CLASSROOM OBSERVATIONS OF INSTRUCTIONAL PRACTICES AND TECHNOLOGY USE BY ELEMENTARY SCHOOL TEACHERS AND STUDENTS IN AN ETHNICALLY-AND ECONOMICALLY-DIVERSE SCHOOL DISTRICT

A Dissertation

by

KAYLA BRAZIEL ROLLINS

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2011

Major Subject: Curriculum and Instruction

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Approved by:

Chair of Committee,	Hersh Waxman
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ABSTRACT

Classroom Observations of Instructional Practices and Technology Use by Elementary School Teachers and Students in an Ethnically-and Economically-Diverse School District. (August 2011)

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Chair of Advisory Committee: Dr. Hersh Waxman

The purpose of this study was to observe pre-kindergarten through fifth-grade public school classrooms to examine differences among instructional practices and technology use by teachers, students and the overall classroom. The current study differed from and built upon previous classroom observational research in a number of major ways. First, the observational data examined both student and teacher technology use and the availability of technology in the classroom. Second, authentic classroom behaviors were examined in relation to technology use; specifically, behaviors related to the impact of technology use on student engagement as well as differences among technology use in classrooms and differences by student socio-economic status. Finally, unlike previous studies, this study focused specifically on pre-kindergarten through fifth-grade classrooms from the same large public school district that was diverse by both socio-economic status (SES) and by student ethnicity.

Overall, the results of this study suggest that technology has not been adequately implemented into the observed classrooms. Technology was available but was not used to a great extent. When technology was implemented, teachers were primarily observed using it to present material and students were observed using it almost exclusively for basic skills activities. This low-level of technology integration occurred in elementary schools of a high performing school district which had a technology plan in place, a low student to computer ratio, and 100% of the classrooms had Internet access.

Furthermore, only 15% of teachers were observed integrating technology to a great extent; however, students in these classrooms were observed on task significantly more frequently than students in classrooms where technology was observed less or not at all. On the other hand, students were observed off task significantly more in classrooms where either no technology integration was observed or where it was only observed a moderate amount. These findings support and build upon previous observational studies. There is still a need, however, for strong, empirical research to be conducted to further examine the use of technology in elementary classrooms.

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CHAPTER I

INTRODUCTION

Technology influences our lives every day, and it has become increasingly common to see numerous computers along with other forms of technology in P-12 classrooms. This is due in part to large financial investments by a number of school districts as well as grants from the state and federal government in order to implement technology into classrooms. The State Educational Technology Directors Association (SETDA), the International Society for Technology in Education (ISTE) and the Partnership for 21st Century Skills pushed for a renewed importance on technology in education in a recent national report (SETDA, 2007).

As part of No Child Left Behind (NCLB), the Department of Education stated that the primary goal of the Enhancing Education through Technology Act of 2001 was "to improve student academic achievement through the use of technology in elementary schools and secondary schools" (U.S. DOE, 2001). Almost a decade later, the federal government continues to mandate that "we must leverage [technology] to provide engaging and powerful learning experiences, content, and resources and assessments that measure student achievement in more complete, authentic, and meaningful ways" (U.S DOE, 2010, p. 3).

This dissertation follows the style of *American Educational Research Journal.*

A recent National Center for Education Statistics (NCES) study looked at the availability and use of technology in elementary and secondary public schools and found that this national sample of teachers reported a 5.3 to 1, student to computer ratio overall and a 5.4 to 1 student to computer ratio at the elementary level (Gray, Thomas, & Lewis, 2010). In the same study, 75% of teachers at the elementary level also reported that they or their students used computers *often* or *sometimes* during instructional time.

Today's elementary classrooms, however, are equipped with more than *just* computers. Elementary teachers reported having: a liquid crystal display (LCD) or a digital light processing (DLP) projector (81%), digital camera (81%), interactive whiteboard (54%), document camera (42%), classroom response system or "clickers" (28%), video conference unit (20%), MP3 player/iPod (18%), and/or handheld devices (13%) available as needed or present in their classrooms every day (Gray, Thomas, & Lewis, 2010). Also, 88% of teachers at the elementary level reported attending professional development for educational technology in the last 12 months.

