing the fieldnotes. Backup copies of the files were also created on the external hard drive and flash drive used for my study. The external hard drive and flash drive are stored in a keyless, locked file box in my home office when not in use. The word documents containing fieldnotes were directly imported into the project folder created for this study in NVivo 9. Once the fieldnotes were successfully saved and stored, the digitally recorded fieldnotes were removed from my personal SmartPen.

Artifact reviews. The actual paper version of digital stories created by the participants with the classroom SmartPen were immediately stored in the slotted classroom data box. These paper versions of digital stories were removed weekly by me

and stored in a keyless file box stored at my home office. The digital Smartpen stories were also weekly downloaded and saved to my password-protected laptop. The SmartPen stories were exported as Wav files and then imported directly into the project file created for this study in NVivo 9. A separate file was created for SmartPen stories to be stored in the project file in NVivo 9. Sub-files were also created to organize the stories by participants who created them. Once the SmartPen stories were successfully saved and stored in NVivo 9 and on my external hard drive, the stories were removed from my personal SmartPen. Photos taken with the digital camera were downloaded weekly through IntelliStudios on my password protected laptop and stored on an external flash drive accessible only to myself. Videos created with the flip-camera were downloaded weekly using Flipshare software and stored on my password-protected laptop. The flip-camera videos were exported as Wav files and then imported directly into the project file created for my study in NVivo 9. A separate file was created for student created videos to be stored in the project file in NVivo 9. Sub-files were also created to organize the videos by participants who created them. Once the photos and videos were successfully saved and stored in NVivo 9 and on my external hard drive, the photos and videos were removed from the digital camera and flip-camera respectively.

I also kept a reflective researcher's log. This log was used throughout the data collection and analysis process to jot down personal reactions to the data and to keep a record of any biases that surfaced.

Analysis Procedures

This part of the chapter describes how the large amounts of data for my study were entered, organized, and analyzed through NVivo 9, a data analysis program

installed and password-protected on my laptop. The use of NVivo 9 allowed for the preparation, organization, and deeper levels of understanding of the data to be iterative, interactive, and manageable at the same time. The program allowed for the multiple sources of data to be put together in one project and simplified the process for coding across all sources, running queries, and creating graphical models of the data. Collected data from pre and post interviews, observation fieldnotes, video journals, and digital artifacts were entered and stored into NVivo 9. Once the interviews, videos, digital artifacts, and observation fieldnotes were imported into NVivo 9, transcriptions for all each were typed and organized into separate source folders for easy retrieval and cross referencing. A researcher's log was kept close by throughout data analysis to record my reactions to the data, to log questions pertaining to the data, and to make note of any biased thoughts that surfaced during the data analysis process. Next, all data entered into NVivo 9 for my study were read through to gain a general sense of the data and to maintain a whole picture of what the data represented (Creswell, 2009). The rereading of the data revealed recurring themes pertaining to my study's research questions and became the basis for initial coding. Initial codes were assigned to represent the themes and were entered as Nodes in NVivo 9 (see Appendix U). All data across all sources were initially coded by these nodes. Whenever new topics and categories emerged, they were added.

Interviews. The pre- and post-study interviews recorded with my personal SmartPen were imported as audio-files into NVivo 9 and transcribed verbatim. Once transcribed, I replayed the audio while reading through the written transcript to ensure that accurate accounts of the interviews were obtained. The transcripts were then reread

and coded by the established nodes. As new themes emerged, they were added as new nodes for coding.

Parent surveys. Data obtained from parent surveys were reviewed and synthesized to create a table (Table 1) displayed earlier in this chapter that depicted which technologies tools were available and how they were commonly used by the participants in the home. The completed surveys are stored in my fireproof, keyless entry data file box in my residence.

Video journal entries. The flip-camera journal videos created by the participants were imported as Wav files into NVivo 9 and stored in separate file folders by participants so that patterns and themes could be analyzed among the participants. Descriptions of their content were transcribed in text dialog boxes that appeared when the videos were opened in NVivo 9. The video transcripts were reread during video replay several times to ensure that the written descriptions accurately portrayed contents of videos. Once accurately described, the transcripts were coded by the pre-established codes. With NVivo 9 portions of the video sources were selected, highlighted, and coded. As new themes emerged, they were added as new nodes for coding.

Website postings. Videos created by participants and voluntarily shared on the secured classroom website were imported as an External source in NVivo 9 on my password-protected laptop. A file including a brief description was created for each posting made which also included a link for the URL path to upload the classroom website. The descriptions were reviewed during video playback for accuracy before coded with pre-established codes. As new themes emerged, they were added as new

nodes for coding. Only three of the five participants opted to weekly post videos to the secured classroom website.

Observations. Fieldnotes were written and recorded with my personal SmartPen in a field notebook specifically design for use with the SmartPen. The simultaneous audio recording and written notes made it possible for a more detailed account to be created describing the preferred ways children used technology for learning. The ability to listen back to the audio while reading through the notes allowed missing information and actual words spoken by the participants to be included in the field notes taken. The left margins of the notebook paper provided space to record my reactions to observations as well as gave a space to jot questions and the emergence of possible themes. Later these marginal notes were entered daily into my researcher's log. The raw field notes were typed in word documents and saved in separate file folders by observation dates on my password-protected laptop. The observation word documents were imported into NVivo 9 and were coded using the pre-established codes. As new themes emerged, they were added as new nodes for coding. The coded data from the observations were also compared to coded data generated from the other data sources.

Artifact reviews. Collected digital artifacts created by participants included photos taken with the digital camera, videos recorded with the flip-camera, and stories written and recorded with the SmartPen. Photos were weekly downloaded from the digital camera into IntelliStudios on my password-protected laptop. The photos were exported as image files and imported into NVivo 9 on my password-protected laptop. The photos were stored in separate file folders by participants so that patterns and themes could be analyzed among the participants. Descriptions of their content were transcribed

in text dialog boxes that appeared when the photos were opened in NVivo 9. The photo transcripts were viewed multiple times to ensure that the written descriptions accurately portrayed contents of pictures. Once accurately described, the transcripts were coded by the pre-established codes. With NVivo 9 portions of the photos sources were also selected, highlighted, and coded with pre-established codes. As new themes emerged, they were added as new nodes for coding.

Videos were weekly downloaded from the flip-camera into FlipShare on my password-protected laptop. The videos were exported as Wav files and imported into NVivo 9 on my password-protected laptop. The videos were stored in separate file folders by participants so that patterns and themes could be analyzed among the participants. Descriptions of their content were transcribed in text dialog boxes that appeared when the videos were opened in NVivo 9. The video transcripts were viewed multiple times to ensure that the written descriptions accurately portrayed contents of videos. Once accurately described, the transcripts were coded by the pre-established codes. With NVivo 9 portions of the video sources were also selected, highlighted, and coded with pre-established codes. As new themes emerged, they were added as new nodes for coding.

Digital stories created with the Smartpen were weekly downloaded from the SmartPen into Livescribe and exported as Wav files into NVivo 9 on my password-protected laptop. The stories were stored in separate file folders by participants so that patterns and themes could be analyzed among the participants. Audio files of the stories were opened and transcribed word for word during audio playback. Once transcribed, the audios were listened to again while rereading through the transcriptions to ensure that

they were accurate accounts of the stories created by participants. Once accurately described, the transcripts were coded with pre-established codes. As new themes emerged, they were added as new nodes for coding.

Continuous analysis of information and artifacts was conducted as data were simultaneously gathered. Data were compared and contrasted by source (interviews, student video journals, observations, digital stories, digital photos, and website postings) and by category. Data gathered on each participant was analyzed both individually and collectively to gain a holistic account of the phenomenon of technology use at the preschool level. Throughout the analysis, patterns between categories and sub-categories were identified and two main categories of themes emerged: communicative and explorative. The two main themes and the subcategories that describe them are depicted in Figure 1.

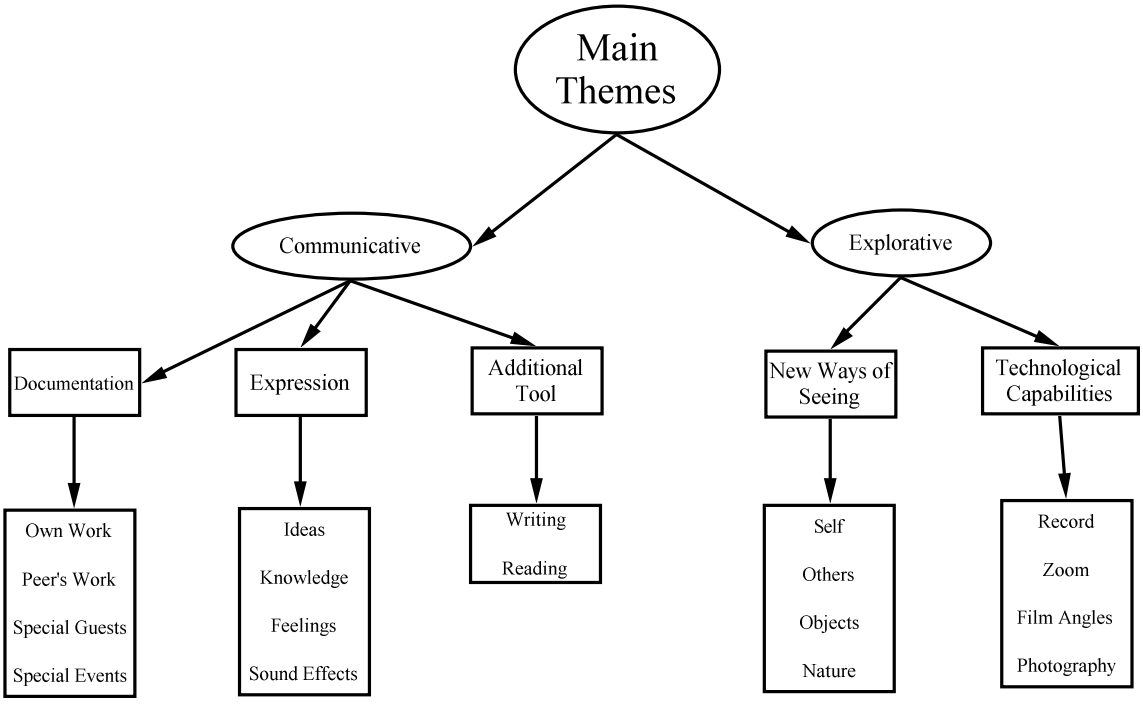

Figure 1. Main themes identified through data analysis

Findings

My study addressed the need for increased understanding regarding the inclusion of technology at the early childhood education level. Exploring in-depth the ways the 4-year-old children in a public Montessori preschool designed with multiple forms of technology preferred to use technology for learning extended existing studies on the inclusion of technology in early childhood education by providing a rich account of the under researched phenomenon. Because research on how to include technology in early childhood education is still developing, describing the specific ways children chose to use technology throughout their learning day with increased independence, confidence, and interest plays an important role in rethinking the ways technology can be added to the environment to extend learning opportunities of children beyond traditional reading and writing activities and to provide daily opportunities for using technology to express learning in multiple forms. Multiple sources of data gathered and put together provided answers to each research question. Themes generated from the findings are supported by direct quotes from the participants, direct observations, teacher interviews, photos, and videos.

Research Question 1 asked, *In what ways do children use technology to create meaning in an environment designed with multiple forms of technology?* In order to describe the ways children used technology to make sense of their world and to create their own meaning, it was necessary to present the classroom teacher's perception of how the ways children created meaning changed when the environment was designed with multiple forms of technology and the children were allowed to explore technology tools

in their own way prior to the study. Unlike Merchant (2009) and Yelland et al. (2008) who found that preschool settings often used technology sparingly and continued to teach literacy skills in traditional ways rather than through varied contexts, purposes, and uses of technology, it was evident in the follow-up interview that Mrs. Nelson, the teacher of the classroom studied, was opened to using multiple forms of technology in ways not yet explored with this age child. During the interview, she expressed how using technology more inclusively in the classroom changed her own definition of literacy and thoughts on how children make meaning,

> I would say that my definition of literacy has definitely expanded. If someone were to tell me that introducing a camera or a flip-camera to the classroom would have changed their learning, I would have done this much earlier in the year even then I did ....they have become just more literate. Words have a different meaning to them. Seeing a word then hearing the word. Then taking control of their own learning has been exciting. So to them now literacy has just become real.Whether they are telling a story or ...we had a story called little cloud in a book. And then little cloud turns into different things...we took out felt pictures of little cloud as it changes to tell the story. But to see a child actually put out little cloud in the sequence steps, which one of our required skills is sequencing, and tell the story using the flip camera as he is telling it and then to share it with a friend just gave a whole new meaning to literacy in our classroom.

Mrs. Nelson, who has taught preschool for 19 years, witnessed a change in how the children approached learning and created meaning once technology was made available to the children in the environment,

> They [the children] began to see things in their environment in different ways. They wanted to record things differently even on field day when you think about it… they are outside playing, but still are asking where is the flip-camera...where's the camera? They wanted to catch moments differently....when we were in an assembly they asked me to take the camera with us...did I have the camera for the fourth grade assembly so I would love to continue to just… to make it [technology] a part of ...just integrate it into our whole environment.

She saw a difference in the way children of the 21st century instantly want answers to their questions and know that with technology, knowledge is only a click away. Mrs. Nelson commented on this shift in learning during the pre-study interview,

> I think a 21st century learner is hands-on, they are instant learners so that they want that information now and they can get it now. Kids now know to say, Ms. Nelson can you go look that up for me whereas we would have said [in the past] we will go to the library and research. They know that instantly I can go get it. So if they are asking about for instance and wondering what a squid ate..we have books around the classroom, but the first response of a three year old was can you go and look it up on the Internet. So these are U-Tube kind of kids so they know where to find information... they know that information is fast..these children are using iPads, and cameras and phones..so they are very much instant learners. I think they are also more in-depth thinkers because of that. So you really can't give them just surface information anymore because they want to know more.

The Montessori Method which helped framed my study described the way the preschool child creates meaning. According to Montessori (1995), the preschool child by nature moves from a self-serving purpose for creating meaning to a desire to explore and make sense of the world around them. Children become more interested in discovering how people of the world live and get along. During the pre-interview, Mrs. Nelson discussed the new role technology plays in this transitional way of knowing for the children,

> Montessori really looks at "who I am..and then who I am in the world around me" so if you think of that tied with even technology...technology gives you who you are...technology can give you access to that world around you. So what we do to encourage this [in the classroom] is we bring in people whether it is with our international cultural celebrations…we bring families in..we have families in our school who come help us celebrate certain cultures. We are doing next week a classroom museum where a person is coming in from the educational global center to speak with us about Japan because the children have been really interested since the Tsunami earthquake. They really want to know more about Japan so she's actually going to come and share with us. So I think just reaching out to the community also making sure the literature is there in the classroom--you never want to take that away. We are hands-on so if we are studying it, the books are there so they know to go get them. Even the 3 year old if they are working with...like today I had a three and four year old doing Australia..not only did they have the map out but they had out books all around them about Australia..they had pictures of people from Australia, they had a box that had objects from Australia..so it became that they were immersed in that culture. So I

> think one of the things we try to do is just bring in the richness and making sure the children are able to be immersed in the learning.

Mrs. Nelson noticed that the children used technology as a means to increase their independence as learners. Preschoolers are drawn to tools which enable them to increase their levels of independence from the adult; they want to be able to do things for themselves (Montessori, 1995). Mrs. Nelson found that the children experienced new levels of independence as emergent writers and readers with the use of the flip-camera, SmartPen, and digital camera. According to Mrs. Nelson, the children used the technology to independently read and write words and stories that they could hear back in their own voice; no longer needing an adult to read it back for them. When asked how this level of independence was made possible, Mrs. Nelson likened the process to how children were introduced to lessons in the Montessori classroom,

> I think it was great to put it [technology] into their learning environment because then it became just a part of what they learned. They know that when they come into the classroom, it is a learning environment...an environment that they want to leave with new knowledge. So introducing it on a shelf the way that we did as a lesson was a wonderful way for them to acquire that knowledge. There are so many times that parents are like well I have... one parent said in fact, "now I bought her a camera but she didn't know what to do with it" ...well the mother did not know how to teach that lesson on how to use it or you know how to sit with the child and say this is what you do...so now the child has acquired a skill that she will use for years to come within the environment. So I think the way it was

> introduced within the classroom was a perfect way for them to learn. And then take it on to other contexts.

I directly observed the classroom teacher introducing Mia to a new feature on the digital camera,

> The Teacher said, "Just like we have to have lessons with all the materials on the shelf before we can use them, there are many materials on the camera…look its like this is the shelf (pointing to each icon). Today we are having a lesson on looking at the pictures…this icon showing an album with an arrow. Do you see it? Ok take the stylus pen like this and hold it between your fingers like this and tap on the album icon gently with the pointy end of the stylus pen like this. See what happens? Here are all of the pictures. To see one, you tap on it with the pointy end of the stylus pen like this. Now you try. [student tries and is successful]. You did it! Now you have had a lesson on how to look at the pictures so you may do that when you work with the camera." [teacher leaves Mia to work with camera on own]. Mia successfully brings up pictures to see without the help of the teacher. She smiles as the picture fills the camera LCD screen and she names the friend she sees. When finished, she shuts the camera off, places it carefully back into its basket, and returns it to the shelf.

The Montessori approach to instruction allowed for the majority of the children to become confident, independent users of technology and opened up new ways for the children develop as emergent writers and readers.

To address the development of the children as writers and readers more directly, I asked Mrs. Nelson to describe more specifically the ways she observed the children creating meaning with the multiple tools of technology now available to them within the classroom. Mrs. Nelson expressed that the children used the available technology tools to express their ideas, to tell their own stories, and to record their work in ways they chose to do so. She described more in-depth the ways the children used the technology tools for writing,

> Using tools such as our flip-camera and our smartpen and our digital camera, the children were able to increase their writing, especially using the smartpen. They wanted to write more and there were children who had never sat down and written a story who wanted to write a story who were looking for the paper to write each day. They were very encouraged by the SmartPen because they could see what they were drawing but then they wanted to hear back their stories so I saw an increase in writing. Also an increase in stories that were written with what we call our Moveable Alphabet [traditional literacy tool in Montessori classrooms] that they would write a story using a hands-on alphabet but then wanted to write that story then on the paper using the SmartPen and give a drawing. We usually draw a picture with our stories so encouraging even those students to do more writing.

Mrs. Nelson clarified that traditional literacy tools were still very much used in the classroom and that they were often used in conjunction with the technology tools. She added that, "there were times that the children chose traditional tools for recording written work over the digital tool options." Mrs. Nelson found this to be especially true with the older children as they flipped back and forth with ease in their use of traditional

and technological forms of reading and writing. The younger children; however, were found to be more drawn to the technology tools because reading and writing could be experienced in ways the children were not yet capable of achieving with the print-based tools alone. Mrs. Nelson shared how there was just an explosion of interest in writing that that resulted from the younger children using the SmartPen,

> It [the SmartPen] is amazing in the classroom because we have so many little ones who want to dictate, what we call a dictating story, so formerly a child would write a story and then come to me or to my assistant and say, "I wrote this story and it's about my mom, a flower, and my house" and we would write it for them. Well this pen allows them to tell that story independently, and using the SmartPen they can as they are drawing they can describe what they are drawing and that pen actually will record and play back what they said so now we automatically have the child's dictation of their story which is wonderful so we don't miss anything in interpretation and you can hear exactly what they said and what was meant.

Mrs. Nelson went on to say that the SmartPen allowed the children to really see themselves as writers with an ability to create stories that could be accurately shared with others. As a result, the children embraced the SmartPen as a writing tool that enabled them to be successful at writing even if they could not formulate actual letters of the alphabet or combine letters to form words.

In the interview session, I asked Mrs. Nelson to share ways, if any, that the children used the Internet as a tool for meaningful learning at the preschool level. Mrs. Nelson enthusiastically shared this example,

> Oh, we used it this morning...there were students studying flags and they asked...they wanted to know the flags of the United States...the state flags, so I pulled up on the computer [Internet] a flag that they could see...so yes, I think that the Internet is definitely... it is just a part of our world and it should definitely be a part of our classrooms.

Mrs. Nelson further shared that the children viewed the Internet as a source of unlimited knowledge that could be accessed for learning at anytime. Growing up in the age of information, these children are accustomed to accessing knowledge instantly and know that answers to their in-depth questions are only a click away. The Internet has opened up ways for the children to increase their knowledge on a subject in a more personal and individualized way. Knowledge is no longer limited to time and space or the knowledge level of the teacher.

In summary, Research Question 1 asked, *In what ways do children use technology to create meaning in an environment designed with multiple forms of technology*? From the interview responses given by the classroom teacher and the information gained from the parent surveys, it was evident that the inclusion of multiple forms of technology in both home and school environments allowed the children to create meaning in new open-ended ways and to share knowledge obtained in varied ways. The children utilized the technology tools with varying degrees of proficiencies and were perceived to be willing to experiment with the new technology tools. I found that the children used the SmartPen, digital camera, and flip-camera to express their ideas, to tell their own stories, and to record their work in ways they chose to do so.

The availability of multiple technology tools in the environment allowed the children to become even more independent learners. The Internet opened up ways for the children to increase their knowledge on a subject in a more personal and individualized way. Their knowledge was no longer bound by time, space, or the knowledge level of the teacher. The younger children were found to be more drawn to the technology tools because reading and writing could be experienced in ways the children were not yet capable of achieving with print-based tools alone. With the technology tools, children were given new ways to explore their world and to learn about it.

Findings obtained from interviews with the classroom teacher and surveys with the participants' parents provided a starting point for understanding the ways children preferred to use technology for learning; however, neither of these sources of data were able to describe the phenomenon of the inclusion of technology at the preschool level from the perspective of the child. This led to Research Question 2 which asked, *What are the ways preschool children prefer to use technology for learning in an environment designed with multiple forms of technology?* The wording of this research question was intentional to emphasize the ways children preferred to use technology for learning rather than how learning with technology was perceived by the adults. In terms of addressing the ways children preferred to use technology to create meaning, it is imperative to present the participants own reflections of their preferences for learning with technology and to document how and when they preferred to use technology to create meaning on a daily basis in an environment designed with multiple forms of technology.