Despite the large percentage of teachers who are attending professional development for educational technology, a high degree of technology immersion in the classroom is not always the result. In a recent four-year study, for example, 21 middle schools were immersed with technology and professional development for teachers; yet, only 6 of the 21 treatment schools reached substantial levels of technology implementation by the fourth year (Shapely, Sheehan, Maloney, & Caranikas-Walker, 2010). In addition to professional development being a high priority, the six successful schools had strong administrator and teacher support for the technology program and a collegial atmosphere at the schools.

With such an array of technology in elementary classrooms, there is a need to examine how the technology is being used, who is using it, and what instructional practices are taking place in these classrooms. Findings from a national survey of teachers showed a reported increase in teachers professional use of technology (e.g., lesson planning) from 2004 – 2007, but during that same time period, the frequency of students use of technology for school work did not increase (Bakia, Means, Gallagher, Chen, & Jones, 2009). Other studies have suggested that teachers are more likely to implement learner-centered instructional approaches when students are using technology, specifically research or production software (Inan, Lowther, Ross, & Strahl, 2009; Lowther, Ross, & Strahl, 2006). Wozney, Venkatesh, and Abrami (2006) found that teachers who favored student-centered instructional approaches also reported that they were more likely to implement computer use and rated their own computer skills and knowledge at a higher level than their more teacher-centered colleagues.

The use of technology with young children has previously been a controversial issue for many in the field of early childhood and elementary education. Critics felt that an emphasis on technology in early childhood classrooms may decrease, and in some cases, eliminate time for imaginative play that is necessary to promote social and emotional learning (Miller, 2005). Many, however, view technology as a way to enhance learning in early childhood when used in developmentally appropriate ways (Boyd, 2008; Rosen & Jaruszewicz, 2009). More than a decade ago, the National Association for the Education of Young Children (NAEYC, 1996) stated in their position statement on technology, “Technology plays a significant role in all aspects of American life today, and this role will only increase in the future” (p. 1). NAEYC is currently revising their technology position statement; however, they were accurate in 1996, the role of technology has and will continue to increase.

Judge, Puckett, and Bell (2006) used data from the Early Childhood Longitudinal Study – Kindergarten (ECLS-K) cohort to examine the movement toward equitable technology access for children in their first four years of school, kindergarten to third-grade. At the time of their study, kindergarten to third-grade classes averaged about one computer for every five students. They also reported that differences in school computer access between children attending high-poverty and low-poverty schools are greatly decreasing. Other studies that have focused on technology use in high-poverty schools as well as with Hispanic, English Language Learners have indicated that technology-enhanced instruction is particularly beneficial for this population (Padrón & Waxman, 1996; Park, 2008; Waxman, Padrón, & Garcia, 2007).

Concerns with Previous Technology Research

Numerous studies have been conducted on the availability and use of technology in schools (Judge et al., 2006; Vannatta & Fordham, 2004; Wozney et al., 2006). These studies, however, have primarily used self-report data from administrators, teachers, students, and parents. Such data are frequently unreliable since actual technology use may be over-represented when using self-report measures (Cuban, 2001). Of the technology observation studies that have been conducted, many of the observations have taken place during preplanned lessons where technology is to be implemented (Grant, Ross, Wang, & Potter, 2005; Inan et al., 2010; Judson, 2006; Means, 2010). These studies provide a valuable look at how technology can be used in the classroom, but they are not representative of actual regular technology use. Very few studies have used systematic observations to examine the extent to which technology is used in the classroom (Lowther, Ross, & Strahl, 2006; Waxman & Huang, 1996) specifically in elementary classrooms. The present study extends previous technology research by conducting systematic classroom observations in pre-kindergarten to fifth-grade classrooms.

Purpose of the Study

A number of studies have been conducted on technology use in schools. The majority of these studies, however, have relied on self-report survey data from administrators, teachers, students, and parents (e.g., Judge et al., 2006; Vannatta & Fordham, 2004; Wozney et al., 2006). While these studies incorporate multiple views on technology, actual technology use may not be accurately represented with the self-report measures (Cuban, 2001). Although previous research has also included classroom observations of technology use, many of the observations have taken place during preplanned technology lessons instead of a more authentic classroom environment (Grant et al., 2005; Inan et al., 2010; Means, 2010). Additional studies have used both survey and observational data to address the connections between teachers' technology beliefs and their instructional practices with very small sample sizes (Judson, 2006; Mama & Hennessy, 2010).

Very few studies have involved classroom observations on a large-scale (Inan et al., 2010; Lowther et al., 2006). Additionally, these studies have focused on the general K-12 population and not specifically on the elementary grades. Previous research has also addressed the digital divide among high and low SES schools from comprehensive national and statewide samples with the absence of observational data (Hohlfeld et al., 2008; Judge et al., 2006).

The purpose of the present study is to examine the use of technology with teachers, students, and in the overall classrooms through observations of pre-kindergarten through fifth-grade public school classrooms. The current study differs from and builds upon previous research in a number of major ways. First, the observational data examines both student and teacher technology use and the availability of technology in the classroom. Second, this study examines authentic classroom behaviors and how they relate to technology use. Third, unlike previous studies, this study focuses specifically on pre-kindergarten through fifth-grade classrooms from the same large public school district that is diverse by both socio-economic status (SES) and by student ethnicity. Finally, this study looks at differences of technology use by SES, student sex and ethnicity.

Research Questions

The research questions that guide the present study are:

1. What types of technology are teachers using in their classrooms?
2. What types of technology are students using in their classrooms?
3. Are there significant ($p<.05$) differences among technology use for teachers by grade-level and content area?
4. Are there significant ($p<.05$) differences among technology use for students by grade-level, content area, and student ethnicity?
5. Are there significant ($p<.05$) differences among technology use in classrooms by socio-economic status?
6. Are there significant ($p<.05$) differences on technology use by type of instructional practices?
7. How does technology use in classrooms relate to students' academic engagement?

CHAPTER II

REVIEW OF RESEARCH

This chapter presents a review of research and literature on classroom technology use, specifically addressing issues related to the use of technology with young children, the impact of technology on classroom instructional practices, and classroom observation research that focuses on technology use. The research is presented in three tables, which include the purpose, the study sample and methods used, and the overall/significant results for each study. Within the tables, articles are listed alphabetically by author.

Technology and Young Children

Developmentally appropriate practice (DAP) is a common phrase in early childhood education and not one that is generally associated with technology. Developmentally Appropriate Technology Use (DATU) is a new phrase recently created by Rosen and Jaruszewicz (2009), however, the discussion surrounding appropriate use of technology has been around for a while. Table 1, *Research and Literature on Technology and Young Children,* provides an outline of eight articles that examine the use of technology with young children. These articles were published between 1996 to 2010.

Table 1

Research and Literature on Technology and Young Children

Study	Purpose	Sample/Method	Results
Fish, et al. (2008)	To investigate the association between home computer experience and cognitive development among preschool children in inner-city Head Start programs	208 children enrolled in four Head Start centers in Detroit, Michigan Assessed for cognitive development (McCarthy Scales of Children's Abilities [MSCA]) and school readiness (Boehm-3 Test of Basic Concepts) 60-question Family Survey (included questions on computer experience)	Children with access to computers scored higher on many cognitive test and school readiness measures Frequency of computer use significantly related to child cognitive scores and school readiness (children who used a computer on a weekly basis out performed daily and monthly users)
Harlow, Cowie, & Heazlewood (2010)	To illustrate how features of the interactive whiteboard (IWB) support teaching actions and provides structure for children to develop knowledge, skills, and aptitudes for learning also referred to as 'key competencies'	One teacher and a classroom of five to six year old children Small rural school in New Zealand Case study approach over a five day period Digital camera, video and audiotape recorders were used in data collection	Findings indicated that it was the teacher's active role in the organization of the learning environment including the integration of the IWB that allowed for student-centered learning and the potential for students to develop key competencies

Table 1 (continued)

Study	Purpose	Sample/Method	Results
Ihmeideh (2009)	To investigate the barriers to the use of technology in Jordanian preschool education	15 kindergartens were randomly selected 30 preschool teachers (two from each kindergarten) and 15 principals All teachers and principals were female (all staff in Jordanian preschools are female) Semi-structured interviews were conducted Each interview took approximately 30 minutes and was audio recorded for later transcription	Findings revealed that the lack of developmentally appropriate software, funds, time, and technology skills were the main barriers to technology use Most preschool teachers saw value in using technology for teaching and learning with preschool students Principals were not certain about the benefit of technology for children
Morgan (2010)	To gain an understanding about how IWB are currently being used in the teaching and learning of young children	30 classroom settings with three to seven year old children Class size ranged from 18 to 30 children Located across four local education authorities in South Wales in the United Kingdom	IWB are used most often for whole class, teacher-centered instruction Group work was the second most frequent use of IWB but the group work was described as repetitive and undemanding with no higher-order thinking