To express their own preferences for using technology for learning, the children created reflective video journals with the flip-camera. Four of the five children opted to

express their preferences by creating the journals. Uncomfortable with talking on the video, Kyra exercised her choice not to create video journals for much of the study period. When asked to talk about the ways she liked to learn, Adeline responded, “I like to write with the SmartPen and pencils because I really like pencils and the SmartPen. I like to take pictures with the camera. I like school.” Ceiley and Melvin iterated the same positive feelings towards using technology for learning. Ceiley shared, “I like to work with my friends. I like to work with the puzzles. I like to write stories. I use the talking pen. I like to take take pictures of my friends and your mamas. I like to make movies with the flip-camera too.” Smiling big, Melvin positively responded, “I love the flip-camera because it is awesome. And I like doing big puzzles. I like to write stories with pencils, paper, and the SmartPen too.” In another journal entry, Melvin shared that he liked to take pictures of his finished work with the digital camera. Like the others, Mia positively shared her experiences with technology, but also expressed that writing stories with the SmartPen was “my mostest exciting thing I have ever done…it talks.”

In another entry, Mia made a video of her work with a dinosaur puzzle. She shared, “this is my dinosaur puzzle work and I like the dinosaur work. I'm doing this puzzle because my mommy tells me to work harder and that's what I'm suppose to do. Thank you.” This video revealed that Mia chose to use technology as a means to show her mother that she was working hard liked she expected her to.

Towards the end of the study, Kyra felt more comfortable with using the flip-camera and attempted to create a video journal of the things she liked to work with. She created one to five second silent videos which featured the letter work that she often

worked with. Kyra talked only once in a video journal entry and did not mention any sentiments towards learning with technology.

Insight into the ways children preferred to use technology for learning was further gained through digital artifacts generated from the children with the SmartPen, flip-camera, and digital camera and observations conducted on four separate occasions which documented how and when the children preferred to use technology for learning. Videos and photos created by the children allowed me to see their work through their lens; to see what the children saw in their own work and in the work of others. Stories written and recorded with the SmartPen allowed me to hear the story behind the scribbles and drawings as well as to hear emotions behind the writing that was created. The observations allowed me to fully experience the ways the children preferred to create meaning in an environment designed with multiple forms of technology.

All of the participants showed a preference for using the SmartPen to write stories. Adeline chose to use the SmartPen to write stories about her family, princesses, flowers, and shopping. With the SmartPen, Adeline was able to create detailed stories of her simple drawings that would not have been understood otherwise by others who simply studied her drawing. Appendix Q shows the illustration for Adeline's story, "This is a flower made with leaves. They are big. And they are round. When the sun comes out and the balloon too, the wind makes it blow higher and higher and higher."

I observed all participants using technology in varied ways during their morning work session. Four out of five participants seemed comfortable using the flip-camera to create videos and the SmartPen to create stories. Kyra struggled with the creation of

audio-recordings with both devices. Though varied in purposes, all five of the participants appeared the most comfortable using the digital camera.

I observed several of the participants using varied forms of technology to document their work, communicate ideas with others, explore the people and objects of the environment in new ways, and to discover how features of the tools worked. For discussion purposes, these observed patterns of uses were classified into two main themes; communicative and explorative. Communicatively speaking, the ways participants preferred to use technology for learning fall into three categories: documentation, expression, and as an additional literacy tool. From an explorative perspective, the participants preferred to use technology to see familiar objects and people of the environment in new ways and to learn the technological capabilities of the flip-camera, digital camera, and the SmartPen.

Communicative Themes: Documentation, Expression, and Additional Literacy Tools

Three main subcategories emerged from the communicative theme. These include documentation, expression, and additional literacy tools. The participants chose to use the digital camera and the flip-camera to visually document and share their learning experiences with others. The majority of the participants also chose to express their own learning and ideas through the creation of videos with the flip-camera and stories with the SmartPen. In general, the participants embraced the flip-camera, SmartPen, and digital camera as additional tools that could be used for writing and reading work.

Documentation. The majority of the participants showed a preference for using the flip-camera and digital camera to visually document their own work in progress or in

completion. Four out of the five participants consistently chose to take digital photos or short videos to document their completed work. Ceiley included the camera as part of the material needed to complete her work. She often set the flip-camera or digital camera down beside her at her work mat so that whenever she had finished working with a given work such as a puzzle, the camera was at her immediate disposal to document her completed work. In contrast, Melvin preferred to complete his work first before bringing a camera to his work space to document his finished work product. Because Melvin carried the cameras over to his work, his photos were often taken from a standing position. Though varied in their approach, both Ceiley and Melvin were more likely to use the digital camera to document work that was finished. Mia, on the other hand, chose to use the flip-camera to create both an audio and visual documentary of her work. When working with the land, air, and water classification work, Mia described her work in a video saying,

> This is Mia and this is my good work with these pictures. I put these pictures right here [under label "water"] 'cause sharks live in water…fish live in water…the plants like this live there too…I put these in the water 'cause that's what I'm suppose to do. I work hard. I am a good worker with my work. These pictures go right here [under label "land"] 'cause that's where they are suppose to be if they live on land. Elephants and lions go on the land. I live on land too. This is my big work I'm talking to you about. These pictures go right here [under label "air"] 'cause they can fly up high. Airplanes and the birds and the helicopter…they fly. This is my work I like to do. It is my big work. Thank you. Now I am done.

Like the other participants, Kyra desired to use technology to document her completed work with the external parts of the whale. The whale work consists of eight control cards, eight picture cards, and eight word labels. After making several attempts to video her completed work with the external parts of the whale, she managed to get one view of her work in its entirety in before she inadvertently turned the camera upside down and could not see her work. Again, Kyra only created a video without audio to document her completed work. After this observation of Kyra, I logged the following into my researcher's log:

> she [Kyra] was often disappointed when reviewing her video when there was no talking...she doesn't seem to make the connection that she must talk during the video to have something to hear back...also wondered if she could be operating the flip-camera similar to a digital camera that takes a snapshot without audio rather than a continuos video stream.

Like Mia, Adeline and Kyra also showed a preference for using the flip-camera to talk about and show their completed work. Adeline was more likely to use the flip-camera to create a video of reading and writing activities she had completed. On one occasion, I observed Adeline video recording her finished spelling words with the Moveable Alphabet. In my fieldnotes I described Adeline as she video recorded the event,

> Adeline returns to her work with her spelled words after seeking help from her teacher. She reads her words one by one: fox, sees, like, wants, to, no, be it, pig, zooming in on the one being read...recording each one read on the camera and this time she is successfully able to read the word "this".

Another time, she had finished reading labels and placed the labels next to their matching objects. She chose to use the flip-camera to document herself reading back the words as she touched each object: pig, bib, six, lips, and pin. During the video playback, Adeline could be heard sounding each word out allowing her to hear her own reading voice and to experience her own growth towards reading fluency. Ceiley also preferred to use the flip-camera to create videos of her completed spelling work with the Moveable Alphabet so that she could hear herself reading back her words during the video play back. Kyra struggled in creating a video of her spelling work. She was able to successfully document the work visually but did not talk during the recording. When Kyra played the video back she was disappointed that she could not hear herself on the video. After repeated attempts with the same outcome, it was evident that Kyra did not understand that it was she who had to do the talking on the video.

Melvin showed a strong preference for using both the digital camera and flip-camera to document and share new knowledge learned with others. One morning, I observed Melvin was working with the North America Puzzle map and supplemental materials related to plants and animals that inhabited the continent. When flipping through the pages of a book on North America, Melvin became fixated on the page showing ice burgs. Excited about this new discovery, he retrieved the digital camera to take a picture of the ice burgs found in North America. With the camera's stylus pen, he chose the photo option and waited with great anticipation for the LCD screen to display its ready mode. Before taking the picture, Melvin looked two or three times through the lens at the ice burgs and adjusted the book each time until he was satisfied with the way it looked. It was evident that Melvin wanted to accurately document his new discovery.

Next, I observed Melvin desiring to share the documentation of his discovery with both his friend and teacher. Showing the friend the picture he had taken with the digital camera, Melvin smiled saying, “Look at this awesome picture. It is icy and lots of snow there. Isn’t it cool?” Showing the same picture taken to his teacher, he was pleased to hear her respond, “Melvin, you captured that picture of the ice berg beautifully. Maybe one day you will go there and take pictures of the ice bergs for books?” After sharing his picture, Melvin returned the digital camera to the technology shelf and picked up the flip-camera saying, “I’m going to make a movie of North America.” From observing Melvin, it was evident that he preferred to use technology in ways that allowed him to document new knowledge and share his discoveries with others.

Ceiley was the most social learner of the participants. As a result, she preferred to create videos which documented work jointly completed with a friend. I observed Ceiley building an alphabet jigsaw puzzle with a friend. Together they negotiated who would build which parts. They were cooperative and focused. When the puzzle was complete, Ceiley wanted to create a video of the work completed with her friend. The two took turns creating videos with the flip-camera in the same cooperative manner observed with the puzzle. When reviewing their videos together, Ceiley took a deep breath and held it in as her lips came to a pout. She said to her friend, “We both need to be in this video… we are friends… and we do work together.” To remedy the situation, Ceiley asked the classroom assistant to create the video of the two of them together. In the video, Ceiley and her friend in unison described their work together,

> We had a puzzle and we did it by ourselves, then we ummm…asked our teacher if we can have a paper and she gave it to us...I [Ceiley] made a D...dog starts with D

> [points to her picture she drew of a dog and letter D was formed with an array of rainbow colors]. And I [Ceiley's friend] made letter R and rectangle starts with R [shows her picture of a large rectangle and a small R written below it].

Immediately after the video was created, Ceiley and her friend enthusiastically watched the video played back. This time, Ceiley smiled and commented, "This is a movie about us being friends doing our work together."

Adeline was the only participant who chose a preference for documenting her work in sequential stages to show the progression of her learning. In a series of 25 pictures taken with the digital camera, Adeline documented her work with the color tablets, a Montessori material that requires the child to match 12 color tablets side by side. From the photos taken, it is evident that Adeline took a photo each time she placed two matching color tablets beside each other. When finished placing all 12 matching pairs, she took a final photo of the completed work.

Another reason participants preferred to use technology tools to document their work was to document work created in the classroom that are in a form that cannot be taken home such as creations with clay, constructions with blocks, and arrangements made with flowers. I observed Ceiley taking a digital photo of the fresh flower arrangement she created as a way to document work that she could not take home or that would not last. The same was also evidenced when Mia used the digital camera to photograph four jigsaw puzzles she had built, and when Adeline used the flip-camera to video-tape her work with the bead work in math that is used by all students and cannot be taken home.

Not only did the participants show a preference for documenting their own work, they also all chose to use the flip-camera and digital camera to document the work of their peers. After taking a picture of her own work with the digital camera, Mia walked around the classroom and took pictures of her peers working. I observed her telling two friends working together, “I’m taking your picture ‘cause you are doing big work. Ok? Say cheese”. Adeline preferred to film and commentate on what work the friends were doing with the flip-camera. I observed her walking around the classroom reporting, “This is my friends working (passes by two boys working)...this is Mia working with her letters on her mat...These friends are making a map...This is the researcher and her work with talking pen.” I observed Melvin video recording the work of the class one day. His teacher’s description of him as their own “little Anderson Cooper from CNN” was fitting as I watched him in action documenting on camera the work of his friends. Just as a news reporter would do, Melvin began his video by introducing himself and giving his filming location,

> This is Melvin. This is Mrs. Nelson’s classroom.[stopping at each friend, he introduces the friend and tells what work the friend is engaged in] Here is Jordan working with numbers. This is Mia's work she works with letters. Galvin is working on the long five bead chain in math. It is big work with lots of beads and numbers.

On another occasion, Melvin chose to use the digital camera to document a classmate writing a story with the SmartPen. He used the zoom feature of the camera and managed to show the girl’s written words on the story paper. I also observed Melvin using the flip-camera to video tape Mia and a friend working together with various photographs of sea

creatures. The two girls matched the pictures with word label cards and checked their own work using a control cards and a miniature reference book. Melvin exhibited advanced filming skills as he captured the two girls in turn choosing a card and interpreting the picture then searching for the word needed. He demonstrated a steady hand filming; he moved the camera smoothly from one person talking to the other.

Like the others, Ceiley and Kyra also seemed to enjoy documenting the work of their friends with the flip-camera; however they chose to film without telling about the work being filmed. They preferred to create visual documentation of the work they saw happening in the classroom.

Lastly, I observed that three of the five participants chose to use technology to record special visitors and events that they wanted to remember. Adeline wanted to remember the kindergarten students' graduation day so she created a video with the flip-camera. She videoed each kindergarten student all dressed up and named each one sitting in a row. She ended the video clip saying, these are fly-up students as they graduate today to go up to elementary. Melvin and Mia both chose to capture memorable people and events using the digital camera. Melvin took photos of the family school picnic, field day, and the magician who came to perform magic tricks for the class. Mia took pictures of visiting parents, class pizza party, and a picture of me, the researcher, taking field notes while conducting an observation of the class.

Expression. The majority of the participants also chose to express their own learning and ideas through the creation of videos with the flip-camera and stories with the SmartPen. Though their choice of tools varied, both Mia and Ceiley preferred to use technology tools to express the kinds of work they liked to work with and the kind of worker they are

when they do their work. Using the SmartPen, Mia expressed, “this is Mia…I am a good student…I am a good worker…I am writing a story.” Ceiley preferred to express herself using the flip-camera. After working with Sand Paper Letters, she created a video and expressed, “These are my letters I make myself…I like letters…I did a good job.”

Melvin demonstrated a preference for using the flip-camera to express his knowledge of a work. Upon completing his work with the United States of America map, Melvin viewed the map through the lens of the camera, and expressed his knowledge of the map saying, "This is the United States of America..this is all...all the states."

The majority of the participants chose to express their ideas through writing stories with the SmartPen. Adeline expressed what it would be like to be at the beach in one of her stories written with the SmartPen,

> This is a fence I made. I'm making myself. Um...because I like going to the beach. The beach is fun. The beach is a funnest place to go. Only if I get hurt I have to get and go to the hospital. And if I don't feel well I will make myself again. It is fun to make me again. It is fun to make myself. I have some sandals on too so i can walk. Heres my shoes and socks...and here's my eyes in order for me to look. I can have a mouth and a nose so I can see and smell. And ears to hear. My hair looks pretty. It is prettiest as whole wide world. It is all the way to my head.

Like Adeline, Mia was also very expressive with her stories written with the SmartPen. She chose to share personal things that meant something special to her. In one of her SmartPen stories, she shared,

> This is Mia. and I am a good student and this is my writing of my work. When I was a little...when I was a little girl my mommy and daddy named me Mia...Mia

> Lashia and they wanted me to have a good smiley face. She...my mommy and my daddy want me to be happy and happy and happy. Well my mommy and daddy named me this name again...they named me Mia. And when my mommy and daddy named me that they were so happy when I was a little girl. Thank you.

In another story created with the SmartPen, Mia expressed how a friend had hurt her feelings. The recording device of the pen picked up the sadness in her tone as Mia wrote,

> This is my paper. This is Mia and I am drawing letters. [pause] [draws] This is my dolphin. I know that somebody cannot come to my work because someone is not my friend. Aneeka is not my friend so I am not going to play with her no more. I thought she was my friend. Now she is not my friend. I said, you want to have a tea party? And she said you want to do that later? And I said yes.

Mia was the only participant who chose to talk about personal feelings in a video clip. It was evident that the SmartPen provided her with another way to work out her feelings.

Both Melvin and Mia not only wrote to express their ideas but also wrote with expression adding sound effects. Melvin wrote and recorded, “This is Melvin. This is a big, big, big fireman...he is jumping, jumping, jumping through this circle thing...down in the front and down..ahhhh...hold on...keep going down here....ahhhhh.” In the same manner, Mia added sound effects to her story she created about a coming tornado. She wrote, “This is a crazy tornado. It's like a uh...a tornado 1…whrrrrh…wrhhhhh…wrhhhh [siren sound] These are giant walls. There is another tornado....whrhhhh....whrhhh...The end.” Both Melvin and Mia enjoyed hearing their stories played back. The added sound effects seemed to give them added pleasure when listening to their stories.

Despite her struggles with recording herself with the technology tools, Kyra managed to draw and verbally express her love for her family once. In her brief story written with the SmartPen, Kyra wrote, “I love my mom. [draws for 30 seconds without talking] I love sissy.”

Additional Literacy Tools. In general, the participants embraced the flip-camera, SmartPen, and digital camera as additional tools that could be used for writing and reading work. Because the participants have grown up seeing the people around them using technology to read and write, they seemed to naturally accept the flip-camera, SmartPen, and digital camera as additional reading and writing tools. Adeline and Melvin both saw the flip-camera as an additional tool for reading. I observed Adeline independently using the flip-camera in a reading lesson. After setting out reading objects (tag, hat, fan, man, and cat) on the table, she picked up the word cards and read them one by one; placing them beside the object named by the card. With the flip-camera, Adeline slowly scanned across each object and read the corresponding word to record her work in a different way than with paper and pencil. When she played the video back, she could hear her own reading voice and check her work on the video with her reading work in place on the table. Melvin used the flip-camera as a tool that could be read to. The following exert from my observation field notes details how Melvin used the flip-camera to read rhyming pairs of words that he had put together:

> Melvin uses the flip-camera to zoom in on the first rhyming pairs. Once zoomed in, he proceeded to sound out the first word, ttt-tr-train...and then rrr-rain. He moved the camera to the next rhyming pair and took a deep breath before he slowly read the next rhyming pair: book...hook. He continued reading with

> confidence each pair even when he misread the next pair as monkey…branch instead of ape…grape. With the next pair he read them as piglet…meat. After looking back at the letters that formed the words, he self-corrected his reading and said instead pig…twig. He moved on to next pair to the left. He sees the snail picture and quickly says snail. When he looked at the picture of envelopes, he paused trying to think of what rhymes with snail but looks like envelopes. After a second or two, he confidently read the rhyming pair as snail/mail.

From this observation, it was evident that the flip-camera allowed Melvin to sit and read words in the same manner as he would have read with his teacher. He was able to self-correct many of his own errors. The flip-camera also afforded Melvin's teacher to have the opportunity to play back the video at a later time to assess his reading and vocabulary comprehension.

The majority of the participants appeared to accept the flip-camera, SmartPen, and digital camera as additional tools available for writing in the classroom. Adeline chose to take a photo with the digital camera of words she spelled with the traditional literacy tool of the moveable alphabet. The photo showed her spelled words of: the gum, the tub, the nut, the mop all spelled with cut-out letters from the moveable alphabet. Like Adeline, Melvin chose to use the digital camera as an additional tool to record a large work that combined writing and reading work with a variety of materials that could not have been documented with the use of traditional paper/pencil methods of recording one's work.

Explorative Themes: New Ways of Seeing and Technological Capabilities

From an explorative perspective, I observed that the majority of the participants showed a strong preference for discovering news ways of seeing the world and for learning how to use the various features of the technology tools. Two main categories emerged including using technology to see familiar objects and people of their environment in new ways and to learn the technological capabilities of the flip-camera, digital camera, and the SmartPen. These categories surfaced as a result of triangulation between the various data sources.

New Ways of Seeing. The majority of the participants showed a strong preference for using technology tools as new ways of seeing the world. I observed Mia on several occasions walking around the classroom using the digital camera as her *seeing guide*. When she passed by friends, she could be heard saying, "Smile for my picture." After taking the pictures, Mia would review the photos and look closely at the face features of her friends using the zoom feature. The digital camera allowed Mia to see the faces of her friends like she had never seen them before. Like Mia, Kyra also seemed to walk around the room using the digital camera as a new lens for seeing her friends.

Three of the five participants quickly discovered how to see themselves in new ways with the use of the flip-camera and digital camera. When Mia was creating a video documentation of her completed work, she was not aware that she had turned the camera lens on herself. During the playback of the video she discovered that instead of her puzzle she thought she had video recorded, she instead had filmed own face! She decided to explore how to film herself more by directly looking into the lens while moving the camera closer and farther away from her body. With the same interest that a baby first

discovers the features of her own hand, Mia examined her own hand up close, turning it over, and wiggling each finger. Later in the same morning, Mia explored seeing herself in new ways with the flip-camera. This time, Mia was interested in video recording her own face. She zoomed in on her smile, her teeth, eyes, and tongue.

Several of the participants were interested in seeing everyday objects in new ways. The zoom feature of the flip-camera and digital camera allowed the children to see details of objects up-close. I observed Adeline zooming in on two colored pencils, a red pencil with a sharper lead next to a yellow pencil with a dull lead. With the zoom, she captured the fine details of the chiseled ridges of wood that formed the lead peek of the red pencil. Similarly, Mia used the digital camera to see the wooden cubes of the Pink Tower more in-depth than she saw them before. Without the camera, the cubes appear identically painted in pink. Examining the pink cubes up-close through the camera's lens, Mia discovered each cube differed having unique indentations and markings of their own. Like Mia, Melvin discovered that the digital camera allowed him to see minute details of sea shells, leaves, butterfly specimens displayed on the science shelf that he could not detect with his naked eye. It was evident that Melvin was interested in seeing objects of nature in ways he has not been able to see before.

Technological Capabilities. The majority of the participants showed a strong preference for working with the technology tools for the mere opportunity to explore how to use the features of the flip-camera, SmartPen, and digital camera. I observed Melvin when he discovered additional recording capabilities of the SmartPen. The following exert from my field notes describes this in rich detail,

> After listening to his story played back, Melvin tapped on the record button to write and record more parts to his story. When finished, he clicked the stop square and tapped the pen on the playback timeline. He listened carefully waiting to see if the added parts of his story were included in the recording. When he heard the new parts, he enthusiastically exclaimed, "this talking pen can tell more than one story on my paper."

In an instant, Melvin had discovered on his own how writing can be a continuous process with the Smartpen; new ideas and details could be inserted at a later time and be heard in the story's entirety. In this same exercise, Melvin discovered that the SmartPen not only had the capability to record what he was saying at the time but it also was able to pick up on the voices of others and noises of the environment that occurred at the same time he was recording his story. This discovery was also documented in my field notes,

> Melvin decided to explore the other options on the SmartPen paper. He clicked on the volume arrows and was excited to hear how his voice got louder and softer when using the arrow control buttons on the paper. While exploring the volume control feature, he suddenly recognized that his voice was not the only voice heard in the recording. He said, "that is me talking." Looking puzzled, he listened more closely and realized that there were other voices and background noises in his recording. He kept playing the audio recording back, turning the volume up each time until he recognized the other voices. When he recognized his friend's voice, he stopped and exclaimed, "that's my friend Jordan, and he is talking on my story too."