Table 1 (continued)

Study	Purpose	Sample/Method	Results
Morgan (2010) continued		Semi-structured interviews with the classroom teacher, observations/field notes of lessons (during two half-day sessions), video recordings of lessons, and informal dialogues with the children	Teacher interviews revealed that all teachers described their teaching as interactive and valued play as a vehicle for learning but observations revealed little interactive learning and only three IWB activities were described by the students as playing
NAEYC (1996)	To present the technology position statement of the National Association for the Education of Young Children (NAEYC) which was created in order to state their position on an issue related to early childhood for which there are controversial or critical opinions	NAEYC position statements are developed through a consensus-building approach that seeks to convene diverse perspectives and areas of expertise related to the issue and provide opportunities for members and others to provide input and feedback	Seven primary issues are addressed The teacher must play an active role in order to appropriately implement technology in early childhood classrooms

Table 1 (continued)

Study	Purpose	Sample/Method	Results
Plowman & Stephen (2005)	To use a case study approach to describe the use of information and communication technologies (ICT) in seven pre-school settings in terms of what is available and how it is used by adults and children	Seven case study settings in Scotland – three were local authority nursery schools, two were private sector nurseries, and two were voluntary sector playgroups Both urban and rural settings Interviews (at least one practitioner and the manager at each site) Observations throughout two half-day sessions at each site (episodes of computer use were recorded ranging from 30 seconds to 30 minutes) Brief conversations with children	Computers were present at all settings Practitioners generally referred to children "playing with computers" Few examples of peer support Adults rarely intervened or offered guidance and the most common form of intervention was reactive supervision Computer interaction was a limited experience for most children
Rosen & Jaruszewicz (2009)	To introduce a new educational term, developmentally appropriate technology use (DATU) which extends	Two contrasting classroom scenarios are provided to illustrate DATU	DATU is defined as use that both respects the unique challenges presented by children's levels of development and capitalizes on

Table 1 (continued)

Study	Purpose	Sample/Method	Results
Rosen & Jaruszewicz (2009) continued	developmentally appropriate practices (DAP) to include technology use		children's natural desire to actively, collaboratively construct knowledge and solve problems
Wang, Kinzie, McGuire, & Pan (2010)	To examine existing theoretical frameworks to suggest how instructional technologies should be used in early childhood education	Review of existing theoretical frameworks	Researchers suggest that instructional technologies should be used in early childhood inquiry education to enrich and provide structure for problem contexts, to facilitate resource utilization, and to support cognitive and metacognitive processes

The eight articles discussed in this section include five research studies, two conceptual/theoretical articles, and one position statement. Of the five research studies, two utilized case study methodology while the other three utilized surveys and interviews to examine larger populations. One of the conceptual/theoretical articles introduced a new educational concept and the other compared existing theoretical frameworks in order to suggest how instructional technology should be used with young children. Additionally, the position statement from NAEYC, an influential early childhood association, provided their position on technology use with young children.

In NAEYC's (1996) position statement on the appropriateness of technology and young children, seven issues were addressed:

1. In any given situation, a professional judgment by the teacher is required to determine if a specific use of technology is age appropriate, individually appropriate, and culturally appropriate.
2. Used appropriately, technology can enhance children's cognitive and social abilities.
3. Appropriate technology is integrated into the regular learning environment and used as one of many options to support children's learning.
4. Early childhood educators should promote equitable access to technology for all children and their families. Children with special needs should have increased access when this is helpful.

5. The power of technology to influence children's learning and development requires that attention be paid to eliminating stereotyping of any group and eliminating exposure to violence, especially as a problem solving strategy.
6. Teachers, in collaboration with parents, should advocate for more appropriate technology applications for all children.
7. The appropriate use of technology has many implications for early childhood professional development.

The theme resonating through the seven issues is the active role the teacher must portray in order to appropriately implement technology into the classroom. NAEYC is currently in the process of revising their position statement to include current research and input from early childhood educators (Rosen & Jaruszewicz, 2009).