The majority of the participants preferred to explore the capabilities of the zoom feature of the flip-camera and the digital camera. When working with a wooden peg puzzle, Adeline discovered that she could use the zoom feature of the camera to isolate a single puzzle piece. Sometimes she chose to actually photograph the images enlarged; other times she simply explored what the pieces looked like when enlarged. Mia also explored the zoom capabilities of the digital camera especially when working with a jigsaw puzzle of President Obama. She discovered how to use the zoom feature to create, an enlarged, life-like portrait of President Obama from the picture created of The President with the jigsaw puzzle. Like Mia, Adeline also discovered that the zoom feature could make objects appear life-size and real. While working with a tonging transfer work, Adeline used the zoom feature to enlarge miniature, ceramic carrots in such a way that the carrots appeared like actual carrots that could be eaten. Even Kyra who struggled with successfully using many of the other features of the technology tools, figured out the zoom capabilities of the digital camera when working with the external parts of the insect cards. She successfully zoomed in on each part of the insect.

Melvin was the only participant to discover the zoom-out feature of the digital camera. I witnessed his discovery of the zoom-out feature during one of my observations. Melvin attempted to photograph a friend's big map work that consisted of colored pencils, wooden world puzzle map, actual paper maps, construction paper, and books about the continents. Melvin struggled to capture the work in its entirety in one photograph. He manipulated the zoom and paid close attention to how the minus sign icon allowed him to film the work in its entirety from a wide-angled view.

Adeline was interested in exploring different views of objects photographed when the objects were placed in different positions or filmed at a different angle. I observed Adeline taking 25 consecutive photos of four phonic books that she worked with on a regular basis in the classroom. Before taking each photo, she repositioned the books to see the how the books looked in isolation as well as together as she manipulated them. Working more with filming angles, Adeline also explored how to create a classroom photograph that showed many friends working at once. She took several pictures, holding the camera at different angles and physically positioning herself differently each time to explore how the same classroom view changed.

The majority of the participants took interest in exploring the many ways people could be photographed. The children explored photographing individuals and groups of people, faces and full figures, self-portraits, still shots verses action shots, and adult figures verses child-sized figures. It took some time for the participants to discover how to angle the flip-camera and digital cameras upward to photograph adults. Many of the photographs and videos taken throughout the study were taken from the eye-level of the child resulting in adults being filmed from the waist down. Both Ceiley and Mia took amazing face photos of their friends. In fact the quality was good enough to be used for photographs included in the class yearbook. The girls both were able to capture friends expressing various emotions of frustration, sadness, excitement, happiness, concentration, pride, silliness, seriousness, and sleepiness. Melvin was the only participant who figured out how to photograph himself with the digital camera. He discovered that by turning the camera around while holding the camera out and away from his body he could take his own portrait.

Melvin not only discovered filming angles while photographing people, but also became fixated on positioning objects in specific ways to create desired photographs. I observed him on several occasions lining objects up straight and in order of their use. There were also times he adjusted the positions of objects to create a different 3-dimensional filming effect.

Melvin and Mia were the only participants who made the discovery of the movie clip feature of the digital camera on their own and were successfully able to create mini videos with the digital camera.

In summary, Research Question 2 asked, *What are the ways preschool children prefer to use technology for learning in an environment designed with multiple forms of technology?* I found that the children preferred to use technology tools to document their work, communicate ideas with others, explore the people and objects of the environment in new ways, and to discover how features of the tools worked. The participants' created video journals and digital artifacts combined with my observations of the participants working with technology in the classroom identified several communicative and explorative ways that the children preferred to use technology for learning in an environment designed with multiple forms of technology. Communicatively, the children chose to use technology to document their own work as well as the work of their peers. Two of the five participants preferred to use technology tools to share knowledge obtained with peers and teachers. The tools also provided a means to share personal feelings and to capture memorable events such as the kindergarten graduation and the family picnic day. From an explorative perspective, the participants showed a preference for using the flip-camera and digital camera for new ways of seeing and experiencing the

people, places, and objects of their environment. The majority of the participants preferred to explore the technological capabilities of the tools, particularly the zoom feature of the flip-camera and digital camera. Finally, the participants were particularly interested in using technology as additional tools to expand their own learning and interests.

Research Question 3 asked, *What impact does an environment designed with multiple forms of technology have on student interest in learning activities?* Because there is limited research on how to include multiple forms of technology into early childhood environments and what impact its inclusion has on student interest in learning, it was necessary to present the classroom teacher's perception of how the design of the environment itself impacted student interest in learning activities as well as to provide a detailed description of the observed environment's design and the observed ways student interest in learning was impacted by its design during my 4-week study.

During the interview, Mrs. Nelson expressed that student interest in learning positively increased as a direct result of the way the environment was designed with multiple forms of technology and the way the tools themselves were introduced to the children. Her exact words were,

> It [the inclusion of technology] has been positive. I think that the way that our environment is set up definitely added to the fact that we could bring in that material [technology] and it not be such a distraction in Montessori. We already have shelves [for learning materials]. We already have lessons that are given where some friends receive a lesson and where some don't. Or some have to wait

> for a lesson later so introducing it and starting to give lessons was very natural for them [the children].

To address this research question more directly, I asked Mrs. Nelson to share specific ways student learning was increased and distractions were minimized in her classroom design which included multiple forms of technology. Mrs. Nelson chose to first address how the distractions were handled.

> Somewhat at the beginning, it was a little distracting in that they were just excited. But it was a great distraction because it was excitement about learning. So when you see children excited about learning then you can use that energy in a positive way so you just say to them, "Oh, would you like a lesson with that work?" Then you say, "Oh I need to make sure that you are doing big work first so you can get a lesson with the new work." So it's a positive distraction, and I would do it again, definitely.

I followed up Mrs. Nelson's responses with a sub-question pertaining to the management of the inclusion of multiple forms of technology within the early childhood classroom. I asked Mrs. Nelson to share how she managed the children's learning and use of technology. Mrs. Nelson shared that,

> The majority of the class ending up having an opportunity to work with them [technology tools] even though we focused on certain groups. Again being in the Montessori environment we have the benefit of knowing that's part of how our environment works--waiting your turn. I think that it could easily be implemented into another type of early childhood environment program and they would have to

> come up with a little schedule where those with red bead necklaces would get to do it now or you would ...so they would have to come up with a way for the children to do it...but they would quicky learn..it became part of ...but initially it was a big excitement of course but it became a part of our work. So then they could choose on their own do I want to record...some children would say, "I don't want record today" or "today I really want to record this work" So I think that it was great the way it was introduced and that they were able to learn to take turns--that is part of their socialization...part of their learning in the real world you have to take turns and share.

It was evident from Mrs. Nelson's in-depth response that the design of the environment itself that included technology naturally among other learning materials made for a smoother run classroom with fewer distractions to the overall learning experiences of the classroom.

Knowing that there is a great need to increase understanding of how to manage the inclusion of technology in early childhood environments, I probed Mrs. Nelson to share how her instructional time was impacted by an environment designed with multiple forms of technology. Mrs. Nelson found that her time for instruction actually increased as a result of the quickness children caught on to using the technology tools. Mrs. Nelson was surprised at how quickly the children became independent users of the technology. She described how Melvin developed into a miniature version of CNN's news reporter, Anderson Cooper,

> The four year olds of the classroom quickly became independent users of the technology. One in paticular, has become our own little CNN Reporter. He is very

> involved in demonstrating the materials to other students so as it started out it was a teacher giving the lessons--something that we presented as we do in Montessori with our lessons but it became quickly something that students could present which is another way we present our lessons that a child can present to another child. So this particular child has become our little Anderson Cooper. He is recording. He is teaching other friends how to use the material, they very much are able to go and get the camera themselves and use it--they can cut it on and cut it off--zoom in and zoom out. In fact, they were able to use the stylus on the camera and teach me things. So I would watch them go back and look at their pictures. One day I looked up and they were looking at a slide show on the camera because they knew how to manipulate it. So it is amazing to see that these are children who live in a technology world so they were not afraid at all to work with the materials.

Mrs. Nelson stressed that even the youngest children were able to independently use technology to create meaning and were not dependent on the adult. With the recording capabilities of the flip-camera and SmartPen, the children could talk about their learning and create stories without the help of the adult. This alone freed up teaching time for the teacher. Mrs. Nelson attributed the increase of instructional time to the way children helped each other whenever they needed help using technology tools. I observed Ceiley seeking the help of Melvin when she could not hear back a story that she had recorded with the Smartpen. The following exert from my field notes describes what happened when she asked for Melvin's help:

> Ceiley plays back her story recorded on the SmartPen. When she tries to hear back her story, she is disappointed that she cannot hear it. She goes to get her friend, Melvin for help. He comes over and shows her how to tap the volume arrows, saying "Watch me…tap this it is louder…you hear it? ….now tap this one and now you can hear it whisper…now you try it." Ceiley taps the arrows and hears her voice on the pen get louder. Melvin walks away leaving Ceiley to do it on her own. Each time she taps the arrow, she holds the pen up to her ear to listen, she nods her head up and down as she listens [as if agreeing with person talking to her on a cell phone].

Distractions were not an issue and the teacher's instructional time was increased rather than reduced when multiple forms of technology was included in the classroom.

Learning increased through unintentional lessons that resulted when one student noticed another student struggling with the use of a particular aspect of the technology tool. I directly observed Melvin seizing a teachable moment when he saw a friend struggling to take a photograph of her work with the digital camera. The following exert from my field notes describes in detail how Melvin was helpful:

> Melvin puts the Lego work away. As he passes by a friend trying to use the digital camera to take a picture of her work with the color boxes, he sees she does not know how to do it. He says, "Here, I will show you what to do. You want to take a picture?" Melvin shows her how to turn the camera on, saying, "click this button and wait till the screen lights up. Now it is ready. Look at the screen. Do you see your work? Then click the silver button like this. That's how you do it. You try it." [girl is successful as Melvin oversees her taking the picture]. Then Melvin

says, “now let me show you how to look at the pictures on the camera that you took.” He takes camera from the girl. He says, “see this house button right here, push it. See these pictures [icons]. Use this pen thing like this [pointy part] and touch this album picture right here. You see all the pictures now? Use this pen thingy to pick one like this. [he taps picture and it comes up…girl nods showing she understands] Melvin gives camera back to girl for her to try. Seeing she is successful, he walks away.

From Mrs. Nelson’s interview responses, it was evident that it was the intentional design of the environment that yielded overall positive learning outcomes for the students. To understand more fully the impact the physical design of the environment had on student interest in learning activities, it was necessary to include a detailed description (Appendix S) and drawing (Appendix T) of the actual physical design of the environment that I obtained directly from my observation of the environment followed by a detailed account of the observed ways student interest in learning was impacted by the designed environment during my 4-week study.

Physical Description of the Environment Designed with Multiple Technology Tools.

Using the flip-camera, I created a visual and auditory recording that described in detail the physical make-up of the environment designed with multiple technology tools. A complete description is include in Appendix S. For the purpose of seeing how the technology tools were included I have included the description of the literacy and technology areas only in this section. The following description of the language and technology materials was taken from the video journal created as I walked around the room and described each shelf and its contents with the flip-camera:

There are four language shelves. There is a big book stand stocked with books the class is reading together. Behind it is the CD player and a record player. The language shelf begins with Sand Paper Letter materials to introduce the children to letter sounds. Also there is picture story writing done in the traditional way where there is a box containing story writing paper and crayons that can be used by the children to compose stories and adult can write their dictated story for the child. There are beginning reader books to look at, to look at a picture and say the word, simple rhyming books, baskets of rhyming pair puzzles all in order ranging from simple to more advanced levels of literacy. There are object baskets for writing and reading work so that childen working on leter sounds may choose whether they want to practice letter sounds with objects, books, or pictures.

And above the 2nd language shelf is a calendar featuring moving cards for the months, days of the week, and numbers of days. Also included on the 2nd shelf are reading works where there are boxes of objects and word cards that children can read and match to the objects as they are learning to read. There are glass object boxes that can be used with the Moveable Alphabet for writing. Next to these are traditional sheets of writing paper to record their spelled words. There are also little cabinets with see through pull-out drawers that contain paper pictures of letter sounds that the children can color and paste into paper booklets.

The 3rd language shelf contains several Moveable Alphabet boxes for writing and spelling work. There are ones that feature capital letters and punctuation

marks that children can explore with and learn their functions as they do more avanced writing work. There are booklets to read in folders. There are chalkboards, dry erase boards, and paper to practice writing or to record written stories on. There are scissors and pencils to use. There are Metal Insets that are traditional Montessori work used to teach handwriting strokes and control with the pencil.

The 4th language shelf houses books to read that are organized into varied reading levels so that children can practice reading at their own level at any time. There are glass boxes housing long vowel picture cards and labels to reinforce long vowel work for more advanced readers.

The technology shelf is a natural extension of the language shelves. On top of the technology shelf is a beautiful wooden tray with an indention that perfectly cradles the SmartPen. Beside it is a record of lessons children have received with the technology matrials. Down below the SmartPen is a shelf that has baskets containing the flip-camera and digital camera as well as supply boxes complete with charger cords and backup batteries. And the basket below holds the folders from which the children get the paper from to write SmartPen stories.

From this physical description, it is evident that all materials in the language area are ordered and sequenced in a way that allows the child to make his own discoveries and to master isolated skills inherent in the works one at a time. All materials are child-sized and accessible. The technology was no exception. It too was organized with beautiful baskets

and allowed children open access to the tools. Everything the children needed to use the technology tools were also available to the children on the shelf including paper, extra batteries, wall chargers, and memory chips. This physical description was found to be congruent with the teacher's account of the way technology was introduced in the same manner as other materials of the classroom were presented.

Account of the Ways Student Interest in Learning was Impacted. This account of the ways student interest in learning was impacted was drawn from the teacher's responses shared during the post-interview and from my own observations of the children conducted in the environment designed with multiple forms of technology. On four separate occasions, I directly observed that the children's independent use of technology positively increased learning opportunities for the participants. The ability to use the flip-camera, SmartPen, and digital camera independently freed the children to pursue what interested them more in-depth without relying on the adult for help. The children did not sit idle waiting for help from the teacher to operate technology; instead, they were able to work with the technology tools for as long as they wanted. I observed Adeline's independent use of the SmartPen and described her experience in the following exert from my field notes,

> Adeline independently used the SmartPen. She quickly found the on button and clicked the pen on. With ease, she tapped on the record circle on the paper and began talking and writing her own story. When she was finished writing and talking, she tapped the pen on the stop square. She tapped on the playback timeline to hear her story played back. When she struggled to hear her story played back, she figured out on her own how to click on the arrows to increase

> and decrease the volume. When the volume reached a suitable level, she said, "Now I can hear it". When she was finished listening to her story, she turned the pen off. She carefully slid the pen back into its leather case saying, "pointy side in first just like a s-s-s-s-snake goes in the hole." She returned the pen in its case to the shelf; placing it back into its tray.

From this observation of Adeline's use of the Smartpen, it was evident that Adeline's interest in writing increased as a result of her ability to independently use the Smartpen for writing her own stories. Like Adeline, Melvin was also observed independently using the SmartPen without asking the teacher for any help. The following exert from my field notes describes Melvin's independent use of the SmartPen:

> Melvin comes to technology shelf area and sees that the SmartPen is available. He takes the pen to a nearby table. He returns to the shelf to get the SmartPen paper. He independently turns on the pen, listening for the beep that indicates it is ready. He taps on the circle to begin recording. His face is fixed on his paper. He is concentrating on what he is saying and drawing. He talks softly as he draws. When he is finished, he clicks on the square to stop recording. He taps on the playback line to hear back his story. He has difficulty hearing his story [since he talked so softly]. He taps on the volume control arrows to see if that makes his story louder. He says, "ooh man I can't hear it. I did not talk loud so I can hear." He taps on the record button again, and tells the story over adding some different pen strokes to the ones already made. This time he speaks louder than before. When he plays it back, he smiles and nods his head saying, "now, I can hear my

> story." When finished, he clicks the pen off and slides it carefully back into its case.

Mrs. Nelson accounted for an increased interest in writing and reading in our post-interview together. She felt that the flip-camera, SmartPen, and the digital camera encouraged more writing among the students. More specifically she shared in our post-interview that

> The children were able to increase their writing especially using the smartpen and they wanted to write more and there were children who had never sat down and written a story who wanted to write a story who were looking for the paper to write each day. They were very encouraged by the SmartPen because they could see what they were drawing but then they wanted to hear back their stories so I saw an increase in writing.

Mrs. Nelson shared further that she had witnessed that the children's interest in reading increased when they discovered that their reading voice could be recorded and heard back with the flip-camera. Children became interested in hearing themselves read on camera so they were motivated to do more reading. Mrs. Nelson added that a student who struggled with learning to read sight words became more motivated to practice the sight words using the flip-camera and SmartPen. She saw that the student

> had worked with her sight words more because she spelled them with the moveable alphabet and then she said them on the flip-camera and she wanted to record saying her words…so that was important. She also wanted to write sentences with the SmartPen that had her sight words in them. So she was hearing

> them and she has increased by at least 6 sight words in the last 4 weeks. And I really think that has to do with the technology.

Mrs. Nelson also accounted that increased interest in reading resulted when students used the flip-camera to record themselves reading books on their own in the book corner of the classroom. According to Mrs. Nelson, “this is a wonderful way for them to practice reading. And some of the older students were reading and recording some of the reading books that they have to read for their series books. So a lot of work has been done in reading.”

The inclusion of multiple forms of technology within the environment stimulated the social development of the children. According to Mrs. Nelson, including the flip-camera, SmartPen, and digital camera in the environment provided a new way of being social for the children. She explained that

> They have become social in a new way in a very responsible way...very responsible for 4-year-olds. Their socialization took on a different meaning rather than just saying to one another, "hey what are you doing" or just going by and talking to someone about their work, it became centered around "do you know how to use that work?" or "Can I help you?" or "Could you write something with the SmartPen and can I hear it?" So it became something different so they put work out and say "can I sit and do this work with you?"

The flip-camera was also instrumental in helping a new student become socially acclimated to classmates. According to Mrs. Nelson, “the flip camera helped the new student to begin to really talk and share with some other students. The new student would ask about using it [flip-camera] and would sit with other students and record with them.

Mrs. Nelson also saw increased positive social interactions between older children and younger children as a result of the inclusion of multiple technology tools in the environment. She witnessed older students sitting with younger students who wanted to record stories they had created. The older student graciously used the flip-camera to record the younger friend telling his or her story. The inclusion of technology helped preschoolers develop beginning social networking skills that are characteristic of 21st Century learners who socially connect to exchange ideas and to learn new ways of doing things (Tapscott, 2009).

Mrs. Nelson found that the children's interest in sharing, listening, and speaking increased with the inclusion of the flip-camera, SmartPen, and digital camera in the classroom. She commented saying, "there was more listening where they would actually sit and listen to each other's stories that they had recorded or they would listen to each other's videos". In regard to speaking, Mrs. Nelson noticed that the children "wanted to hear their own voice… so that is wonderful as you are introducing the foundation of sounds in early childhood by hearing your own voice." The children's desire to share their learning increased with the recording capabilities of the flip-camera and digital camera. According to Mrs. Nelson,

> A child would record their work and they would want to show it back whether through our video site and sometimes we would look at those together at the end of the day on our screen in our classroom or just showing it to each other with the hand-held camera and so lots of sharing and listening and speaking.

It was evident from talking with Mrs. Nelson that the children's interest in sharing, listening, and sharing had definitely increased as a result of an environment designed with multiple forms of technology.

With the inclusion of multiple forms of technology in the environment, Mrs. Nelson found that the students became more motivated to do bigger, more concentrated work. According to Mrs. Nelson, "the kind of work they chose changed. They wanted big work because big work could be recorded." Children desired to do work that required many steps so that they could make longer videos of their work. At other times, children chose to do bigger work to be video taped by another friend. I directly observed Mia encouraging others to do big work so that she could take a picture of their big work. The following exert from my field notes describes the incident,

> "I'm takin your picture cuz you are doing big work. Ok? Say cheese". Afterwards, she returns to her table and turns the camera off. She puts it back in its basket and very carefully returns it to the shelf. She returns to her table to put her traditional math work away. She says, "I'm gonna do more work so I can take another picture with the camera".

The children were also more motivated to do work that they filmed others doing or that they observed peers doing with a given technology tool. An example of this motivation was observed when Adeline walked around the room trying to decide what work she would do next. She stopped at Mia's table and noticed that she was using the SmartPen to write a story. Adeline told Mia, "I want to write a story with the talking pen next." She went to the shelf and removed a SmartPen paper from the folder. She took the paper to an available table and set it down. She sat down with her paper and waited until Mia had

finished working with the SmartPen. I also observed this kind of peer motivation with Ceiley when she was using the flip-camera to create a video journal of the things she likes to work with in the classroom. While creating her video, she passed Melvin who was writing a story with the SmartPen. Seeing Melvin, Ceiley said, “I’m gonna do the story pen after Melvin is done.”

Student interest in learning was positively impacted by the positive feedback students received from their parents who viewed their posted videos, photos, and digital stories on the secured classroom website. Mrs. Nelson noticed that children were more motivated to work with their lessons after parents commended their work. Mrs. Nelson also shared positive feedback that she had received from the school principal and parents of the participants,

> Oooh, the parents are...thrilled! The principal has gotten calls ...the Assistant Principal too...parents stopped me yesterday..who was just getting on the website...she had been busy before and just now viewed it and said, "I can't believe it...that was wonderful..I was so excited to see my child...so it has really increased our communication and it has given them a window into our classroom that they didn't have. They could always come visit the classroom, but parents cannot always leave their jobs to come so this allows them to sit at their office or be at home and click on and actually see some things that their child has done whether it be some pictures they have taken...and really seeing it from their child's angle or point of view so I really try to say "This is a picture from Adeline's view" .."this is Adeline's world or this is Mia's world" so the parents can see that in

> particular so it just opened up a whole new line of communication between school and home.

Mrs. Nelson found that outside communication with participants' parents had been positively impacted by the inclusion of multiple forms of technology in the environment.

It was evident from data gathered in the teacher post-interview and observation field notes that the inclusion of technology had an overall positive impact on student learning. From reviewing data collected from my interviews with Mrs. Nelson and my own observations of the classroom, I was pleasantly surprised that the students were not the only ones who experienced an increased interest in learning as a result of the technology tools made available in the classroom. The classroom teacher's interest in learning heightened as she considered additional ways to increase learning opportunities for the children with technology. In our post-interview, Mrs. Nelson shared that,

> I would really like to see them to do some...they are called digital stories where they take the pictures they had made and really sequence them and say this is beginning so you could actually retell say the flower story and they took each picture of the steps of the cloud and put that together digitally and you have a flannel board basically but digital--a new tech-flannel board when you are telling the stories. So I like ...so that is what we saw. And that is what we saw. We saw a child, as we looked at the child, we thought what is he doing? He was angling things a certain way and would take a picture at different angles. He would set things up the way he wanted to see them...so really I would like to give them more of that. So I would definitely...I plan to have that technology shelf up and

> going...introducing it..probably not the first day of school next year, but definitely as we go through the year.

When asked if she would continue to include multiple forms of technology in the environment, she enthusiastically replied, “Yes, I would as long as it was still within a learning environment.” When asked if there were other technology tools that she would like to add to the environment to allow the children to create meaning in additional ways, Mrs. Nelson responded,

> I think so. I would like to, as I said earlier, we do not have a computer for the children in the classroom so I think I would love to add along with our tools on the technology shelf to have a computer there, possibly a laptop, something that they can automatically download to...it's not that they cannot download...it's the fact that things are in my office and it is not as accessible for them but if it was set in the child's environment then they could download and do all of that..the storyboard...they could do that. So I would love to see a laptop.

From Mrs. Nelson’s response, it is evident that the inclusion of technology tools in this classroom environment will continue to be explored and expanded to provide the children with increased opportunities for learning with technology.

In summary, Research Question 3 asked, *What impact does an environment designed with multiple forms of technology have on student interest in learning activities?* It was evident from the data collected and analyzed from the post-teacher interview and observation field notes that student interest in learning activities varied among the participants, but overall learning for all participants positively increased with

the inclusion of multiple forms of technology in the environment. The design of the environment itself contributed to the increase in learning that was evidenced by the teacher and me. The children's interest in reading and writing increased with the inclusion of technology tools in the classroom. Learning increased through unintentional lessons that resulted when one student noticed another student struggling with the use of a particular aspect of technology. The children were more motivated to do work that they filmed others doing or that they observed peers doing with a given technology tool. I found that the kind of work that the children chose to do changed as a result of the inclusion of technology in the environment; they desired to do work that required many steps so that they could make longer videos of their work. Student interest in learning was impacted by the positive feedback students received from their parents who viewed their posted videos, photos, and digital stories on the secured classroom website. I found the responses given by Mrs. Nelson in our post-interview to be congruent with my own observations of the children and concur that the design of the environment which included multiple forms of technology positively impacted student interest in learning activities with minimal disruptions to the teacher's instructional time and to the overall learning of the classroom.

Evidence of Quality

To ensure the quality of my single case study, I used a systematic, structured approach to collect and analyze data from multiple sources across varied times and dates during the 4-week study period. In the interest of objectivity, I made my learning of the ways children preferred to use technology for learning transparent by recording my reflections and experience of learning as a participant observer using the researcher log

available with the NVivo 9 data analysis program. During observations of the children, I kept field notes that provided a running account of my observations and experiences in the field. This enabled me to provide readers of my study a snapshot of the learning activities that happened in the moment and that could be read and revisited time and time again (Geertz, 1973, p. 19).

During my study, I continually interacted with the data on a daily basis as I read through and analyzed data collected from teacher interviews, observations, field notes, participants' video journals, and digital artifacts generated by the participants. Interacting daily with the data enabled me to directly experience and to richly describe the ways children preferred to create meaning with technology in an environment designed with multiple forms of technology.

Weekly, I analyzed the digital artifacts created by the children and the web postings made to the secured classroom website. The classroom teacher was interviewed before and after the study to obtain her perceptions of literacy and the ways she perceived the children were able to create meaning in an environment designed with multiple forms of technology. Immediately following interview sessions with the teacher, the notes and audio recordings of the interviews were downloaded and entered into NVivo 9. The teacher participant was given both paper and email copes of the interview transcripts to give her an opportunity to change or add to any of the responses she gave. Immediately following classroom observations, I entered the field notes into NVivo 9 and coded the notes according to existing nodes and new nodes when new themes emerged. Weekly, I downloaded digital contents from the flip-camera, SmartPen, and digital camera and entered them directly into NVivo 9 installed on my password protected laptop. Daily

throughout the study and after, I reviewed the contents of the digital artifacts and analyzed their contents using an Artifact Review Guide (Appendix G).

Throughout my study and in the weeks thereafter, I conducted constant comparisons of the data and ran categorical queries of the data with NVivo 9 to check for consistencies across patterns and categories emerging from my analysis of the data. These patterns and categories were constantly compared and triangulated across all sources until two main themes emerged; communicative and explorative (See Appendix U). These main themes frame the phenomenon of the inclusion of technology in the early childhood Montessori classroom.

This active interaction with the data throughout the study helped me to create and re-create an accurate portrait of the inclusion of technology in early childhood education phenomenon on a daily basis.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of my qualitative single case study was to explore how 4-year-old children in a public Montessori preschool designed with multiple forms of technology located in a mid-South state preferred to use technology for learning at school. I also sought to richly describe the ways the environment designed with multiple forms of technology fostered student interest in learning and what learning connections were made while using such tools as digital cameras, flip camera recorders, and SmartPens in the classroom. My single case study comprised of five participants at one mid-South public Montessori preschool. Data were collected across varied times and dates over a 4-week time period and included face-to-face audio-taped teacher interviews, student video journals, parent surveys, classroom observations, digital artifacts (photos, videos, and stories) created by participants, and a researcher's log. This chapter presents an interpretation of the findings, implications for social change, recommendations for action, and recommendations for further study. In addition, a reflection of my experience with the study is provided. The chapter concludes with a closing statement.

Interpretation of Findings

The Montessori method and the New London Group's literacy design that incorporates multiliteracies provided the conceptual framework for my study. The Montessori method advocates an instructional approach that is child-driven and provides the child with an environment that is prepared with all of the essential tools of the time so that the child may fully explore his world and make discoveries of his own. The literacy vision of the New London Group to provide an environment design that allows for

children to create and re-create meaning in ways that extend beyond traditional forms of writing and reading is evident in all subsequent areas of the discussions and provided an affirmative framework upon which to build this case study of the ways children prefer to use technology for learning in an environment designed with multiple technology tools. The findings of this study reveal the ways 4-year-old children in a Montessori preschool preferred to use technology for learning and how the environment designed with multiple forms of literacy impacted student interest in learning activities.

The first research question was, *In what ways do children use technology to create meaning in an environment designed with multiple forms of technology?* The evidence revealed that the ways children used technology to create meaning varied as a result of the environment designed with multiple forms of technology, the freedom given to the children to direct their own learning, and prior experience using technology in the home environment. Four of the five child participants of this study readily embraced the inclusion of multiple technology tools in the learning environment and naturally included the tools as part of their everyday learning in the classroom. Because the majority of the children were given opportunities to use various technologies in their home environment, perhaps their willingness to accept the SmartPen, digital camera, and flip-camera as additional technology tools for learning at school was based on earlier success experienced with technology in their home environments. This aligned with Tapscott's (2009) study that found that "children who have grown up digital are more comfortable, knowledgeable, and literate with technology than ever before in history" (p. 2).

Like Tapscott's findings, I also found that the children were more likely to assimilate technology rather than accommodate for it like adults do (p. 19). The children

of this study did not gravel with how the technology fits into existing learning; instead, they simply went with the idea that they were given another tool to use for learning. This was evident when observing the teacher introducing the technology tools in the classroom. The teacher did not build up an in-depth explanation of why the tools were added or give restricted uses for any of the tools introduced. Instead, she simply introduced them as other tools that they could use for learning throughout the day. I did not observe any of the children asking why the tools were included in the environment; they assimilated or adopted the technology as new ways to learn in the preschool environment.

The children accepted the technology as part of their environment. The inclusion of the tools alone did not result in their use by the children. I found that the children preferred to use technology as it was relevant to their work and learning needs. The participants of my study compare to Stevensen's (2008) respondents, who when given access to technology only perceived it useful when it was made relevant to them or when it served one or more of their basic human needs (Montessori, 1995). In addition, my study's results are congruent with Gibbons's (2007) findings in which a majority of the participants accepted the use of new technologies as naturally as they did the use of books, pencils, and paper. I also found that the children did not use technology to the exclusion of other traditional preschool learning materials.

Despite the children's natural acceptance of emerging new technologies, Boyd (2008) and Merchant (2009) found that the inclusion of technology at the preschool level in Montessori schools and preschools in general continues to be debated. As a result, the inclusion of technology at the preschool level is still in developmental stages. I found the

same to be true at the school site of my study. Mrs. Nelson shared the struggles that her school has faced with embracing the use of technology and how their position on technology at the preschool level is evolving. She found that many of her early childhood colleagues were not certain where Maria Montessori would have gone with technology for the young child.

Despite the uncertainties of the benefits offered by the inclusion of technology in preschool, I found that the classroom teacher was willing to expand her own definition of literacy and to explore the use of multiple forms of technology not yet researched with the preschool child. Mrs. Nelson's new definition of literacy fit in with Coiro, Knobel, Lankshear, and Leu's (2009) description of the multiple ways to become literate which took into account "changes in social and cultural ways of doing things, ways of being, and ways of viewing the world" (p. 7). Like Cohen (2005), Plowman & Stephen (2003) and Yelland et. al, 2008), Mrs. Nelson was willing to move past the idea of simply adding a computer to the classroom and towards the creative use of technologies that allow for collaboration, exploration, and knowledge building that is not otherwise possible with traditional preschool materials.

My research extended these other studies with its finding that when an environment is designed with multiple forms of technology and allows children the freedom to choose when and how they wanted to use the technologies, the children were able to create meaning in multiple ways that went beyond traditional reading and writing experiences. The studies of Cohen (2005), Plowman & Stephen (2003), and Yelland et. al (2008) each focused on the impact of the inclusion of one emerging technology at a time and the learning was teacher directed and tied to specific instructional themes and goals. I

found that children were able to independently express their own ideas, tell and write their own stories, and record their own work in ways they chose to.

The second research question asked, *What are the ways preschool children prefer to use technology for learning in an environment designed with multiple forms of technology?* Yelland et. al (2008) researched how multiliteracies could be implemented in preschool environments from the perspective of the teachers. Whereas their work was instrumental in challenging educators to rethink literacy practices in the early years to include technology, their findings did not consider the child's perspective or take in account the cultural and social needs of the child growing up digital today (Tapscott, 2009). For my study, I embraced the vision of multiliteracies held by the New London Group (1996) which viewed learners as active agents in the meaning-making process and focused on following the child's lead and interests where technology was concerned (Montessori, 1995). My findings helped address the need for research on the inclusion of technology in the early years that incorporates multiliteracies.

Lowe (2009) found that the 4-year-old preschooler seeks to be independent in what he wants to do and in how he wants to do it. Advancements in technology have allowed the preschoolers to have more control over their learning than ever before (Sprenger, 2008, Lowe, 2009). I found this to also be the case with my research of 4-year-old children. I found that after initial guidance of a teacher or peer, preschoolers quickly became independent users of technology and were able to think about choices of technology tools to use for their desired learning outcomes. Findings of my study coincided with Lowe's finding that digital videos created by the children allowed them to reflect on their own play and learning while at the same time providing valuable insight

for the adult into their perspectives and preferences (p. 33). Congruent with Lowe's (2009) findings, I found that a range of technologies made available to the children on an every day basis allowed the children to "discover the place and purpose for the use of technology in their everyday lives" (p. 27). Like the participants of Lowe's study, I found that providing children with multiple forms of technology to choose from enabled children to use technology tools that matched their own levels of understanding. This was evidenced when Kyra struggled to use the audio recording feature of the SmartPen and flip-camera. Despite her struggle, she was still able to choose the tools to create visual documentations of her work.

Burnett (2010) reviewed research pertaining to the implementation of technology and literacy development for children aged 0-8 in educational settings from 2003 to 2009. After reviewing the literature, Burnett argued the need for more "extensive exploratory research in the field which considers how digital practices within educational settings relate to other dimensions of children's literacy learning" (p. 265). My research offers better understanding of how the children of one public Montessori preschool classroom related the new technologies to other dimensions of their learning: they showed a preference for using technology to document their work, communicate ideas with others, explore the people and objects of their environment in new ways, and to discover how features of the technology tools worked.

Carrington (2005) and Tapscott (2009) increased awareness of the digital landscape of children today with detailed descriptions of the new technologies that have inundated society as a whole. They have challenged educators to rethink what learning should look like for the young child in this new digitized world. I accepted the challenge

and found that because children grow up digital, the majority of the participants appeared to accept the flip-camera, SmartPen, and digital camera as additional tools for writing and learning in the classroom. The results indicated that the children became more interested in writing because of the capabilities of the technology that allowed them to hear their own voice tell their story back. This was especially true for Melvin and Mia who added both emotion and sound effects to their writing with the SmartPen.

Marsh's (2004) and Smith's (2005) studies found that young children ages 2 ½ to four years old were able to experiment and make meaning with digital texts and tools. Mavers (2007) found that young children can engage with emerging technologies when they are made available and relevant to their current lives; it is a matter of "*being* rather than *becoming* literate" (p. 172). The results of my research were congruent with Marsh, Smith, and Mavers work and added to knowledge base how the young child valued both the freedom to work and the freedom of choice to carry out the work. Additionally, I found that through their own exploration, the children often discovered how to use the tools for other uses and purposes and were more at ease to explore technological capabilities than the adults were. Tapscott's (2009) $4 million dollar study of the net generation (population 20 years and younger who grow up digital) found the same to be true that the children often understand new technologies better than their parents and educators. This was evidenced in my study when Melvin was teaching the teacher how to work the slide show feature on the digital camera and when Adeline taught her mother how to use the digital camera.

My investigation revealed that when participants wanted to find answers to their questions; they turned to the Internet. This observation coincides with Tapscott's (2009)

findings which revealed that the digital generation by nature turns to the Internet to "communicate, understand, learn, find, and do many things" (p. 9). This was not to say that children did not still enjoy looking for information in books. My research found that children also enjoyed learning about cultures with books and maps. Studies conducted by Miller (2005) expressed concern that children are less interested in paper and pencil literacy activities and interacting socially with others when technology is offered as a choice in the learning environment. My analysis found that the children still were interested in traditional media.

Another benefit realized in my investigation was the fact that technology was found to be relevant to the child's real work rather than just to be relevant to play-oriented activities with pretend technology tools. The study revealed that the flip-camera, SmartPen, and digital camera were used as real learning tools to accomplish real learning tasks that were relevant to the child's process of learning.

The third question asked *What impact does an environment designed with multiple forms of technology have on student interest in learning activities?* The results of my research indicated that when the inclusion of multiple forms of technology within the environment were combined with the freedom afforded the children to use the technology in ways they preferred, student interest in learning activities increased. There was evidence indicating increased student interest in listening, sharing, communicating, writing, reading, and doing more concentrated work.

Burnett, Dickinson, Myers, and Merchant (2006) explored how the writing process could be transformed with the use of keyboards and mouse devices. Like their study, I found that the digital tools employed in this study enabled children to write

regardless of their ability to physically use a pencil to form letters. I found that the children of this investigation were much like the children studied by Burnett et. al's (2006) in that they were both highly interested in creating multimodal texts which included "their own drawings, digital photographs, and images from the internet and clipart" (p. 20).

An ethnographic study by Pellettier, Reeve, and Halewood (2006) found that computers could support kindergarten children in building knowledge rather than just using computers to express pre-existing knowledge in story writing activities (Andrews, 2004; Burnett, 2009). My research evidenced similar ways children were able to use technologies to build knowledge. I observed Melvin using the digital camera to build his knowledge of the ice bergs of North America. He discovered the ice bergs in a photograph he found in a book about North America. He chose to capture his learning with the digital camera and flip-camera so that he could record this new knowledge and share it with others. The flip-camera, SmartPen, and digital camera were found to be effective tools for preschool children to use to document and to share knowledge gained. Repeatedly, children used these tools to record the work they completed and to talk about discoveries they had made. By allowing the children to use these tools in the classroom, the children were able to quickly see evidence of their knowledge gained and were more interested in doing bigger, more concentrated work to share with others. The one-step playback features of the tools provided children with the instant gratification 21st century learners are accustomed to receiving (Tapscott, 2009).

Burnett et. al's (2006) study found that the children expressed increased confidence in their ability to use the computer and found it was easier to create texts for

purposeful communication with an audience that would respond (p. 25). I observed the same to be true when the majority of the children enjoyed reviewing pictures or videos made by their peers with the flip-camera and digital camera. The positive peer feedback received boosted the confidence of the camera user and motivated the child to create more texts to be shared with his or her peers. Additionally, my investigation found that positive parent feedback from posted videos, pictures, and stories to the secured classroom website also increased the confidence of the children's ability to use the technology tools and increased their desire to use the tools to express their learning.

Unlike critics (Armstrong & Casement, 2001; Cordes & Miller, 2000; Healey, 1998; Miller, 2005), who argued that children using technology takes away valuable learning from play and socialization, my study found that the new interactive, mobile, and one-click operative features of the flip-camera, SmartPen, and digital camera technologies opened news ways for play and socialization. The mobility of the SmartPen, digital camera, and flip-camera allowed the children to be on the move rather than stationary when using the tools. My research's findings are congruent with Coiro, Knobel, Lankshear, and Leu (2008) who found that advancements in technology have made it more possible to move past print-based traditions and provide more opportunities for children to develop multiliteracies and be better prepared for their social futures. The teacher of my study found that the inclusion of multiple forms of technology within the environment allowed the children to be social in a new way. In contrast to Miller (2005) that found a decrease in socialization with use of technology, the opposite was found to be true in this investigation. There was evidence that the children were more interested in writing if it allowed them to share the writing socially among peers. I found that the

children socially connected with one another's ideas and work through the use of the flip-camera, SmartPen, and digital camera.

I found that four out of the five child participants of my study preferred to use technology independently to create meaning. Many of the children in my investigation were drawn to the technology tools because the tools increased their independence as learners. Children of this age are drawn to materials that allow them to be independent as they explore and make sense of their world. Like the children in Marsh's (2006) and Merchant's (2005) studies, the children of my study were eager to interact with a variety of technological tools and applications. Because the features of the selected technology tools could be used with one click, the children of my study were able to successfully direct their own learning as confident, independent, and motivated users of technology. The teacher participant of my study also attributed the ways children were able to be successful, independent users of the various technology tools to the manner in which the tools were included within the environment and introduced to the children for independent use.

A review of the literature showed a lack of research of how technology has been incorporated in the early years to promote writing and social behaviors. Though limited in number, the majority of the studies conducted were focused on reading and supplemental print-based activities which were teacher selected and based on curricula standards (Burnett, 2010; Andrews 2004; Burnett 2009). In contrast, my research allowed the children to direct their own learning and found that their interest in writing developed naturally from their inner need to communicate and express to others what they need and what they are learning. This finding coincides with the Montessori method that describes

the natural way children are drawn to writing (Montessori, 1995). Mrs. Nelson, the classroom teacher of this investigation found that by allowing the children to direct their own learning with the technology tools, there was an explosion of interest in writing that resulted, especially with the children who used the SmartPen.

Through my study, I exposed that the design of the environment itself allowed children to increase in their independence and confidence as emergent writers and readers. Montessori (1995) emphasized that the child's learning environment should be prepared with the essential tools of the time and guide children towards their independence with the tools of the environment. A review of the literature showed that much has been theorized about transforming learning environments to reflect the influence of technology (Bawden, 2001; Cope & Kalantzis, 2000; Marsh 2005; Harrison et al., 2009; Hisrich & Blanchard, 2009); but very few studies have actually researched how such a transformation would take place in classrooms. Of the few studies conducted, the focus was on the incorporation of a computer station in the classroom and on technology activities that were teacher directed (Burnett, 2009). My investigation details how multiple tools with mobile capability can be included and used throughout the classroom. The variety and mobility of the tools allowed the children to freely and confidently explore how to become writers and readers. Additionally, the inclusion of multiple forms of technology in the classroom better mirrors most of the home environments the preschoolers come from. Creating more home-like settings in preschools possibly enhances child outcomes at school (Reggio 1999; Montessori, 1995). In this case, technology in both environments should look more similar so that children

growing up digital are able to come to preschools designed with technology that allows them to cultivate 21st century skills.

It was evident from Mrs. Nelson's interview responses that overall she felt that student learning had positively increased as a result of the inclusion of multiple forms of technology within the classroom. A review of the literature pertaining to the inclusion of technology at the preschool level conducted prior to the start of my study revealed that early childhood educators have been reluctant to incorporate technology into the classroom due to rising issues with the management of students' use of the technology, distraction to the overall classroom learning that has been experienced with the inclusion of a computer in the classroom, and the reduction of the teacher's instructional time due to time required to assist students when problems arise with the technology (Burnett, 2010; Chen & Chang, 2006; Miller, 2005; Plowman & Stephen, 2005). Unlike these studies that suggested the inclusion of technology in the preschool environment would cause classroom disruption, consume the teacher's instructional time, and distract students from learning; with the exception of one student, I found the opposite to be true. The inclusion of multiple technology tools in the environment actually reduced classroom interruptions. Children were able to be less dependent on the adult and rely more on peer help as well as the capabilities of the technologies themselves. Rather than relying on the teacher to come and check their completed work, children used the cameras to document their work knowing that the teacher could see their work later; freeing the teacher to continue to teach without stopping to acknowledge the completed work of children.

Burnett, Dickinson, Myers, and Merchant's (2006) study reported positive findings for the inclusion of technology in preschool settings when the teacher directed

the learning and technology enhanced the study of a particular theme the class was focused on and built on existing skills children were learning. Similarly, my analysis reported positive findings for the inclusion of technology in preschool; however, the positive findings of my study were based on child-driven learning and the ability of the children to choose topics of their own interest when the environment was transformed rather than enhanced with multiple forms of technology. As a result, the teacher and I both witnessed that the children were able to experience learning in a way not possible through traditional instructional methods alone. At the preschool level, learning is mostly hands-on; children cannot take products of learning home if their work was with blocks, puzzles, fresh flowers, or clay. I found that children preferred to use the flip-camera or digital camera so that they could capture their learning, make a record of it, and share it in a way they could not do before.

Finally, the evidence indicated that an environment designed with multiple forms of technology allowed the children to become literate in new ways that are more reflective of 21st century living and learning. This evidence is congruent with Tapscott's (2009) and Boyd's (2009) descriptions of what the digital child needs to learn and grow in a world that is continually inundated with emerging technologies that offer new ways of thinking, communicating, and being.