In order to prepare future elementary education teachers for DATU, Rosen and Jaruszewicz (2009) set up a framework to inform teachers and teacher educators. First, teachers need to become technologically literate themselves. Second, teachers must understand the needs and interests of the children in their class as they relate to technology. Third, teachers have to be informed about the hardware, software, and Internet choices that they are making for their class. Fourth, teachers should scaffold the children's technology experiences with appropriate expectations. Finally, teachers should take into account the potential for technology as an assessment tool. Technology is here to stay, therefore, it is vital for elementary teachers to be informed about appropriate uses of technology in the classroom.

Wang, Kinzie, Mcguire, and Pan (2010) provide a similar theoretical perspective as Rosen and Jaruszewicz (2009) about technology use in early childhood education. Wang and colleagues, however, focus entirely on applying technology to inquiry-based learning in order to: enrich and structure problem contexts (i.e., present problems in a real life context, increase motivation and engagement levels), facilitate utilization of resources (i.e., provide access to resources with various perspectives, help children search and assess various resources), and support cognitive and metacognitive processes (i.e., differentiate learning, facilitate peer collaboration). While the researchers note that inquiry-based learning activities integrated with technology are complex, they believe it could greatly benefit children's thinking.

Harlow, Cowie, and Heazlewood (2010) conducted a case study in a classroom of five-and six-year old children to examine how the interactive whiteboard (IWB) can help children to develop knowledge, skills, and aptitudes for learning. Findings indicated that the use of the IWB allowed student-centered learning to take place and the potential for key competencies to be developed. Similar to the theme of the NAEYC position statement on technology, researchers noted that the active role the teacher played in creating the learning environment and orienting the IWB to meet student needs and interests was essential.

Morgan (2010) also examined the use of IWB with young children in order to assess their use for teaching and learning with three to seven-year old children. Researchers gathered data from 30 classroom teachers through semi-structured interviews, conducted two observations (i.e., field notes of lessons) of each of the 30 classrooms, took video recordings of the lessons, and had informal conversations with the children. Contrasting the findings of Harlow and colleagues (2010), findings revealed that IWB were used most frequently for whole class, teacher-centered instruction. Teacher interviews, however, indicated that all teachers described their teaching as interactive and valued play as a vehicle for learning but observations, for the most part, did not reflect this type of instruction with IWB.

Plowman and Stephen (2005) used a case study approach to investigate the availability and use of information and communication technologies (ICT) in seven preschool settings in Scotland. Researchers interviewed at least one teacher and the manager at each site, observed computer use during two half-day sessions at each site, and engaged in brief conversations with children. Teachers generally referred to children "playing with computers," also noting that computer skills and knowledge of technology is important for children for later schooling and employment but not necessarily great educational significance. Findings also revealed that while computers were present at all settings, there were few examples of peer support and teachers rarely provided guidance except in the form of reactive supervision.

In 2009, Ihmeideh investigated the barriers to the use of technology in preschools in Jordan. Preschool teachers (*n*=30) and principals (*n*=15) were interviewed at 15 different schools. Findings revealed the most frequently cited barriers to technology use were a lack of developmentally appropriate software, funding issues, time constraints, and inadequate technology skills. For the most part, preschool teachers saw value in the use of technology for teaching and learning, yet, principals were uncertain about the benefit of technology for young children.

Technology use with young children has shown to significantly relate to children's cognitive scores and school readiness (Fish, et al., 2008). Approximately 200 families of children enrolled in urban Head Start programs were surveyed about their children's home computer use. Almost half of the families surveyed had home computers. Children who were reported using computers at home on a weekly basis performed better than those who were reported using computers on a daily or monthly basis. These findings suggest that a moderate use of computers could have positive cognitive outcomes for young children in urban areas.

The research and literature reviewed in Table 1 examined technology use with young children from various perspectives including conceptual/theoretical models, a position statement, case studies, principal and teacher interviews, classroom observations, surveys, and student assessments. Each of these articles, while different in methodology, helped to expand upon the somewhat limited research on the use of technology with young children. A common theme throughout much of the literature was the need for the teacher to portray an active role in the formation of an effective technology-enhanced learning environment. It was clear that having a certain type of technology equipment (e.g., IWB) does not automatically create student-centered learning environments. Additionally, the presence of technology in the classroom does not prevent the possible barriers (e.g., lack of time and inadequate technology skills) to technology use.

Overall, the current research on technology use with young children is based on self-report, survey and interview data if conducted on a larger scale. Observations have been used in small case studies but need to be implemented systematically in large-scale studies as well. There is a need for strong, empirical research to be conducted to examine the use of technology with young children.