Conclusions

I found that when multiple forms of technology are included within the environment and children are allowed to choose when and how to use those tools for learning, children will create meaning in new ways that are characteristic of 21st century learners. With the continual growth of technology and changing landscape of literacy,

early childhood educators must rethink the educational implications an environment designed with multiple forms of technology can provide. The results of my investigation reduce the gap in the literature and provide a clearer picture of the inclusion of technology at the preschool level phenomenon.

The inclusion of multiple forms of technology within the preschool environment and the freedom to choose how and when to use the tools for learning were welcomed by the majority of preschool children; and generally, the students were motivated to extend learning with the new tools available to them. Teachers who include multiple forms of technology in the environment may find increased interest in literacy activities that include but also extend beyond traditional reading and writing activities.

This research was limited to five participants over a 4-week period. The benefits of a preschool environment designed with multiple forms of technology that were revealed in this short time frame provides a model for teachers to use to design preschool environments with multiple forms of technology. I focused on three tools: the flip-camera, SmartPen, and the digital camera. These tools are just a few of many other tools that could be included in the environment to allow the children additional ways to build knowledge, record work, share ideas, and explore their environment. There are also other ways that the flip-camera, SmartPen, and digital camera could be used and studied for effect over a longer period of time to discover more of the ways children prefer to learn and create meaning with these specific tools. The inclusion of additional tools such as the iPad and laptops with mobile Internet capabilities would allow the children to experience greater independence in their learning as they could more readily download and send their own digital pictures, stories, and videos.

Implications for Social Change

The results of my study reveal that an environment designed with multiple forms of technology better mirrored most home environments of preschoolers and gave children the freedom to choose when and how they wanted to use technology for learning. With continued debates regarding the appropriate inclusion of technology in early childhood education (Burnett, 2010), my research fills a significant gap in the existing literature, as no previous study was found which attempted to explore how to effectively include multiple forms of technology for learning in the preschool years or that allowed the children to be agents of their own learning with the included technology. My research will generate positive social change as its findings create a social awareness among early childhood teachers, parents, and educational leaders of the many ways that an environment designed with multiple forms of technology provide children to be literate and to be prepared for successful living and learning in a world that is continually impacted by technological advances. The significance of conducting my research was to bridge the technological gap children experience between their home and preschool worlds and to provide a model design for preschool environments that better mirror home environments that naturally integrate technology so that children can experience learning in a more familiar and preferred way at preschool through technology.

The results of my study demonstrate how the inclusion of multiple technology tools in the preschool environment allowed 4-year-old children to use the flip-camera, SmartPen, and digital camera to document their learning in ways that they could not do before with traditional media. The design of such an environment, that includes multiple forms of technology, may contribute to the improvement of the development of multiple

ways to be literate of young children who grow up in a world that is digital, as well as reduce reliance on the adult for instant feedback and increase social interactions with peers. As a result, the knowledge gained from this research could contribute to positive social change as children are given increased opportunities for creating meaning and sharing knowledge with others. Such positive changes as these hold potential for better preparing young children for their social futures and learning that is more characteristic of the 21st century.

Potential educational advantages from my study include increasing awareness among early childhood educators. The inclusion of technology in the preschool environment may be enhanced through an increased understanding of the balance between traditional and technological ways of learning that can be obtained when children are allowed to choose among both print-based and digital tools included in the preschool environment to demonstrate learning. I found that 4-year-old children preferred to use the digital camera and flip-camera to record their reading and writing work over print-based materials. The results also revealed how children did not use technology tools to the exclusion of more traditional media to learn with; thus, striking the desired balance between traditional and technological ways of learning in early childhood education.

Further benefit to the children served by early childhood programs may emerge simply from enhanced understanding that children who are given the freedom and time to explore the ways meaning can be created with multiple forms of technology in the preschool environment will be more willing to embrace new ways of knowing, expressing knowledge, and communicating with others. As more technological tools are introduced in society, such as iPads and SmartPhones, today's preschooler will benefit

from knowing how to choose technology tools for varied purposes. Technology will continue to change in its form and capabilities; thus, it is more important to create learners who are willing to embrace new ways of knowing and who are not intimidated by change or the introduction of new tools for learning and communicating with others. Designing preschool environments with multiple forms of technology will help children to embrace change and accept continual advances in technology as opportunities to obtain knowledge and to communicate with others in new ways.

Recommendation for Action

From the conclusion of my study, it is evident that an early childhood learning environment that currently uses technology sparingly or not at all should carefully reconsider technology's purpose and place within the child's learning environment. As the data revealed, children readily used the technology tools for learning when the environment was designed with multiple forms of technology and they were allowed to freely choose when and how they wanted to use the available tools; therefore, providing early childhood educators with continual, professional development pertaining to how to design preschool environments with multiple forms of technology and how to empower the young child as a 21st century learner is essential. The key is to provide teachers with adequate training and the motivation to redesign environments with multiple tools of technology that offer the child new ways to obtain and share knowledge rather than adding a computer in a corner that is restricted in its use and purposes for learning. Although the majority of the children handled the flip-camera, SmartPen, and digital camera with care and used them for learning in ways that were not disruptive to the

overall learning of the classroom, early childhood teachers need to be mindful of the child who carelessly handles the tools and disrupts the learning environment for others.

The findings of my investigation will help parents to make better informed decisions when selecting the kind of preschool their child will attend. They will want to choose a preschool environment that extends learning opportunities beyond those experiences tied to traditional reading and writing activities to allow their child to cultivate twenty-first century learning skills. Parents of preschoolers might also look for ways to incorporate multiple forms of technologies in the home that would allow their child to create meaning in new ways.

The results of my research will also provide school leaders, particularly the local Steering Committee affiliated with the University, made up of 20 Montessori school directors impacting approximately 915 students and families, with insight into how 4-year-old children use technology tools such as the digital camera, flip camera recorder, and SmartPen to extend preschool learning opportunities beyond those experiences tied to traditional reading and writing activities, allowing them to cultivate twenty-first century learning skills.

Universities which offer pre-service teacher training might rethink how their programs are preparing teachers to incorporate technology into early childhood education. Perhaps, they could add a technology component to the coursework so that teachers would feel more confident in their use of newer technologies and would as a result be more likely to include technologies in the classroom.

The findings of my investigation will help technology manufacturers to rethink how they can make technology more accessible and affordable for classroom use. Since

so many schools operate on limited budgets and were built before the Internet was introduced, it is essential that companies think of alternative ways to bring the Internet into the classroom. This can be accomplished through data package plans via flash drive Internet access if the companies would offer affordable rates for classroom use. This would increase the availability of Internet access at a reduced rate to educators and students and reduce the overall costs associated with the inclusion of technology in school environments. Classrooms could be brought into the 21st century instantly without building renovation or expensive equipment costs.

Recommendations for Further Study

Although my research provided an increased understanding regarding the phenomenon of the inclusion of technology at the preschool level, the results also revealed the need for further research. My case study was limited to five participants attending one public Montessori preschool. Further investigation which studies more children from both public and private sectors of schools would add to the understanding of the inclusion of technology at the preschool level.

In addition to the small sample size, my research was also limited by the four-week time period. It is recommended that this investigation be replicated over a longer time frame, perhaps a year or even over the three year period in which students are enrolled in the Montessori preschool classroom. Furthermore, a follow-up study of these participants would be insightful to fully see the impact that an environment designed with multiple forms of technology had on the development of the children during their preschool years. It would be interesting to find out if the results of this research are still relevant.

The participants of my study were freely allowed to choose when and how they would like to use multiple forms of technology for learning. The flip-camera, SmartPen, and digital camera were widely used; however, the Internet, Skype, and the computer were used on a limited basis due to their accessibility to the child. An investigation which explores the uses of these tools made more accessible to the child would be beneficial to educators who may be apprehensive about integrating these other forms of technology into the classroom.

My analysis also revealed that children, who had regular access to technology in the home, readily accepted and experimented with the technology tools included in their preschool environment. The participants, who had technology available in the home but had limited use with it, exhibited interest in the tools included in the classroom, but lacked the confidence and ability to independently use them. These results indicate the need for further investigation to be conducted pertaining to the development of a single literacy that is bound by traditional forms of reading and writing that is experienced by preschool students who do not have access to multiple technology tools in either the home or school environment.

Researcher's Reflection

Due to my genuine interest in how technology can be better included in early childhood environments, it was necessary for me to maintain a researcher's log to record my personal reactions to data and to express my own assumptions and biases. This log enabled me to keep my personal reflections and assumptions separate from the data being analyzed (Merriam, 2002). It allowed me to bracket my personal feelings so that I could

be reflective through the data analysis process without interfering with the actual data analysis process (Hatch; Merriam, 2002).

My bias included a heightened interest in multiple forms of technology and multiliteracies strategies applied to a Montessori environment that derives from my personal background in Montessori and my genuine interest in how technology can be better used in early childhood environments. As a Montessori preschool teacher and parent of a preschooler enrolled at a Montessori school, I am accepting of instructional tools and practices that follow the child's interests and allow her to direct her own learning. Having included multiple technologies in my home for my preschooler to explore, I am comfortable with allowing her to choose which tools she prefers to use for learning when at home. Ironically, I have not included the same technologies in my Montessori preschool classroom and wonder if my students are being limited in the ways that they are allowed to learn and create meaning. Since I had not yet included multiple forms of technology in my preschool classroom, I did not bring any pre-conceived ideas on what technologies the children would prefer or how the environment designed with multiple forms of technology would impact student interest in learning activities. As a Montessori parent and teacher, I bring to the research both knowledge and years of teaching experience with the Montessori Method approach.

When conducting my study, I assumed the following: (a) participants have the freedom to choose when and how to use multiple forms of technology tools for accomplishing learning tasks at school, (b) participants voluntarily participated in all aspects of the study, (c) the classroom to be studied was designed with multiple forms of technology before the study, (d) participants provided honest reflections pertaining to the

use of multiple forms of technology tools on a video clip, and (e) teacher participant provided honest responses to interview questions. It was also assumed that the child participants were self-directed enough to choose the technology tool preferred to accomplish learning tasks. These assumptions were pertinent throughout my research as I thoughtfully read through and compared data compiled from teacher interview responses, student generated digital artifacts (stories, photos, and videos), field notes taken during classroom observations, and student video journals to richly describe the inclusion of technology at the preschool level phenomenon.

In terms of the outcomes of my investigation, I did not bring any pre-conceived ideas on what technologies the children would prefer to use for learning or in what ways the environment designed with multiple forms of technology would impact student interest in learning. I was not even sure that the inclusion of multiple forms of technology in a Montessori preschool would be beneficial or not. However, during my observations, I was surprised at how naturally the technology fit into the carefully prepared preschool environment. It was if it had been there all along. The children seemed to accept the technology tools as a natural part of their learning environment. It was during my observations that I became aware of the following personal assumptions: a) that the technology would not fit into the environment in a way that was conducive to the flow and learning of the classroom and b) that the children using technology would be distractive to other learners in the room. When the data revealed that the technology was used in the same manner as the other materials in the room were and that distractions actually decreased with the inclusion of technology, I was pleasantly surprised.

Because I often struggle with figuring out how to use new technologies and gravel with how they fit in with the way I prefer to learn and do things, I was surprised that the children did not struggle with how to use the new technology tools. For the most part, the children quickly became confident, independent users of the technology tools and were able to use the tools to create new meanings and to be social in a whole new way. Throughout my study, I experienced with all my senses and came to the realization, that when the environment is designed with multiple forms of technology, and the children are given the freedom to choose when and how they prefer to use the tools, the children use the tools to create meaning in ways that they are comfortable with and in ways that were not possible with traditional preschool materials alone.

Concluding Statement

As the digital landscape of children continues to change, it is imperative that early childhood educators rethink what learning environments should look like for young children who need to be literate in multiple ways and who must be better prepared for their social futures. Designing the environment with multiple technology tools combined with the freedom of the children to choose how and when they prefer to use the technologies for learning can offer children new ways of thinking, communicating, and being that are more reflective of 21st century living and learning. Rather than focusing on how technology fits into *existing* curricula, educators need to focus on the *new ways* technology allows children to create meaning and make sense of their world that extends beyond traditional reading and writing activities.

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Appendix A: Letter to Principal

112 Honeysuckle Drive
Hendersonville, TN 37075

<Insert Date>

<Principal's Name>
<School Name>
<Street Address>
<City, State ZIP>

Dear <Name of Principal>

I am interested in a study of multiliteracies at the preschool level. There is a significant lack of research regarding the best way technology can be used at the preschool level to incorporate multiliteracies, yet multiliteracies studies conducted at the elementary, high school, and collegiate levels demonstrates that environments embracing expanded definitions of literacy and learning that go beyond traditional reading and writing activities better prepare students for a constantly changing and unpredictable future. My study will explore children's preferred uses of technology for learning in an environment that allows them to choose when and how to use technology. Your school has been identified as a public school with a preschool program that meets the parameters of the study. I have already obtained approval from XXXX as required by your school system to collect data for my research project entitled " The Ways Preschoolers Prefer to Use Technology for Learning", and I am respectfully requesting your support in my research effort.

If granted permission to work in your school, I would first meet with the classroom teacher to discuss her plan for introducing her students to multiple technology forms and multiliteracies strategies. I would conduct interviews with the classroom teacher who chooses to participate to gain understanding of their preferred uses of technology tools. I am also requesting that the classroom teacher would be able to help children SKYPE with the researcher during community group to share learning experiences with the researcher when not present in the classroom. Skype exchanges between the classroom teacher, students, and researcher will be analyzed for student interest in social interactions using the technology tool of SKYPE. I would also like permission to come to the school to conduct four separate full morning observations to observe the students choosing technology tools for learning. The study would conclude with a follow-up interview with the classroom teacher. Overall, my data collection would have only minimal impact on school operations. Specific measures will be taken to protect the confidentiality of the students, teacher, and school as is indicated in the study design.

I greatly appreciate your consideration of my research effort and look forward to the opportunity to work with the children and teachers at your school. I hope to hear from you within the next seven days. For your convenience, I have attached a sample

agreement letter that you can use for your response if you are willing to have your school participate in my study.

Respectfully,
Darlene Estes-Del Re

Appendix B: Letter of Cooperation

Darlene Estes-Del Re
112 Honeysuckle Drive
Hendersonville, TN 37075

<insert date>

Dear Mrs. Estes-Del Re,

Based on my review of your research proposal and your prior approval obtained from XXXX, Head of Research for our school system, I give you permission to conduct the study entitled, " The Ways Preschoolers Prefer to Use Technology for Learning" for the purpose of exploring the children's preferred uses of technology tools for learning at school in an environment designed with multiple technology forms which are readily available for the children.

I believe that your study can provide valuable information to XXXX regarding ways to expand definitions of learning that may help our children be better prepared for a constantly changing and unpredictable future. I hereby notify you that in compliance with the school system policy, you are approved to use student data and students as subjects for a 4-week time frame to fulfill your dissertation requirements. In accordance with Family Education Rights and Privacy Act (F.E.R.P.A.) you are granted access to student information for evaluation purposes only to conduct your study. You may not use specific names of the students in your published reports. Individual's participation will be voluntary and at their own choosing following obtained consent from parents. We reserve the right to withdraw from the study at any time if our circumstances change.

I confirm that I am authorized to approve research in this setting following the approval of the school system's Research Director, XXXX. I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the research team without permission from Walden University IRB.

Sincerely,

XXXXX
School Principal

Appendix C: Letter of consent from a teacher

<insert Date>

Dear Teacher,

I have obtained the principal's support to collect data for my research project entitled " The Ways Preschoolers Prefer to Use Technology for Learning", and I would like to invite you to take part in a research study of children's preferred uses of technology for learning at school in an environment that allows children to decide when and how they want to use technology. You are invited to participate in the study because you are a Montessori preschool teacher who expressed interest in participating in research pertaining to technology use in preschool. This form is part of a process called "informed consent" to allow you to understand what is involved in the study before deciding whether you would like to take part. This study is being conducted by a researcher named Darlene Estes-Del Re who is a doctoral student at Walden University. Mrs. Estes-Del Re is also a Montessori preschool teacher at a private Montessori school.

Background Information:
The purpose of this study is to explore how and when children in a Montessori classroom prefer to use technologies for learning when multiple forms of technology are made readily available to them in the prepared environment to determine how best to integrate technology in early childhood education.

Procedures:
If you agree to be in this 4-Week study, you will be asked to:

- Participate in an audio-taped interview regarding your definition of learning and literacy and your attitude towards new technologies and the inclusion of technology in the Montessori preschool environment. You will be asked how student interest in learning are impacted by an environment designed with multiple forms of technology.
- Help the 3 to 5 participating students who wish to create a video-journal weekly post one of their created videos or stories to the classroom website already in use by your classroom during the transition time before all students go to recess. You will help one student post one video or story to the website per day requiring 5 minutes of your time daily for the 4-week duration of the study.
- Co-Host a parent information meeting regarding the nature of the study for parents of the child participants prior to the start of the study. Post parent information video clip created by researcher and supporting information documents introducing study to parents on your classroom website for parents to view who could not attend the parent information meeting.
- Participate in a follow-up audio-taped interview with researcher at the end of the study.
- Allow the researcher to introduce the students to the study using a puppet show at community time on Wednesday of the first week of the study that will take 15 minutes.

- Allow the researcher to conduct four 2-hour observations of children working during normal morning work time. The researcher will quietly observe and take notes during the observation.
- Allow Classroom Assistant to oversee 2 to 3 participating children to create 3 to 5 minute video journals using the flip-camera to talk about what work they did and what tools they liked best using that day on Thursdays and Fridays during the transition time before students go to lunch.
- During Group Community Time on Mondays, you will be asked to conduct a 10 to 15 minute SKYPE session on Interactive White Board in classroom with your whole class and researcher to share news of the day or anything else.
- Research activities for participating 3 to 5 students **only** include 4 weekly video journals created by students using flip-camera, weekly posts to classroom website, and four 2-hour classroom observations in which researcher will observe whole class but only collect data on the 3 to 5 participants. **All** students will continue to be engaged in regular instructional activities which include use of Montessori materials, traditional tools, and technology tools during the 4-week study.

Voluntary Nature of the Study:
Your participation in this study is voluntary. This means that everyone will respect your decision of whether or not you want to be in the study. If you consent, the researcher will explain the study to you in further detail. No one at Walden University or your school will treat you differently if you decide not to be in the study. If you decide to consent now, you can still change your mind later. If you feel stressed during the study, you may stop at any time. You may skip any questions you feel are too personal. You may opt out of the study at anytime by sending an email to the researcher or by discussing it with her in person.

Risks and Benefits of Being in the Study:
By participating in this study, you may have added stress to your daily workload. Helping students post video clips to classroom website will require you to take extra time and effort to respond. However, this project might help others by identifying which technologies are preferred by the children for language and social activities and should be included in preschool environments.

Compensation:
Participation in this study is strictly voluntary. You will not receive any compensation for your participation.

Confidentiality:
Any information you provide will be kept confidential. The researcher will not use your name or personal information for any purposes outside of this research project. All published documents of the project will conceal your identity as well as the identity of your school and students.

Contacts and Questions:

You may ask questions you have now. If you have questions later, you may contact the researcher via phone at 615-264-1235 or by email at darlene.estes-delre@waldenu.edu. If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott, the Walden University representative who can discuss this with you. Her phone number is 1-800-925-3368, extension 1210. Walden University's approval number for this study is <IRB will insert approval number here> and it expires on <insert expiration date>. You may also contact the researcher's dissertation chair, Dr. Irmgard Gruber. Her email is irmgard.gruber@waldenu.edu.

Attached is a copy of this consent form to keep for your records.

Statement of Consent:
I have read the above information and I feel I understand the study well enough to make a decision about my involvement. By signing below, I am agreeing to the terms described above.
Participant's Printed Name:_____.

Date of Consent:_____.

Participant's Signature (actual or electronic): _____.
Electronic signatures are regulated by the Uniform Electronic Transactions Act. Legally, an "electronic signature" can be the person's typed name, their email address, or any other identifying marker. An electronic signature is just as valid as a written signature as long as both parties have agreed to conduct the transaction electronically.

Appendix D: Parental Consent Form for a Child

Your child is invited to take part in a 4-week research study of the tools children prefer to use (including newer technologies) when learning at school. All children will continue to complete regular educational activities planned by the teacher according to the Montessori Curriculum as well as have access daily to the following tools speech-to-text word processing, SmartPen, Flip camera video recorder, secured classroom website, digital camera, and scanner. Your child was chosen for the study because he or she meets the following criterion of the study: a 4-year-old child in his/her second year of Montessori preschool, is typical in cognitive and physical development for a 4-year-old, and has experienced technology at home. This form is part of a process called "informed consent" to allow you to understand this study before deciding whether to allow your child to take part.

This study is being conducted by a researcher named Darlene Estes-Del Re who is a doctoral student at Walden University. Mrs. Estes-Del Re is also a Montessori preschool teacher at a private school and is a Co-Director of the Montessori Teacher Training Program at the local university.

Background Information:
The purpose of this study is to explore which multiple forms of technology tools are preferred by children for learning at school and to determine how technology should be included and used in the preschool environment.

Procedures:
If you agree to allow your child to be in this study, he or she will be asked to participate in the following activities which are specific to the research study and are in addition to regular Montessori instructional activities planned by classroom teacher:

- Be observed during four 2-hour classroom observations conducted by the researcher while your child goes about regular educational activities with whole class.
- Create an optional weekly 3-5 minute video journal using the Flip Camera to self-reflect about tools he or she chose to use to complete learning activities (to describe what tools they enjoyed using during the week). This video will be created during transition time before lunch on Thursdays or Fridays so that no regular instructional time is missed. Students will not miss any time from lunch.
- Weekly post a video or story created during regular instructional time to the already established secured classroom website with the help of the classroom teacher. These posts will be shared to the secured classroom website with the help of the teacher on Thursdays or Fridays during transition time before recess so that no regular instructional time is missed. Children will not miss recess. You will be able to view their posts on the classroom website. Students are not required to post, but instead are given the opportunity to do so if they elect to do so.
- Participate as a listener and an observer during a 10 minute or less weekly SKYPE session held during community group time with the whole class that is

led by the classroom teacher. The teacher and researcher will talk via SKYPE. The teacher will share news of the day or other exciting learning activities with the researcher as all children listen and observe.

Voluntary Nature of the Study:
Your child's participation in this study is voluntary. This means that everyone will respect your decision of whether or not you want your child to be in the study. No one at the school will treat you or your child differently if you decide for your child to not be in the study. If you decide to let your child join the study now, you can still change your mind during the study. If your child feels stressed during the study, he or she may stop at any time. They may also choose which parts they want to participate in. If you consent, I will explain the study to your child and ask them if they want to participate. If you decide you want your child to skip parts of the study or to drop out of the study, please send me an email at darlene.estes-delre@waldenu.edu.