Instruction and Technology

Stipek and Byler (2004) found that elementary education teachers' beliefs and goals were closely related to their instructional practices in the classroom. Research has shown that teachers who believe in student-centered, constructivist instructional approaches are more likely to integrate technology into their lessons and use technology in their classrooms than teachers with teacher-centered instructional approaches (Hermans, Tondeur, van Braak, & Valcke, 2008; Rakes, Fields, & Cox, 2006; Smeets, 2005; Wozney, et al., 2006). For the most part, these studies relied on self-report, survey data, which do not take into account observations of actual classroom practices. Table 2, *Research on Instruction and Technology,* summarizes nine studies that examined instruction and technology. These articles were published between 2005 to 2010.

Table 2

Research on Instruction and Technology

Study	Purpose	Sample/Method	Results
Fletcher (2006)	To investigate technology integration practices on two elementary campuses through the use of a self-report survey	Two elementary campuses in a suburban, small-town independent school district, which resides outside of a large southeastern metropolitan city 45 teachers at the Pre-K to 5th grade-level Student population at both schools is primarily Hispanic Teachers at both schools are primarily Caucasian and female Technology Integration Survey for Faculty – targeted to assess if teachers integrate technology into their teaching and if teachers ask students to use technology in their learning	Results indicated that teachers were not implementing technology within their classroom learning environment at the teacher-centered level (with the exception of lesson planning) Results also indicated that teachers were not implementing technology within the classroom learning environment at the student-centered level
Hermans, Tondeur, van Braak, & Valcke (2007)	To investigate the relationship between teachers' educational beliefs and their computer use, while	525 primary school teachers from 68 schools in Belgium Participants were distributed evenly across grades and 81%	Constructivist teacher beliefs were found to be a strong predictor of classroom technology use

Table 2 (continued)

Study	Purpose	Sample/Method	Results
Hermans, Tondeur, van Braak, & Valcke (2007) continued	controlling for the impact of technology-related determinants (computer experience, supportive computer use, general computer attitudes) and teacher-related demographic variables (gender and age)	were female and 19% were male with ages ranging from 22 to 64 years old Survey – included questions about computer experience, the extent to which computer are used to support classroom practices, and the General Attitudes Towards Computers instrument	Traditional teacher beliefs seem to have a negative impact on the integrated classroom use of computers
Hohlfeld, Ritzhaupt, Barron, & Kemker (2008)	To examine the trends in technology integration in Florida's public schools with a focus on examining relationships to SES	2,345 public elementary, middle, and high schools who participated in the Florida Innovates survey for all four school years Statewide datasets – the Florida School Indicators Report and the Measuring Adequate Yearly Progress (AYP) Reports Based on percentage of economically disadvantaged students, the top 30% of schools (at each school level)	Students at high SES schools had greater access to production software Low SES schools were provided with significantly more technology support A larger percentage of teachers at high SES schools were reported using technology for lessons and for administrative purposes Students at low SES elementary

Table 2 (continued)

Study	Purpose	Sample/Method	Results
Hohlfeld, Ritzhaupt, Barron, & Kemker (2008) continued		were classified as low SES and the bottom 30% were classified as high SES for data analysis	and middle schools used significantly more content software and students at all levels of high SES schools used significantly more production software
Judge, Puckett, & Bell (2006)	To use data from the Early Childhood Longitudinal Study – Kindergarten (ECLS-K) Class of 1998-1999 to examine the progress toward equitable technology access and use over children's first 4 years of school	ECLS-K secondary data (which included adaptive, individually administered child assessments, parent interviews, and teacher and school administrator questionnaires) 8,283 children in their 4th year of school – 53.5% White, 18.6% Hispanic, 14.8% African American, and 8.5% Asian/Pacific Islander 63.1% of children attended low-poverty schools and 36.9% attended high-poverty schools	Differences in technology access between high- and low-poverty schools have decreased, except in home computer access (children attending high-poverty schools had less access to home computers) Third-grade teachers at high-poverty schools rated themselves more prepared to use computers with their classes than third-grade teachers from low-poverty schools Students attending high-poverty schools used the computer most frequently for reading and students attending low-poverty schools used the computer most frequently for Internet purposes

Table 2 (continued)

Study	Purpose	Sample/Method	Results
Judge, Puckett, & Bell (2006) continued			Frequent use of reading software was negatively correlated with reading and mathematics achievement
Mama & Hennessy (2010)	To explore the link between the level of technology integration, teacher attitudes, and student engagement	11 primary school teachers A multi-case design was conducted, involving thematic analysis of pre- and post-lesson interviews and unstructured lesson observations	Findings showed that a teacher's perception of the role of technology in fulfilling the lesson objectives influenced the degree of technology integration The level of technology integration appeared to influence student engagement during the lesson
Rakes, Fields, & Cox (2006)	To investigate the relationship between technology use and skills and the use of constructivist instructional practices among teachers in rural schools	123 teachers (71 fourth-grade teachers and 52 eighth-grade teachers) from 11 rural school districts in a southern state All schools received funding from the Delta Rural Systemic Initiative and the Technology	Findings indicate a significant, positive relationship between both levels of classroom technology use and personal computer use and the use of constructivist instructional practices, with personal

Table 2 (continued)

Study	Purpose	Sample/Method	Results
Rakes, Fields, & Cox (2006) continued		Literacy Challenge grant Schools ranged from 54% to 91% free and reduced lunches Survey – the Level of Technology Implementation (LoTi)	computer use being the strongest predictor
Smeets (2005)	To investigate the characteristics of learning environments and the contribution of ICT to learning environments	331 grade 8 primary teachers in the Netherlands 84% of the teachers were male Average years of experience in education was nearly 21 (ranged from 1 to 44) Survey – included teacher and class variables, characteristics of the learning environment, and the use of ICT	Use of ICT generally showed traditional approaches to learning Use of open-ended ICT applications was greater with teachers who created powerful learning environments for their students and when more computers were available
Wozney, Venkatesh, & Abrami (2006)	To examine the relationship between motivational, instructional, and school factors that impact the nature	764 elementary and secondary teachers in Quebec Both private and public schools	Findings indicated that teachers who prefer more student-centered approaches towards instruction are more likely to

Table 2 (continued)

Study	Purpose	Sample/Method	Results
Wozney, Venkatesh, & Abrami (2006) continued	and frequency of computer technology integration in schools	Survey – the Technology Implementation Questionnaire (TIQ)	integrate computers more frequently, perceive themselves as having a higher computer proficiency, and report themselves as being at a higher level of computer integration in the classroom
Wu & Huang (2007)	To investigate cognitive, emotional, and behavioral engagement in teacher-centered and student-centered technology-enhanced classrooms	54 ninth-grade students from two science classes Public junior high school in Taiwan One class was student-centered and the other was teacher-centered (both taught by the same teacher) Data collection – classroom video recordings, field notes, students' worksheets, computer activity recordings, achievement tests, and self-report questionnaires	Students in the student-centered class reported having significantly higher emotional engagement, however, the emotional engagement level had no impact on students' learning achievement at that time In the teacher-centered class, low-achieving students improved as much as the high-achieving groups In the student-centered class, the high- and medium-achieving groups performed significantly better than the low-achieving group

The nine studies summarized in this section included five studies based on self-report data from teacher surveys, two studies comprised of secondary data analyses with longitudinal data, one included a multi-case design with teacher interviews and unstructured observations, and one integrated multiple forms of data collection to closely examine two classrooms. Teacher surveys were utilized in five studies to provide teachers' views on technology, how they use technology in and out of their classrooms, and the way in which technology use relates to certain self-reported instructional practices. One of the secondary data analyses studies used a statewide dataset from the public school system and the other was from a national study sample. Additionally, a multi-case design study compared data reported in teacher interviews with data collected in unstructured observations. Finally, multiple forms of data collection were utilized in two technology-enhanced classrooms to examine the differences between student-centered and teacher-centered instruction.

Mama and Hennessy (2010) suggest that teachers' classroom practices as they relate to technology integration do reflect their beliefs. As part of a multi-case design study, 11 teachers were interviewed and observed in order to assess the level of technology integration in the classroom. The researchers concluded that the level of technology integration depended on the teachers' perception of the usefulness of technology in fulfilling the lesson's objective. Additionally, researchers determined that the level of technology integration influenced student engagement during the lesson.