Risks and Benefits of Being in the Study:
By participating in this study, your child may be distracted from his or her daily work. But this study might help others to rethink how technology can be used more meaningfully for the preschool child and more effectively prepare young children for the future. Your child will only be allowed to share created videos or stories on the secured classroom website.

Compensation:
Participation in this study is strictly voluntary. You or your child will not receive any compensation for your child's participation.

Confidentiality:
Any information your child provides will be kept confidential. The researcher will not use your child's information for any purposes outside of this research study. Also, the researcher will not include your child's name or anything else that could identify your child in any reports of the study.

Contacts and Questions:
You may ask any questions you have now. Or if you have questions later, you may contact the researcher via phone at 615-264-1235 or by email at darlene.estes-delre@waldenu.edu, or you may email the chair of her dissertation committee, Irmgard Gruber at irmgard.gruber@waldenu.edu. If you want to talk privately about your child's rights as a participant, you can call Dr. Leilani Endicott. She is the Walden University representative who can discuss this with you. Her phone number is 1-800-925-3368, extension 1210. Walden University's approval number for this study is <IRB will enter approval number here> and it expires on <IRB will enter expiration date>.

The researcher will give you a copy of this form to keep.

Statement of Consent:

I have read the above information and I feel I understand the expectations of the study and my child's involvement well enough to make a decision about my child's participation. By signing below, I am agreeing to the terms described above.

Printed Name of Child _____

Printed Name of the Parent /Guardian _____.

Date of consent _____.

Parent's Written or Electronic* Signature _____.

Researcher's Written or Electronic* Signature _____.

Electronic signatures are regulated by the Uniform Electronic Transactions Act. Legally, an "electronic signature" can be the person's typed name, their email address, or any other identifying marker. An electronic signature is just as valid as a written signature as long as both parties have agreed to conduct the transaction electronically.

Appendix E: Introduction to study

The following puppet show will introduce the children to the study and will give children the opportunity to ask questions about the research study.

Puppet Show Script:

Researcher: Good morning. Thank you for letting me and Walden (puppet) join circle time with you today. My name is Mrs. Estes-Del Re. I have many jobs. I am a mom, teacher, professor, and researcher. When I am here with you I will be a researcher.

Walden: Researcher? What does it mean to be a researcher?

Researcher: A researcher is a special kind of scientist who helps people to better understand the way things work.

Walden: What kinds of things do researchers do?

Researcher: Researchers study things by watching, listening, videotaping, asking questions, writing notes, and collecting samples.

Walden: Why are you coming to this classroom?

Researcher: I am interested in learning what tools children like to use when they are learning at school like when they want to write, draw, read, and talk to each other.

Walden: Why don't you just ask the teacher or their parents to tell you what the children like best?

Researcher: I want to watch and learn from the children because I think they can best help me to understand which tools children think work better and are more fun to work with than others.

Walden: Does that mean you will be watching the children when they work?

Researcher: Sometimes I will be an observer and write notes in my field notebook (show notebook) with my SmartPen (show pen).

Walden: Who will read what you write about the children and this classroom in your notebook?

Researcher: I will be the only one who reads my notes. My notes will help me to remember all the things I saw and heard when I am here in the classroom. The only time I would have to tell someone else is if you tell me that someone is harming you. I would talk about it first with you before I tell someone.

Walden: Will you write the names of the children in your notebook?

Researcher: No, I want to keep their work safe and protected so I will use a symbol made up of numbers instead of names so only I will know who I am writing about.

Walden: Will all the children in the class be participating in your research study?

Researcher: Here is how research with children works. First I met with all of the children's parents with their teacher at Parent Night and told them what my research this time is to find out what tools four year old children prefer to use for learning. Parents were able to ask questions about my work with their children. The parents of the 4-year old children who have been in this classroom since they were 3 years old signed a consent form that gave their permission for their child to participate in my study.

Walden: What about the children who are 3 and 5 years old? They will still see me come to the classroom, but I will only be writing about the children who are 4 years old. Everyone will sill get to do all of the activities that they normally do.

Walden: What if some children do not want to be in the study? Will they be in trouble?

Researcher: It is okay to say "yes" and it is okay to say "no". No one will be upset if some children do not want to be in the study. It is okay either way. If you want to participate or not, you will still get to do all of the same things you normally get to do in the classroom. I will only write notes and talk with the children who want to participate.

Walden: How will you know who said "yes" and who said "no"? What if they change their minds?

Researcher: When I arrive to the classroom, I will check my mail folder which has envelopes from the students in it. The envelopes will only be seen by the student and researcher. Inside the envelope will be a card that the student can mark with x's beside the research activities they would like to participate in that day. (show example of mail folder with student envelope and concealed participation card inside).

Walden: When will the children do classroom work and when will they do research activities with you?

Researcher: On Wednesdays, I will visit the classroom. I will spend most of the morning watching everyone doing their regular classroom work. I will be an Observer. I will only write notes about the children who are part of the study this time. Just before lunch, I will invite the children who are part of the study this time to come into the teacher's office to talk with me about their work and the tools they like to use in the classroom. In research, we call this an interview. Most of the time I am in the classroom, I will just be an Observer just like other observers who come to your classroom.

Walden: Can the children make pictures and stories for you?

Researcher: Yes! Just remember to put your symbol I will give you on the back so only I will know who made the things for me. Whenever we collect things in research, we call it

data. Here is a special Data Collection Box that I will leave in your classroom for you to put things you want me to have. Some data can also be shared on this zip drive that you will learn how to use.

Walden: Will you come everyday forever?

Researcher: I will come once a week on Wednesdays and spend the entire morning with you. I will do this for four weeks.

Walden: What if we want to share data with you or talk to you and it is not your day to be here?

Researcher: You will be able to post video messages to me on the classroom website and on Mondays you will be able to talk to me using SKYPE during Community Group Time with the help of your teacher. You can write notes to me using the notebook and SmartPen that I leave in your classroom. You can put things in the data box for me. Always remember to use your symbol so I know who you are.

Walden: What will happen when you are done with your research?

Researcher: I will not be visiting each week. I will be putting all my notes, videos, and collected data together to tell the story of how children prefer to use tools when they want to write, draw, read, and communicate so that other schools and people will know which tools to put in preschool for children to use.

Walden: Can the children still SKYPE and talk to you?

Researcher: With the help of your teacher and the permission from your parents and school, you most certainly can.

Researcher: We have learned a lot about my work as a researcher today. Thank you for being such good listeners. Later today, your teacher will meet with the students who will

be a part of my study to let you ask more questions and to let them check their participation card and put it inside their envelope inside the researcher mail folder. If you decide at anytime that you do not want to be in the study, you can let your teacher or your parents know and they can let me know. Remember, it is okay to say “No, I do not want to be in the study.”

Appendix F: Multiliteracies Tools Reference Guide

Multiliteracies Learning Strategies & Tools OBSERVATION GUIDE		
Strategy/Tool	**Description of Strategy/Tool**	**Preferred Use for Learning**
Digital Camera	A camera that captures both still and moving images that can be stored on memory chips and downloaded to computers for sharing or printing.	Children used the digital camera to document their finished work, to create a step-by-step sequence of a lesson they knew, to share obtained knowledge with others, and to explore objects in new ways using various film angles.
SmartPen	A recording pen device that allows one to write and record simultaneously. With children, stories can be drawn and told at the same time so that the stories are accurately interpreted. The recordings can be downloaded for transcription and listening.	Children used the SmartPen to write stories and to hear their stories played back. They also used the pen to hear the recorded stories peers had written.
Flip Camera Recorder	A digital camera that shoots and records pictures and videos instantly with just a simple click of a button that can immediately be downloaded or sharing. Can be used for creation of video journals.	Children used the Flip-camera to create videos documentations of their completed work. They used the camera to create journals of the ways they liked to learn. They used the flip-camera to see objects and people in new ways. The camera was also used to document the work of peers and to capture memorable classroom events.
Website Posts	Electronic posts containing videos, pictures, or stories shared on secured classroom website.	The secured classroom website allowed for children and the classroom teacher to post videos, photos, and stories generated by the children for parents and school administrators to see and comment on.
Traditional Literacy Tools	Traditional literacy tools include paper, pencil, crayons, markers, books, paint/easel, etc…	Children used traditional tools including: paper, pencil, crayons, markers, books, maps, paint, play dough, puzzles, moveable spelling alphabets, chalk boards, and more.

Appendix G: Artifact Review and Rubric

Type Of Student Generated Artifact:	Types of Tools Used to Create	Type Of Learning Activity:	Frequency of Use 1-4 scale (1 not often; 2 some; 3 often; 4 most often)
Written Stories	SmartPen	Child-directed	4
	Paper/pencil	Teacher-directed & child directed	3
	alphabet letters in a box	Teacher-directed	2
	Picture story writing paper	Teacher-directed	2
Pictures, Paintings, & Illustrations	Water color paint	Child-directed	3
	Tempera paint	Child-directed	4
	Crayons	Child-directed	4
	Markers	teacher-directed	2
	Colored pencils	teacher-directed	3
	Paper drawings	child-directed	4
	Computer Drawings	teacher-directed	1
	SmartPen	child-directed	4
Video recordings	Flip-Camera	Child-directed	4
	Digital camera	Child-directed	2

Appendix H: Prestudy Interview questions for teacher

Below are interview questions that will be used for the pre-study interview. The answers from these questions will be used to answer the first research question related to this study:

1. How would you define literacy and what it means to literate in the 21st century?

   The following topics will be addressed, as needed, as follow-up prompts:
   - What kinds of literacy activities are available for children to create meaning in the environment?
   - How is technology used in the classroom?
   - What influence has technology had on literacy development for the children?

2. What are the ways technology has been included in the preschool environment?

   The following topics will be addressed, as needed, as follow-up prompts:
   - Do children rotate turns with the computer?
   - Are literacy activities teacher-directed or child selected?
   - Are technology tools made readily available for independent use of children?
   - Besides the computer, what other technology tools are included in the classroom?

3. How would you define learning and what it means to learn in the 21st century?

   The following topics will be addressed, as needed, as follow-up prompts:
   - What kinds of literacy activities are available for children to create meaning in the environment?
   - How is technology used in the classroom?
   - What influence has technology had on learning for the children?

Appendix I: Follow-Up Interview Questions for teacher

Below are follow-up interview questions that will be used for the post-study interview. The answers from these questions will be used to answer the second and third research questions related to this study.

1. Can you describe in what ways children used technology for learning in the classroom?

   The following topics will be addressed, as needed, as follow-up prompts:
   - Tools associated with writing.
   - Tools associated with speaking, listening, and sharing ideas.
   - Tools associated with social interactions and collaboration.
   - Tools associated with reading.

2. Now that you have had the opportunity to redesign the environment with multiple forms of technology and allow the children to express their preferred uses for technology for learning over a four-week time frame, how would you define preschool learning for the 21st Century.

   The following topics will be addressed, as needed, as follow-up prompts:
   - Definition of literacy and what is means to be literate?
   - Implementation (teacher-directed or child selected activities)
   - Literacy Development (oral stories, written stories, read stories—SmartPen, Dragon Naturally Speaking word processing program, video recordings, digital camera)
   - Communication outside classroom (email messages, video messages, SKYPE messages)

3. Identify any technology tool (s) or strategy (ies) you discovered and explain how children used it?

4. Could you describe what you perceive to be the benefits or advantages of providing children with an environment designed with multiple forms of technology that affords them the opportunity to choose when and how they use technology for learning?

   The following topics will be addressed, as needed, as follow-up prompts:
   - Socialization (email, video messages, SKYPE messages)
   - Implementation (teacher-directed or child selected activities)
   - Language Development (oral stories, written stories, read stories—SmartPen, Dragon Naturally Speaking word processing program, video recordings, digital camera)
   - Communication outside classroom (email messages, video messages, SKYPE messages)

5. Could you describe what you perceive to be the limitation or disadvantages of designing the environment with multiple forms of technology and allowing children to choose how and when to use technologies for learning?

   The following topics will be addressed, as needed, as follow-up prompts:
   - Implementation (teacher-directed or child selected activities)
   - Language development (oral stories, written stories, read stories—SmartPen, Dragon Naturally Speaking word processing program, video recordings, digital camera)
   - Communication outside classroom (email messages, video messages, SKYPE messages)

6. Would you continue to allow children to use multiple forms of technology according to their preferred uses in the future?

7. Can you envision any other ways to include varied forms of technology that could be meaningful for children?

Appendix J: Parent survey of Home Experiences with Technology

Parent Survey
Home Experience With Technology

Child's First Name: ……...
Age of Child: …….
Number of Years Attending Montessori School: ……..

Questions:

1. **What types of technology are used in your home?**

2. **Describe the ways your preschool/kindergarten child uses technology in your home.**

3. **When your child wants to know more information on a topic of interest, what are some ways at home that you and your child can search for more details on the topic?**

4. **Describe the different ways your child creates picture and stories in your home.**

5. **Describe the kinds of reading activities that your child engages in at home.**

Thank you for participating in this survey. I assure you that all responses will be kept confidential.

Appendix K: Educational Activities vs. Research Activities

Educational Activities VS. Research Activities

Regular Ongoing Educational Activities for All Students	Research Activities (part of study for only 3 to 5 participants) And Classroom Teacher
Montessori Lessons in • Reading • Math • Cultural Subjects • Writing • Practical Life • Sensorial lessons • Science • Art Technology Tools • Digital Camera • Flip-Camera (video) • SmartPen • Computer • Interactive White Board • SKYPE sessions • Starfall.com software reading program • Dragon Naturally Speaking word processing program • Electronic books • Books and CDs • Music and CDs • KidPix software	Interviews with participants • Interview with Teacher on multiliteracy practices at beginning and end of study. Video Journal created by participants • Weekly on Thursday or Fridays during transition before lunch so no instructional time is missed. • 3 to 5 minutes in length • Created using flip-camera recorder • To be shared with researcher as data Weekly Post to Secured Classroom Website • Weekly on Mondays, Tuesdays, Thursdays, or Fridays with help of classroom teacher during transition time before recess so no instructional time is lost. • Videos or stories posted are shared from earlier work created during regular instructional time. • Requires 5 minutes of teacher's time Field Notes on Classroom Observations • Four 2 hour observations of participating students will be conducted. While the researcher observes the whole class, only field notes and data will be collected on the 3 to 5 participants. • Observations will occur only on Wednesday mornings

Appendix L: Management of Educational & Research Activities

Management of Educational Activities & Research Activities

Montessori Educational Activities for ALL Students	Time	Research Activities for ONLY 3 to 5 Participants & Teacher
1. Morning Work Cycle 8-10:15 (children working on work of choice while Teacher selects certain students to work with or just monitors students at work). Work time allows all students to work with technology tools and Montessori materials. All Students will write in journals Using the SmartPen. (Teacher teaches; Researcher Observes) 2. Community Group Time 10:15 • Calendar/Jobs for Day • Songs • Story • Special Feature if any Puppet Show on Wednesday only to introduce Research Study & Role of Researcher to classroom (Researcher to Present) 3. Bathroom/Wash Hands 10:35 (students age 3 & 4 are pulled from group by Classroom Asst. to use restroom and wash hands for lunch)	WEEK 1	1. Observation: 2 hours on Wednesday Researcher observes the 3 to 5 participants while they are working without disturbing flow or work of class or teacher. Researcher only takes notes on participants. 2. Video Journal with Flip-Camera (Thursday and Friday) 3 minute video created by each Participant telling what tools they Liked using that morning and to Describe what work they did. For Example: I wrote a story about My friends at school. I liked it Because I used pictures I took Myself with the digital camera. (This Break time was selected

		because it does not disturb rest of classroom. Videos can be made in adjoining teacher office where classroom assistant can supervise). Students will not miss lunch.
4. Line Up/Walk to Lunch 10:45 5. Lunch 10:50-11:20 am		
6. Transition Time 11:20-11:45 During this time children are Back in classroom. They take This time to change shoes for Outside play, put coats on, use Restroom if needed, and sit in Line waiting to go to recess. As Children wait, teacher engages Students in songs, flashcard Sound activities, CD with Book.		3. Weekly Post to Classroom Website one post per participant per day taking 5 minutes on Monday, Tuesday, Thursday, Friday—one post per child per day (consists of downloading shared video of work or created story completed as part of regular instructional activity earlier in morning) with help of teacher in teacher office while Classroom Assistant supervises this transition time. Students will not miss recess.

RECESS: 11:45-12:15		
1. Morning Work Cycle 8-10:15 (children working on work of choice while Teacher selects certain students to work with or just monitors students at work). Work time allows all students to work with technology tools and Montessori materials. All Students will write in journals Using the SmartPen. (Teacher teaches; Researcher Observes) 2. Community Group Time 10:15 • Calendar/Jobs for Day • Songs • Story Special Feature: SKYPE With researcher on Mondays only: share news with each other for 5-7 minutes. Projected on Classroom Interactive White Board. 3. Bathroom/Wash Hands 10:35 (students age 3 & 4 are pulled from group by Classroom Asst. to use restroom and wash hands for lunch)	WEEK 2	1. Observation: 2 hours on Wednesday only Researcher observes the 3 to 5 participants while they are working without disturbing flow or work of class or teacher. Researcher only takes notes on participants. 2. Video Journal with Flip-Camera (Thursday and Friday) 3 minute video created by each Participant telling what tools they Liked using that morning and to Describe what work they did. For Example: I wrote a story about My friends at school. I liked it

4. Up/Walk to Lunch 10:45 5. Lunch 10:50-11:20 am		Because I used pictures I took Myself with the digital camera. (This Break time was selected because it does not disturb rest of classroom. Videos can be made in adjoining teacher office where classroom assistant can supervise). Students will not miss lunch.
6. Transition Time 11:20-11:45 During this time children are Back in classroom. They take This time to change shoes for Outside play, put coats on, use Restroom if needed, and sit in Line waiting to go to recess. As Children wait, teacher engages Students in songs, flashcard Sound activities, CD with Book. RECESS: 11:45-12:15		3. Weekly Post to Classroom Website one post per participant per day taking 5 minutes (consists of downloading shared video of work or created story completed as part of regular instructional activity earlier in morning) with help of teacher in teacher office while Classroom Assistant supervises this transition time. Students will not miss recess.
1. Morning Work Cycle 8-10:15 (children working on work of choice while Teacher selects certain students to work with or just monitors students at work). Work time allows all students to work with technology tools and Montessori materials. All Students will write in journals Using the SmartPen. (Teacher teaches; Researcher	WEEK 3	1. Observation: 2 hours on Wednesday only Researcher observes the 3 to 5 participants while they are working without disturbing flow or work of class or teacher. Researcher only takes notes on participants.

Observes) 2. Community Group Time 10:15 • Calendar/Jobs for Day • Songs • Story Special Feature: SKYPE on Mondays only With researcher: share news with each other for 5-7 minutes. Projected on Classroom Interactive White Board. 3. Bathroom/Wash Hands 10:35 (students age 3 & 4 are pulled from group by Classroom Asst. to use restroom and wash hands for lunch) 4. Up/Walk to Lunch 10:45 5. Lunch 10:50-11:20 am 6. Transition Time 11:20-11:45 During this time children are Back in classroom. They take This time to change shoes for		2. Video Journal with Flip-Camera (Thursday and Friday) 3 minute video created by each Participant telling what tools they Liked using that morning and to Describe what work they did. For Example: I wrote a story about My friends at school. I liked it Because I used pictures I took Myself with the digital camera. (This Break time was selected because it does not disturb rest of classroom. Videos can be made in adjoining teacher office where classroom assistant can supervise). Students will not miss lunch. 3. Weekly Post to Classroom Website one post per participant per day taking 5 minutes (consists of downloading shared video of work

Outside play, put coats on, use Restroom if needed, and sit in Line waiting to go to recess. As Children wait, teacher engages Students in songs, flashcard Sound activities, CD with Book. RECESS: 11:45-12:15		or created story completed as part of regular instructional activity earlier in morning) with help of teacher in teacher office while Classroom Assistant supervises this transition time. Students will not miss recess.
1. Morning Work Cycle 8-10:15 (children working on work of choice while Teacher selects certain students to work with or just monitors students at work). Work time allows all students to work with technology tools and Montessori materials. All Students will write in journals Using the SmartPen. (Teacher teaches; Researcher Observes) 2. Community Group Time 10:15 • Calendar/Jobs for Day • Songs • Story Special Feature: SKYPE With researcher on Monday only: share news with each other for 5-7 minutes. Projected on Classroom Interactive White Board. On Wednesday, Researcher will join group to thank class for letting her be a part of the classroom. She will tell them that she will post a video to the classroom website that will tell her findings. They can view it with their parents.	WEEK 4	1. Observation: 2 hours on Wednesday only Researcher observes the 3 to 5 participants while they are working without disturbing flow or work of class or teacher. Researcher only takes notes on participants.

3. Bathroom/Wash Hands 10:35 (students age 3 & 4 are pulled from group by Classroom Asst. to use restroom and wash hands for lunch)		2. Video Journal with Flip-Camera (Thursday and Friday) During Transition Break preparing for lunch 3 minute video created by each Participant telling what tools they Liked using that morning and to Describe what work they did. For Example: I wrote a story about My friends at school. I liked it Because I used pictures I took Myself with the digital camera. (This Break time was selected because it does not disturb rest of classroom. Videos can be made in adjoining teacher office where classroom assistant can supervise). Students will not miss lunch.
4. Up/Walk to Lunch 10:45 5. Lunch 10:50-11:20 am		
6. Transition Time 11:20-11:45 During this time children are Back in classroom. They take This time to change shoes for Outside play, put coats on, use Restroom if needed, and sit in Line waiting to go to recess. As Children wait, teacher engages		3. Weekly Post to Classroom Website one post per participant per day taking 5 minutes (consists of downloading shared video of work or created story completed as part of regular instructional activity earlier in morning) with help of teacher in teacher office while Classroom

Students in songs, flashcard Sound activities, CD with Book. RECESS: 11:45-12:15. 7. Teacher Planning Time: 1-2pm Teacher has duty free time to Plan lessons, hold meetings, etc. Kindergarten students attend Specialty Classes at this time. The 3 and 4 year old students are at Rest time with Classroom Asst.		Assistant supervises this transition time. Students will not miss recess. 4. Teacher Follow-Up Interview on Wednesday Only 1:15-1:45pm With researcher in teacher's office. Researcher will transcribe interview with teacher and email the script by the end of the week to her for her to check it for accuracy.

Appendix M: Alternative Measures for Parent Contact

Introduce Study & Obtain Consent

There is a possibility that some parents will not be able to attend the scheduled Parent Informational Night to learn about the study, understand the role of the researcher, and to give consent for their child's participation. The following alternative measures will be offered to reach parents who were unable to attend the Parent Informational Night:

- Home Packets Sent Home to Parents Who Did not Attend Informational Session held at school. A sign-in sheet for attendees will help teacher and researcher to account for who attended. Packets will include a CD containing a videotape created by the researcher describing the study. Packets will also include Parent Consent Letters and envelopes to return signed consent forms to the classroom teacher.

- Video Clip of Introduction to Study and Researcher will be posted to secured classroom website for parents to access and view. The Parent Consent Form will be posted as a document for viewing. Parents will be instructed to download form and sign and return form to teacher or will be instructed in how to get a Home Packet sent home.

Appendix N: Montessori vs. Traditional Education

Montessori Method:	**Traditional Method:**
1. Emphasis is on cognitive and social development	1. Emphasis is on social development
2. Teacher has unobtrusive role in classroom	2. Teacher is center of classroom as "controller"
3. Environment and method encourage self-discipline	3. Teacher is primary enforcer of discipline
4. Mainly individual instruction	4. Group and individual instruction
5. Mixed age grouping	5. Same age grouping
6. Grouping encourages children to teach and help each other	6. Most teaching is done by the teacher
7. Child chooses own work	7. Curriculum is structured for the child
8. Child discovers own concepts from self teaching materials	8. Child is guided to concepts by the teacher
9. Child works as long as he wishes on chosen project	9. Child is generally allotted specific time for work
10. Child sets own learning pace	10. Instruction pace is usually set by group norm
11. Child spots own errors from feedback of material	11. If work is corrected, errors usually are pointed out by the teacher
12. Child reinforces own learning by repetition of work and internal feelings of success	12. Learning is reinforced externally by repetition and rewards
13. Multi-sensory materials for physical exploration	13. Fewer materials for sensory development
14. Organized program for learning care of self and environment	14. Less Emphasis on self-care instruction
15. Child can work where he chooses, move around and talk at will (yet not disturb the work of others); group work is voluntary	15. Child usually assigned own chair: encouraged to participate, sit still and listen during group sessions
16. Organized program for parents to understand the Montessori philosophy and participate in the learning process	16. Voluntary parent involvement

Appendix O: Sample Video Recording Guide

Context of Video	Type of Learning Activity Recorded:	Transcription Notes
Time: Date: Participants: Length:		
Time: Date: Participants: Length:		
Time: Date: Participants: Length:		

Appendix P: Data Samples

Classroom Teacher, Pre-Study Interview:

Researcher: So would you say that most of the activities are teacher-directed with technology or student driven?

Classroom Teacher: I have found that it really ends up being student-driven because in Montessori we teach the lessons so once I teach them how to do it whether it is even using my computer...once they have been given a lesson on how to do it, they can go and do it and they are able to do that. So the steps of getting the flip-camera and recording and getting the SmartPen and recording--they can definitely do...now there are some steps of sometimes downloading that you know as a teacher I may have to go over and do a code to help them. But if we had a classroom computer, that was a computer just for the children c(with internet live access) that they did not have to go into the teacher's office to use then I think it would be even more child-directed. I think I could step back and they could do the whole thing.

Researcher: What are the ways that you would define learning...talking about more than literacy...learning...what does that mean today to be a 21st century learner? What type of learner?

Classroom Teacher: I think a 21st century learner is hands-on, they are instant learners so that they want that information now ad they can get it now. Kids now know to say, "Ms. N can you go look that up for me whereas we would have said we will go to the library

and research. They know that instantly I can go get it. So if they are asking about for instance and wondering what a squid ate..we have books around the classroom, but the first response of a three year old was can you go and look it up on the internet. So these are U-Tube kind of kids so they know where to find information... they know that information is fast..these children are using iPads, and cameras and phones..so they are very much instant learners. I think they are also more in-depth thinkers because of that. So you really can't give them just surface information anymore because they want to know more. So that's exciting and that may be just part of our classroom too because we nurture that.

Classroom Teacher, Follow-Up Interview:

Researcher: Since literacy also involves speaking, listening, and sharing and communicating with others, have you seen any difference in the tools that have allowed the children to do those things?

Classroom Teacher: Yes, I have seen especially with the flip-camera, I have seen with a student that was new to my classroom in the 9 weeks who through the flip camera began to really talk and share with some other students asking about using it and sitting with other students and recording with them. I saw older students sit down with younger students they wanted to record so for instance a three year would sit and maybe she had done a story but she would tell her story on the flip-camera to a four or five year old student using the flip-camera. So there was that interaction. And more listening where they would actually sit and listen to each other's stories that they had recorded or listen to

each other's videos. But also wanting to hear their own voice so thats wonderful as you are introducing the foundation of sounds in early childhood by hearing your own voice to play with the other child who goes to speech. Then there is the young child who goes to speech twice a week--he was very involved in wanting to touch the Smartpen and wanting to move it and to listen to his voice and that is something that we have been encouraging him to do to hear himself back so that was important and then sharing ideas with others so they wanted to share they were eager to show each other what they were doing. A child would record their work and they would want to show it back whether through our video site and sometimes we would look at those together at the end of the day on our screen in our classroom or just showing it to each other with the hand-held camera and so lots of sharing and listening and speaking.

Researcher: And just thinking about your 4-year-olds that were the target of this study, would you say that you felt that they were capable and able to be independent users of the technology tools?

Classroom Teacher: YES, I have to laugh--Absolutely. One in paticular, has become our own little CNN Reporter. He is very involved in demonstrating the materials to other students so as it started out it was a teacher giving the lessons--something that we presented as we do in Montessori with our lessons but it became quickly something that students could present which is another way we present our lessons that a child can present to another child. So this particular child has become our little Anderson Cooper. He is recording. He is teaching other friends how to use the material, they very much are

able to go and get the camera themselves and use it--they can cut it on and cut it off--zoom in and zoom out. In fact, they were able to use the stylus on the camera and teach me things. So I would watch them go back and look at their pictures. One day I looked up and they were looking at a slide show on the camera because they knew how to manipulate it. So it is amazing to see that these are children who live in a technology world so they were not afraid at all to work with the materials.

Researcher: Now that you have incorporated technology into your environment, and you have had the opportunity to see how the children use the tools, how would you define literacy after watching their exposure and seeing what literacy is? Has it changed in definition? Has it expanded?

Classroom Teacher: I would say that my definition of literacy has definitely expanded. If someone were to tell me that introducing a camera or a flip-camera to the classroom would have changed their learning, I would have done this much earlier in the year even then we did ....they have become just more literate. Words have a different meaning to them. Seeing a word then hearing the word. Then taking control of their own learning has been exciting. So To them now literacy has just become real. Whether they are telling a story or ...we had a story called little cloud in a book. And then little cloud turns into different things...we took out felt pictures of little cloud as it changes to tell the story.But to see a child actually put out little cloud in the sequence steps, which one of our required skills is sequencing, and tell the story using the flip camera as he is telling it and then to share it with a friend just gave a whole new meaning to literacy in our classroom.

Child Participant Reflective Video Journal:

Created by Melvin

“This is Melvin. [smiles big] I love the flip-camera because it is awesome. And I like doing big puzzles. I like to write stories with pencils, paper, and the SmartPen too.”

“This is Melvin. I like working with letters...I like to work with the cameras.”

Created by Mia

“This is Mia and I like to work with ...this is my friend's work [points to color tablet work on shelf]...And I like to read books. I like to do the Knobbed Cylinders. And I like to do blocks and I like to do the Brown Stairs. And I like to work with numbers and I like to do math and I like to paint. [Prompt: you like to make stories?] Yes. [How do you like to make stories?] I like to make stories because that is my mostest exciting thing I have ever done and [what do you write stories with?] A pencil. [what else do you use to write stories?] A pen. [what kind of pen do you use?] My pen. [What does the pen do?] It talks. [is it the talking pen?] Yes. [Do you like to take pictures?] Yes, I like to take pictures of my work.”

“This is Mia. This is my dinosaur puzzle work and I like the dinosaur work. I'm doing this puzzle because my mommy tells me to work harder and that's what I'm suppose to do. Thank you.”

Created by Adeline

“I love to work with this and this is my work [shows hanging beads on teen boards] In ten minutes I like to play.”

“This is Adeline. And I like to write with the SmartPen and pencils because I really like pencils and the SmartPen. I like to take pictures with the camera.[do you like to make videos?] yes. [what other work in the classroom do you like to work with?] I like school.”

Created by Ceiley

“This is Ceily. And I love chips. It is my favorite thing to do and this is my favorite thing to eat and I love pizza. I like to work with my friends. I like to work with the puzzles. I like to write`stories. I use the talking pen. I like to take take pictures too.”

“This is Ceiley and I like to work with coloring..I color with crayons..I like to work with the camera and takes pictures of my friends and your mamas. I like to make movies with the flip camera.”

Created by Kyra

“This is Kyra. I like to work with letters.” [films without talking for remainder of video]

Observation

8:40am Ceiley just arrives to school. She comes in and walks across the classroom in search of the teacher. When she finds her, she taps the teacher gently on her shoulder then waits to be acknowledged. In a moment, the teacher turns and smiles to greet Ceiley and extends her hand to shake hands. Ceiley returns to the cubby area where she greets the classroom assistant. She puts her things away. She walks straight over to the language shelf with the flip-camera. She says, "I want to make movie about my work I like to do." She picks up the flip-camera and independently turns it on and watches for the green ready alert. She clicks the big red button to begin recording. She walks around the room filming the work she likes to do but also the work of her friends that she sees along the way. [she is like a sports commentator informing her viewers of what is happening in the classroom]. [This was not the designated time for creating video journal yet Ceiley wanted to do it]. As she is walking around videoing, she stops to watch Melvin writing his story with the SmartPen. She says, "I gonna do the story pen after Melvin is done." She clicks the big red button to stop her video. Then she stands and plays it back. She holds it up to her ear to listen [much in the same way as a cell phone]. Then she holds it down to play it again to see the video.

8:30 Melvin chooses to write a story with the SmartPen. He gets the pen and places it at a table. He then gets his paper. He returns to his table and sits down. He carefully removes the pen from its leather case. He turns the pen around twice until he located the power button. He listened for the ready beep. He then tapped on the record button. He writes his story.

8:40am When finished writing his story, he clicks the stop square at the bottom of the paper. He then clicks on the playback line to hear his story back. His eyes grow big and a smile sweeps across his face as he hears himself talking back from the pen. Another child walks over to Melvin and observes him. Melvin turns and says, “I am still working with the talking pen.” The child walks away leaving Melvin to continue his work. Melvin taps on the playback line again and holds the pen up close to his ear to hear his story. Then he taps on the record button and decides to write and record more parts to his story. When finished, he clicks the stop square and then the playback line. He listens carefully waiting to see if the added parts of his story are there. When he hears the new parts, he says, “this talking pen can tell more than one story on my paper.” [He made a new discovery that writing can be continuous with the SmartPen so you can come back and add to stories already written] Melvin then decides to explore the other options on the paper. He clicks on the volume arrows and gets excited to hear how his voice gets louder and softer when using the arrow control buttons on the paper. He recognizes his own voice saying, “that’s me talking…” Looking puzzled, he realizes that there are other voices that were recorded [background noises] he keeps turning volume up and plays his story back until he can recognize the other voices. When he recognized his friend, he said, “that’s ----he is talking on my story too.” He turns the pen off. He carefully slides the pen back into its leather case, remembering tip goes in first. Then he returns the pen to the shelf.

10:10 Mia finishes the planet puzzle and tries to make a video of her completed puzzle. Mia successfully filmed her puzzle but when she went to hear it back she could not hear anything, perplexed she took it over to her teacher. The teacher showed her the volume

control buttons. Mia click on the louder option [plus sign] and smiled when she could hear herself on her video. She returns to her mat and videos her planet work. 9:50am Mia finishes the Obama puzzle and takes it back to the shelf and gets another puzzle work out that consists of four separate wooden jigsaw puzzles to build. She completes the puzzle and goes to the shelf to get the digital camera. She takes a picture of each of the four puzzles she built. She sets the camera aside on her mat while she puts all of the puzzle pieces back into the wooden box. She puts the puzzle work away and comes back with a larger jigsaw puzzle of the planets. Before beginning work with the planet puzzle, Mia uses the stylus pen to review pictures taken by others with the digital camera.

Researcher's Reflection Log:

I enjoyed meeting the parents and found that talking about my study with potential participant's parents was exciting—it was surreal at times—thinking about all the preparation that has led to this moment. As expected, technology catches people's attention. Not only did parents of Mrs. Nelson's class stop by my table, but several parents from other classroom did as well. For the most part, the parents were receptive to hearing about the study. A few were in a hurry and said they would look over the packet and let Mrs. Nelson know. I explained to the parents that their child's participation was voluntary and that the identity of their child would be protected using pseudonyms. Many of the parents shared with me how much their children were enjoying the technology piece in the classroom this year. In response, I shared the importance of the study that

will document the ways children preferred to use technology will be to changing the way technology is included in preschool for learning. 98% of the parents are African-American and come from the immediate neighborhood of the school. Mrs. Nelson shared that 80% of them have a high school level of education. All parents of the 4-year-old children of Mrs. Nelson's classroom took a home-packet with them to read over. Five of ten parents completed the consent form immediately and gave it to me. This was exciting since I was hoping for three to five participants! It was also interesting to hear the parents talk about their desire for technology to be included in their child's school experience. I let the parents know that I would be available in the mornings to answer any questions pertaining to the study. Overall, meeting with the parents went smoothly.

What surprised me was that technology knows no educational boundaries—no matter the level of education of the parents or income levels—the parent surveys revealed that technology was very much a presence in the home with iPods, iPads, iPhones, laptops, video games, etc…My question is since the home environment is technologically rich and used more for leisure—how would the inclusion of technology in the classroom be accepted as a learning tool rather than an entertainment vice? I'm wondering if the inclusion of technology will be too distracting and viewed as time for play rather than learning or will the children be able to respect and embrace the included technology tools as learning vices? These are the questions I bring to the study and am eager to explore more fully as I observe the children directly over four weeks.

Today was my first classroom observation of the ways children preferred to use technology for learning in Mrs. Nelson's classroom. In the morning I touched base with Mrs. Nelson. We talked as we checked to see if the technology materials were charged up and ready to be used by the children. She shared with me that the children were talking about becoming researchers and are starting to call pictures that they draw "data!" How exciting is this??? I am so excited to have this opportunity to learn from these children. As the children arrived, they greeted their teachers and the participants of the study went immediately to the researcher mail folder to complete their participation cards. I checked the pockets to know which research activities the children wanted to participate in. At this point, they checked all activities. I am thinking that as the study goes forth, they will develop preferences for some research activities over others. As a result there may be more variance in their participation response cards.

At the start of the observation, I was still questioning whether the children would be able to use the technology tools responsibly and in a way that did not disrupt the overall learning of the classroom. I wondered if the technology tools would require more of the teacher's time to assist students with operating them. About 30 minutes into the observation, I found myself captivated by what I saw. The children used the technology tools in the same manner as the other Montessori materials—with extreme care, respect, and responsibility. Children using technology tools were more interested in using the tools to learn with than to cause disruptions with. There was definitely calmness to the classroom that I did not expect. Curious children would look on as others used the tools, but were careful not to disrupt the learning of the child working with the technology tool.

So far, I did not see that the technology required the teacher additional time beyond what was normal. Overall, the inclusion of technology in the classroom did not seem to cause disharmony.

Watching the five participants today, Kyra stands out as one who struggles in general with all aspects of the day. She is tired, needs extra prompting from the teacher, seems to lack initiative, and seems so unsure of herself. I am curious to see if technology helps her or hinders her learning. Marcus already stands out as one who seems the most comfortable with the technology. He was eager to help others. He readily used the technology to document his work. I am eager to watch him over the next 4 weeks.

SmartPen Stories Transcribed:

Written by Melvin

This is Melvin. This is a big, big, big fireman...he is jumping, jumping, jumping through this circle thing...down in the front and down..ahhhh...hold on...keep going down here....ahhhhh.

This is Melvin. This is me and this is my curly hair. I have curly, curly, curly hair. [draws] This is my my my...my head and my puffed up eyes. He thought he was an owl. [draws for 60 seconds without talking] He has very long legs. I'm done. I push stop next so I can hear it.

This is Melvin. I draw someone. I don't draw noses so good. I draw a sun. I draw some flowers. I draw grass up high.

Written by Mia:

This is Mia. and I am a good student and this is my writing of my work. When I was a little...when I was a little girl my mommy and daddy named me Mia...Mia Lashia and they wanted me to have a good smiley face. She ..my mommy and my daddy want me to be happy and happy and happy. Well my mommy and daddy named me this name again...they named me Mia. And when my mommy and daddy named me that they were so happy when I was a little girl. Thank you. Now I am done. I push stop.

This is a circle. It has it goes like this it goes around and around. This is mi book...this is me book...this is mye book...this is my book. {self corrects her spelling of sight word "my"] I'm done.

I just cut the pen on. This is a crazy tornado. It's like a uh...a tornado 1...whrrrrh..whrrrh...whrhhh...[siren sound] These are giant walls. There is another tornado....whrhhhh....whrhhh...The end

Written by Adeline

I made my daddy and me going on a fieldtrip. Then I make balloons and my daddy makes balloons. We have some wheels at the bottom so we can go shopping. Me and my

brother...we drive...and we are going...it is fun for us..and we like to go...I' m done [with her story].

I made a flower. It's my favorite. I like flowers...and they're pretty...and then I made a snake...because snakes are pretty...and they're really pretty and I like flowers and I made them for my friends. That is a half moon and I like half moons when it is dark ...that's a snake...it's eating the half moon...and that is the grass. [this smartpen story was created first as a pencil drawing then attached to SmartPen paper so child could use SmartPen to tell her story that she made a picture of.]

This is a big slide no it's a snake This is a house and this is the windows. The windows go down and go up. And another window on top. And a smiley face...s-s-s-m-m-m-i-l-ey face [draws out word as until drawing of face is complete]. And now I want to hear it [the story played back].

This is a fence I made. I'm making myself. Um...because I like going to the beach. The beach is fun. The beach is a funnest place to go. Only if I get hurt I have to get and go to the hospital. And if I don't feel well I will make myself again. It is fun to make me again. It is fun to make myself. I have some sandals on too so i can walk. Heres my shoes and socks...and here's my eyes in order for me to look. I can have a mouth and a nose so I can see and smell. And ears to hear. My hair looks pretty. It is prettiest as whole wide world. It is all the way to my head.

This is a flower made with leaves. They are big and they are round. When the sun comes out and the balloon too, the wind makes it blow higher and higher and higher.

Written by Ceiley

My story is...I draw a lady and a man running to get married. They get the same house. They say come live with me.

I like to color. [draws for 15 seconds without talking] I wrote an "r". {draws for another 15 seconds without talking] I'm making colors. {yet the pen is black...it is a black and white drawing]. And I love to color and that's my favorite thing to do. I did it. Let me spell my name now. [says each letter of name aloud as she writes it on the paper]

Written by Kyra

This is my name. [draws without talking for 25 seconds] I love my mom. [draws for 30 seconds without talking] I love sissy.

This is Kyra. I am drawing a flower. I cannot draw a good one. [draws a sun]. This is a sun. It is a circle. [continues to draw without talking].

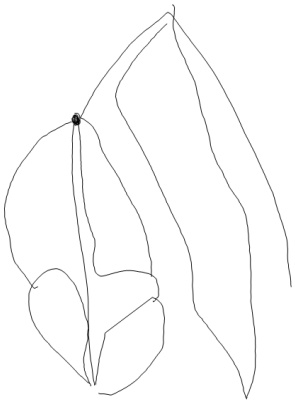
Appendix Q: SmartPen Story by Adeline

Audio Transcription:

"This is a flower…made with leaves.

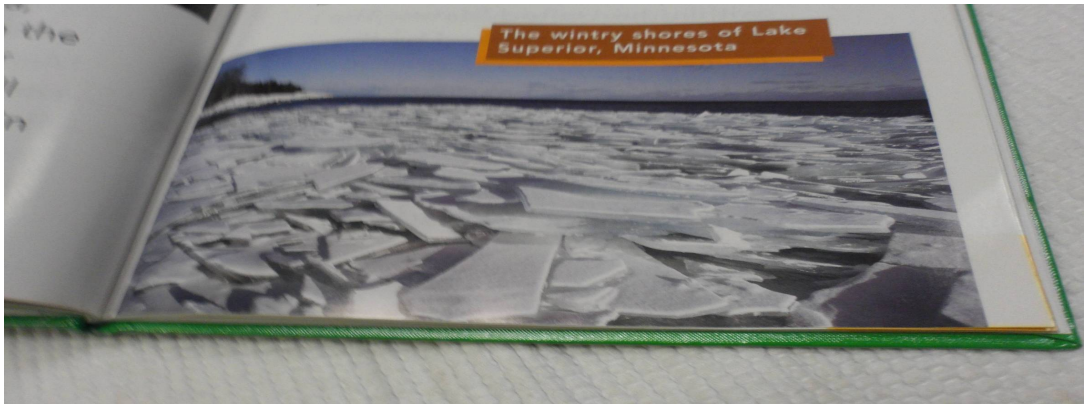
They are big and they are round. When the sun comes out and the balloon too, the wind makes it blow higher and higher and higher."

Illustration:



Appendix R: Photo Samples

Melvin's uses the digital camera to take this photo of Kyra working with Sand Paper Letters and picture cards to document the work of one of his peers.



Melvin uses the digital camera to take this photo of the shores of Lake Superior so he can share with his peers and teacher what he discovered about ice bergs.

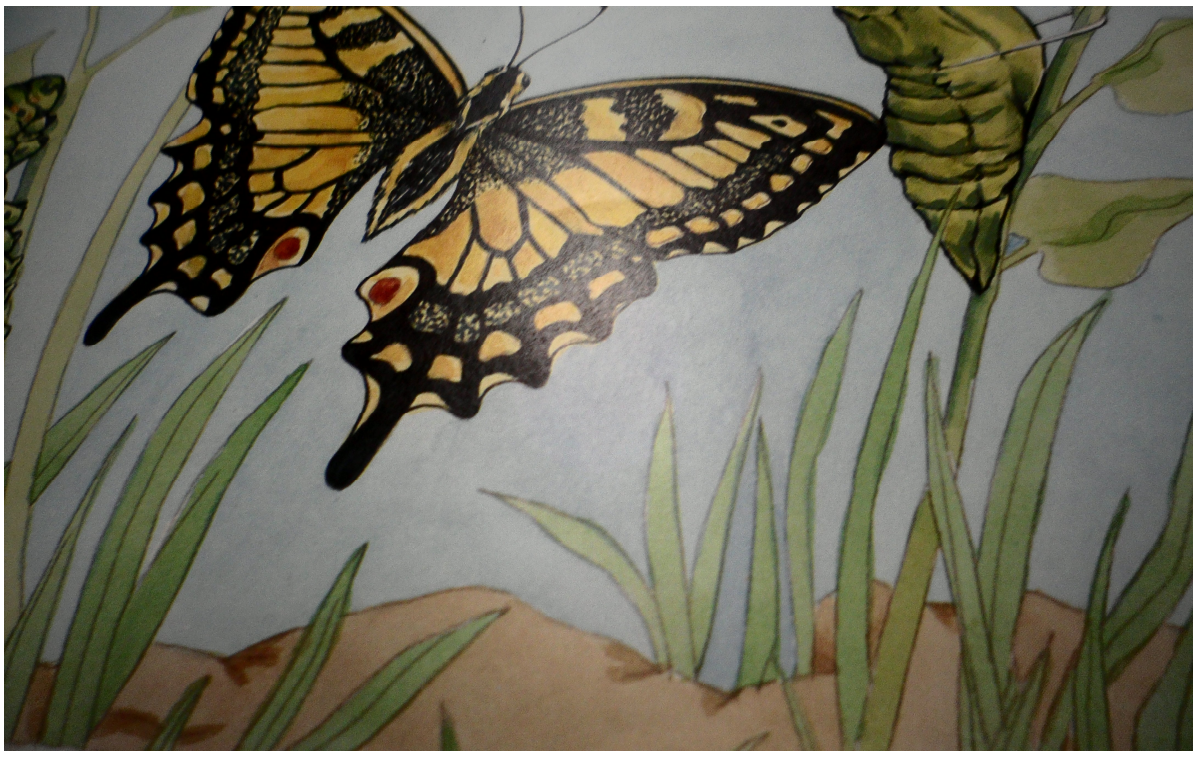
Nia took this photo of her finished work with the clock. This photo shows her preference for using technology to document her finished work and desire to record work that she was not able to take home.

Nia takes this photo with the digital camera of her work with traditional puzzle maps and books about Australia.

Melvin took this photo of a peer's work with the long bead chain that represents 7x7x7. The work was too big to fit in the view of the camera so Melvin explored the zoom-in and out features of the camera. The photo was taken once Melvin discovered how to get the complete work in the camera's view.

Adeline took this photo with the digital camera of books she can read. This is 1:25 photos taken in sequence of the books demonstrating Adeline's interest in photographing the books from various angles.

Melvin discovered how to take a picture of his own shirt with the digital camera by holding the camera out from his body and by turning the camera's lens the opposite way.



Ceiley used the zoom-in feature of the digital camera to take this picture of a butterfly in a picture book about butterflies.

Appendix S: Physical Description of Classroom

Immediately to the left as you enter the classroom is the math shelf featuring the Montessori clock and the golden bead materials. Complete with addition and subtraction charts and other materials to practice these operations more in-depth. Beside the shelf are the number rods. And this area is the bead cabinet complete with long and short bead chains for squaring and cubing work in math. Nearby the bead cabinet, in the back of the classroom just off of the teacher's private office are wall to wall storage cabinets. Above the cabinets are eye catching cultural objects from Africa: dolls dressed in African clothes, drums, books, foods, baskets, and such. Below the cabinet is a low counter that features science objects of study that the children can pick up and explore on their own. They happen to be studying sea creatures and this has evolved over the weeks. They have watched sea creatures grow in water. They have studied the parts of sea creatures as well as the parts of butterflies and insects. And then there is a large open area in the center of the classroom that allows children the space to work on individual lessons or for the whole class to gather for group lessons. Straight ahead is an exit door that leads out to the play ground and courtyard where gardening is included. There is a large projector screen hanging down on the wall located in the front of the classroom where the internet can be projected and seen by the class.

Walking farther into the classroom, still on the left side of the clasroom, there are four language shelves. There is a big book stand stocked with books the class is reading together. Behind it is the CD player and a record player. Beside the CD player is a portrait of Maria Montessori. The language shelf begins with materials to introduce the children to letter sounds. These include Sand Paper Letters that can be traced by the

children as they visually look at and say the sound. Also there is picture story writing done in the traditional way where there is a box containing story writing paper and crayons that can be used by the children to compose stories and adult can write their dictated story for the child. There are beginning reader books to look at, to look at a picture and say the word, simple rhyming books, baskets of rhyming pair puzzles all in order ranging from simple to more advanced levels of literacy. There are object baskets for writing and reading work. So there are lots of literacy items for the children to work with just on this first shelf. Coming to the next shelf, there are objects boxes that compliment and go with Sand Paper Letter learning. So that childen working on leter sounds may choose whether they want to practice letter sounds with objects, books, or pictures.

And above the 2nd language shelf is a calendar featuring moving cards for the months, days of the week, and numbers of days. Also included on the 2nd shelf are reading works where there are boxes of objects and word cards that children can read and match to the objects as they are learning to read. There are glass object boxes that can be used with the Moveable Alphabet for writing. Next to these are traditional sheets of writing paper to record their spelled words. Below these works are jigsaw puzzles letters and a felt alphabet roll that can be unrolled so that children can place cut-out letters and objects along it to reinforce letter sounds. There are also little cabinets with see through pull-out drawers that contain paper pictures of letter sounds that the children can color and paste into paper booklets. Walking further, we come to the 3rd language shelf there are several Moveable Alphabet boxes for writing and spelling work. There are ones that feature capital letters and punctuation marks that children can explore with and learn their

functions as they do more avanced writing work. There are booklets to read in folders. There are chalkboards, dry erase boards, and paper to practice writing or to record written stories on. There are scissors and pencils to use. Above the 3rd shelf, there is a job chart posted with pockets labeled with helping jobs that the children can sign up to help with to keep the environment lovely and ordered.

3:32 There are Metal Insets that are traditional Montessori work used to teach handwriting strokes and control with the pencil. Below are large Moveable Alphabets so young children can spell with the larger letters contained in these boxes.

That brings us to the exit door that leads to the playground and garden area. There is a large round analog clock that hangs on the wall next to the exit door. There is a woven basket on the floor that holds neatly rolled floor mats that the children use for whenever they work on the floor. The floor mat becomes their work space to place work on. Next to this basket of work mats is the 4th language shelf. There are more books to read that are organized into varied reading levels so that childre can practice reading at their own level at any time. There are glass boxes housing long vowel picture cards and labels to reinforce long vowel work for more advanced readers. There is a miniature metal mailbox beside these to allow the children to check daily messages left by the teacher to read. Below these are trays holding the academic work plans used with the kindergarten children. Beside this last shelf is a table where students may work. Beside this table is the technology shelf. The technology shelf is a natural extension of the language shelves. On top of the technology shelf is a beautiful wooden tray with an indention that perfectly

cradles the SmartPen. Beside it is a record of lessons children have received with the technology matrials. Down below the SmartPen is a shelf that has baskets containing the flip-camera and digital camera as well as supply boxes complete with charger cords and backup batteries. And the basket below holds the folders from which the children get the paper from to write SmartPen stories.

Walking across the classroom towards the projector screen wall, you find four shelves housing the traditional Sensorial materials in Montessori: knobbed cylinders, pink tower, the long stair, color boxes, Brown Stair, sound boxes, baric tablets, touch tablets.
To the left is the 2nd Sensorial shelf which houses the botany cabinet and supporting materials to explore types and parts of leaves further. There are puzzles for children to learn the external parts of reptiles, birds, fish, mammals, and amphibians. There are traditional paper booklets to record these works. There are baskets containing life cycle of the butterfly and frog complete with word labels, reference books, and 3-D objects. On top of the shelf is a basket containing the external parts of the whale since they are studying sea creatures. Behind this shelf is one of four very large picture windows that brings the outdoor classroom into the indoor. There is a bog located just outside the classroom; a short walk down the back hill of the classroom. From this view, there are many trees and park like vegetation. turning slightly the other three windows wrap around the classroom letting the natural light spill in. Just in front of the first window is a quiet book area where children may sit in the wooden rocking chair and read books. In the windows sill nearby there are many small potted plants for the children to care for and discover more about plant life with. There is also a very large floor plant with broad flat

leaves that create an open umbrella effect. There are also hanging plants found around the room. So plants are a very important part of the environment. Near the large floor plant one finds the last Sensorial shelf that has the Geometric Solids and their bases found on top. a definite favorite work of the children. There are some wooden jigsaw puzzles and the Geometric Cabinet that contains six drawers of geometric shapes. On the second shelf down, there are the constructive triangle boxes in which children explore how geometric shapes can be formed with the combinations of varied triangles. There are more puzzles to explore and some parquetry work as well. In the corner of the windows there is a large mirrorred easel on which can paint or apply shaving cream. Behind it is a drying rack where children can hang wet pictures. Beside it in front of the windows one finds art shelves with clay work and pasting work for collages. Then come the four practical life shelves and tables for individual work within. Overlooking the practical shelves is the sink and counter area where children wash their hands and get drinks from the water fountain. This is also the area where children have snack two at a time and wash their own dishes. Just to the right of the sink area is the cubby area that has two sets of cubbies lining the 2 walls that lead to the classroom door. Walking around, you can see student work left out on a floor mat such as this particular child's South America Map. Looking around again one finds work left at a table for the child to return to complete. In this classroom children are permitted to work at tables or at floor mats.

Now walking back over to the Practical Life shelves...There are opportunities to spoon and use your fingers for fine motor development. There are screwdriver boards, necklaces making by stringing beads, and zipping/snapping/button practice with a cloth doll. There

are sifting work and squeezing work. And basting work to work those hand muscles. More spooning and lots of natural items...rocks and plants...And a tall plant that invites the children to care for it and feel its broad flat leaves. So this is the Practical Life area.

Walking back again towards the cubby area one finds the visitor observation chair. This is also near the classroom restroom. There is a handwashing stand with a mirror. There are brooms the child's size to use whenever they want to sweep and mop and take care of the classroom.

Beside the Handwashing stand are landforms for the child to study the geographical differences in the land.

Scanning the classroom from this angle outward we see another math shelf that contains beginning math work focused on 1-10 skills with the Spindle Boxes and Cards & Counters. There are number rods children grade and count from 1-10.

Looking to the other side of the cubbies is the map shelf that contains a puzzle map of the USA as well as a map for each of the continents. There are globes and pin maps to explore the capitals. There are maps beside the stand that the children have created and are continuing to add pieces to daily.

These are the children cubbies. They bring backpacks and inside shoes, lunch boxes. And above, the older students have multiple one subject notebooks which they record their

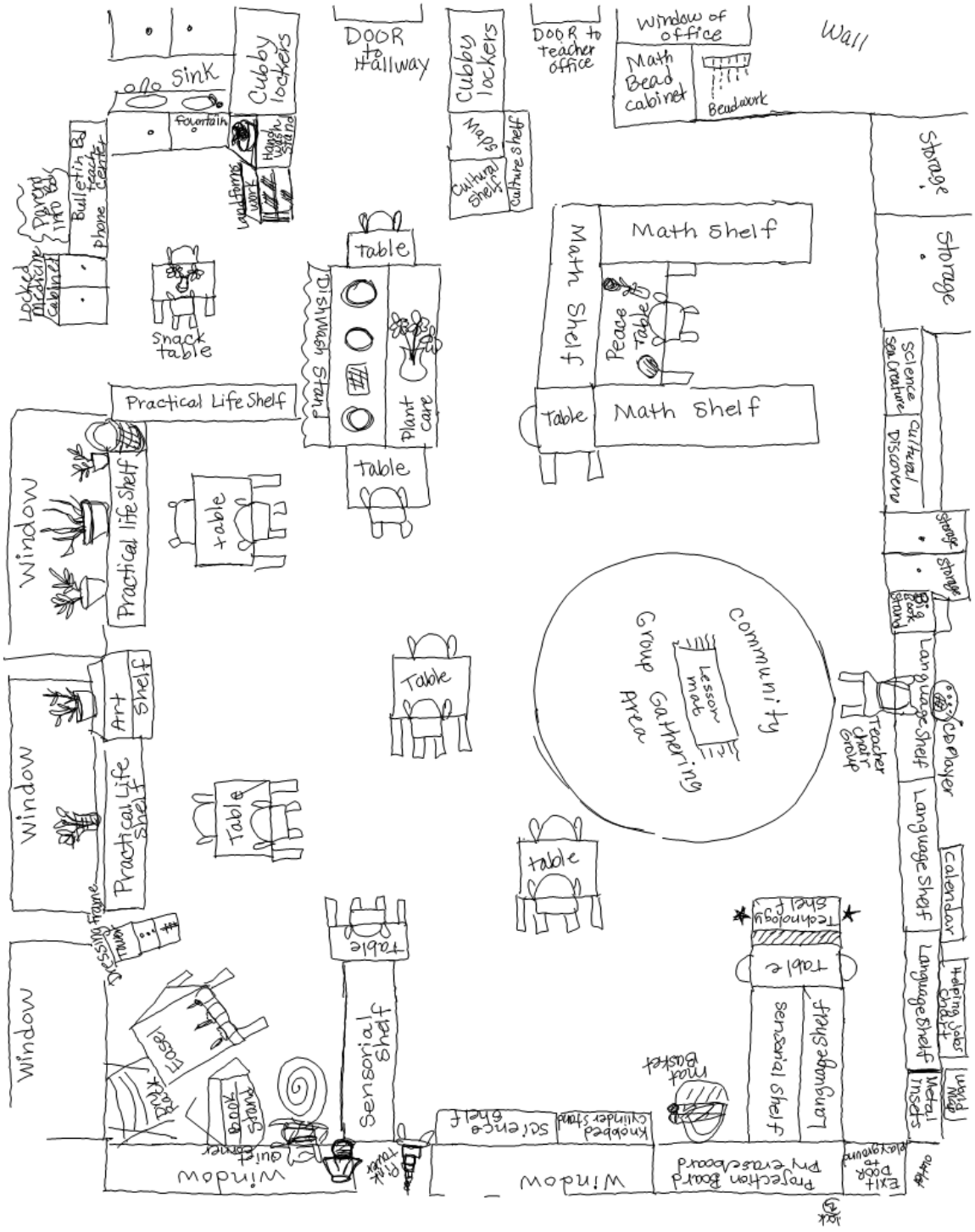
work in. This enables the teacher to track the work that the older children do across various subjects. There are lovely cultural and science materials displayed above the cubbies inviting the children to learn about birds, eggs, nests, and other naturally occurring things at this time of the year. On the oppsite cubbies, one finds on top beautiful miniature flags of countries with books celebrating the differences that we all have. There is a mobile display of planets hanging down from the ceiling. There are restmats stored below the cubbies that the children use for rest time.

Taking one last scan of the classroom, I notice the soft white curtains that soften the rooms. There are flourescent commercial lights that line the ceiling. they are often kept off during the morning. Lamps are used and the natural light from the windows creates a soothing atmosphere.

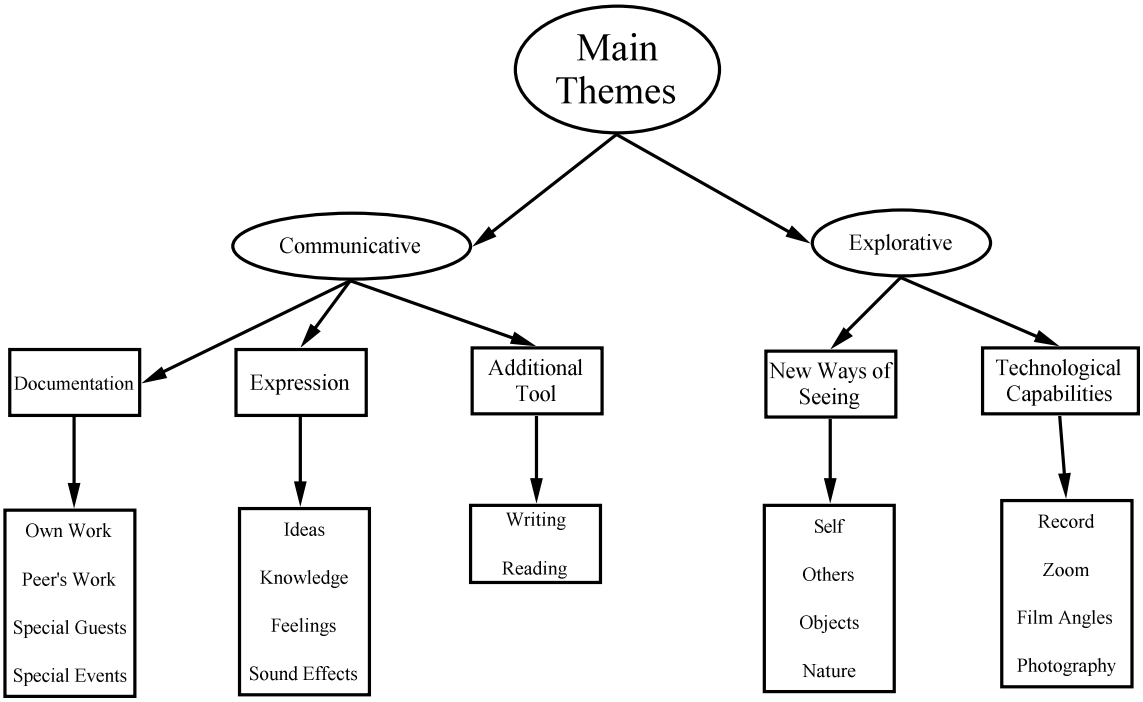
The teacher's office is behind the bead cabinet; just to the right of the cubbies. This is where the teacher stories classroom supplies. She has a desk and a computer there. This is where the teacher interviews for this study were conducted.

So this is the classroom...The site of ths study both visually and auditorally documented using the flip-camera.

Appendix T: Drawing of Classroom



Appendix U: Concept Map of Data Analysis Themes



Curriculum Vitae

Darlene Estes-Del Re, Ph. D.
112 Honeysuckle Drive
Hendersonville, TN 37075
615.428.8680
estesdelre@gmail.com

Education:

Doctoral of Philosophy—Early Childhood Education
Not yet obtained
Walden University, Minneapolis, Minnesota
4.0 GPA
Research Interests: Developmental Appropriateness of Technology
New Literacies and Socialization in Preschool
Play-based Curriculum
Asperger Syndrome and Learning delays

Master of Education—Curriculum & Instruction Effectiveness Pre-K-12
December 1995
Trevecca Nazarene University of Nashville, Tennessee
4.0 GPA

Bachelor of Science with Liberal Studies Concentration—Elementary Education K-8
May 1992
Christian Heritage University, El Cajon, California
3.8 GPA

Relevant Professional Experience:

Co-Director of Montessori Teacher Education Program 05/2010-Present
Belmont University, Nashville, TN

As a co-director of the Montessori program at Belmont University, I share leadership responsibilities of the program including hiring, training of staff and students, marketing, recruiting, curricula planning and implementation, program assessment, staff meetings, and university accreditation.

Adjunct Professor—Montessori Teacher Education Program 06/2004-Present
Belmont University, Nashville, TN

As an Adjunct Professor in the Montessori Program at Belmont University, I am responsible for teaching courses in Philosophy, Practical Life, Classroom Leadership, Parent Education, Classroom Management & Organization (COMP), Literacy/Language,

and Art Education. As a Montessori Teacher trainer, I adhere to a constructivist model of teaching by creating student centered learning environments and opportunities for collaboration. I model the principals of Montessori expected of teachers so that students can mirror those when they intern in Montessori classrooms. My teaching is also influenced by Parker Palmer's Courage to Teach.

Owner/Director of Honeysuckle Montessori School 06/2000-Present
Hendersonville, TN

Desiring to create a nurturing, enriching, and engaging environment that supports the developmental potential of each child, I established Honeysuckle Montessori School. Honeysuckle Montessori School realizes that building joyful, lifelong scholars should begin in the early years by presenting each child with the "keys" that will unlock the doors encountered along their educational path. For over a decade now, I enjoy being a director that teaches and is an active part of the academic, social, and spiritual growth of the children at Honeysuckle Montessori.

Community Service:

Sunday School Teacher 09/2008-Present
Christ Church Cathedral, Nashville, TN

As a Sunday school teacher of the four year old atrium, I am blessed to guide children in their spiritual formation. I carefully prepare the atrium environment for the children to experience God in their own way through the meditative materials available. I participate in parent informational meetings.

Visionary Team 04/2004-Present
Belmont University, Nashville, TN

As part of the visionary team for the Montessori Teacher's Education Program at Belmont University, I helped to create a visionary plan for the new Montessori Teacher Education Program beginning at Belmont University. I assisted with planning the curricula and coordinating the academic calendar. With the team, I developed an action plan for marketing and recruitment which included attendance at American Montessori Conferences and speaking at the Tennessee Association for Education for Young Children Conference.

Montessori Community Building Team
Belmont University, Nashville, TN

The Montessori Community Building Team was created to bring together the ideas, needs, and concerns of Directors of local Montessori schools that the Belmont University Montessori Teacher Education Program serves. I help create an agenda that highlights

positive happenings in the Montessori community as well as empowers the directors to try new ideas and strategies at their schools. As a team, it is our goal to bring greater understanding of the Montessori Method to the local community.

Licenses and Certifications:

Tennessee State Teacher Professional License
Early Childhood Pre-K-3rd grade
First through 8th grade
Effective August 1992-August 2015

American Montessori Society Certification
Early Childhood 3-6 years
December 1997 to present.

Classroom Organization Management Program (COMP)—Teachers Training
Vanderbilt University, Nashville, TN
Pre-K-12 grades (COMP)
July 2005

Catechesis of Good Shepherd Certification
Christ Church Cathedral, Nashville, TN
Level I
Ages 3-6
April 2008

Professional Affiliations:

Member of American Montessori Society
Member of International Society of Technological Educators

References:

Irmgard Gruber, Ph.D.
Early Childhood Education
Walden University
Minneapolis, MN 55401
734-997-7058
Irmgard.gruber@waldenu.edu

Dr. Trevor Hutchins, Ph.D.
Diverse Learners & Contemporary Issues
Belmont University
Nashville, TN 37207

Rhonda McKay, M.A.T.
Montessori Teacher Education Program
Belmont University
Nashville, TN 37207
615.460.6233

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