Wu and Huang (2007) investigated cognitive, emotional, and behavioral engagement in one teacher-centered and one student-centered, ninth-grade classroom where technology was integrated to a great extent. Data collection occurred through video recordings, field notes, examining student work, computer activity recordings, achievement tests, and surveys. Results indicated that students in the student-centered class reported having significantly higher emotional engagement; however, emotional engagement had no impact on student achievement. Interestingly, in the teacher-centered class, low-achieving students improved as much as the high-achieving students did. Yet, in the student-centered class, the high- and medium- achieving groups performed significantly better than the low-achieving group. These findings suggest that different modes of instruction might be beneficial for students of varying achievement levels; however, the sample size is too small for broad conclusions to be drawn.

Fletcher (2006) found almost no technology integration in two elementary schools after surveying 45 teachers about their technology integration practices. Results indicated that teachers were not implementing technology within their classroom-learning environment at the teacher-centered or student-centered level. Teachers did indicate, however, that technology was used when gathering information for lesson planning.

Judge et al. (2006) analyzed ECLS-K data and examined the frequency of computer use for instructional purposes for kindergarten to third-grade students from schools categorized as low and high poverty. Also, third-grade teachers at high-poverty schools rated themselves as being more prepared to use computers with their classes than did teachers at low-poverty schools. Findings revealed that the computer was most frequently used for reading at high-poverty schools and for Internet purposes at low-poverty schools. Additional findings indicated that there were significant negative correlations between the frequency of use of reading software and reading and mathematics achievement for third-grade. These findings suggest that while the gap is closing for equitable access to computers, there is still a difference in the type of instruction used with computers for students at low and high poverty schools.

Hohlfeld, Ritzhaupt, Barron, and Kemker (2008) used statewide data from the state of Florida to examine the digital divide in K-12 public schools. Their findings indicated that students at high socio-economic status (SES) schools had greater access to production software which helps to provide what is needed to develop 21st Century Skills. Low SES schools, on the other hand, were provided with significantly more technology support. However, a larger percentage of teachers at high SES schools were reported using technology for their lessons and for administrative purposes. Finally, similar to the findings of Judge and colleagues (2006), students in low SES elementary and middle schools used significantly more content software and students at all levels in high SES schools used significantly more production software.

Each of these studies further adds to the research on the use of technology in the classroom by helping to describe how teachers might choose to integrate technology and to examine differences in instructional practices with technology by SES. However, even with access to technology increasing across the board, observers of technology use in the classroom have generally found it to be underutilized (Cuban, 2001). The studies summarized in Table 2, vary from large-scale studies where longitudinal, secondary datasets were used to case studies involving a small number of participants. All findings were based on self-report forms of data with the exception of the two case studies, which involved some form of observation (e.g., field notes and video recordings). Large-scale classroom observational studies examining technology use are necessary to understand the potential impact of technology integration with teachers and students in the classroom.

Classroom Observation Studies of Technology Use

Several observational studies have been conducted examining the classroom practices of elementary teachers (McCaslin et al., 2006; Maxwell, McWilliam, Hemmeter, Ault, & Shuster, 2001; Stipek & Byler, 2004). Observational studies are important in order to link actual instructional techniques and behaviors to student outcomes. Although there have been a few large-scale observational studies conducted with a focus on instruction and technology (e.g., Inan et al., 2010; Lowther et al., 2006; Huang & Waxman, 1995), these studies do not primarily focus on elementary grade-levels. Table 3, *Research on Classroom Observation Studies of Technology Use,* summarizes nine studies that examine technology use in the classroom through methods of observation. These studies were published from 1995 to 2010.

Table 3

Research on Classroom Observation Studies of Technology Use

Study	Purpose	Sample/Method	Results
Grant, Ross, Wang, & Potter (2005)	To evaluate the use of mobile laptop carts by focusing on classroom practices, degree and type of technology use, academically focused time, student engagement, teacher technology skills, teacher attitudes towards technology as well as student and teacher reactions to the laptop program	Four fifth-grade classes at an elementary school in a suburban city outside a large urban city in the southeast United States Two Apple iBook laptop carts 23 to 27 students per class 9 pre-arranged classroom observations were conducted using three instruments – School Observation Measure (SOM), Survey of Computer Use (SCU), and Rubric for Student-Centered Activities (RSCA) 4 teachers completed two different surveys – Teacher Technology Questionnaire (TTQ) and Technology Skills Assessment (TSA) Focus groups – all four fifth-grade teachers and eight to ten fifth-grade students	Results indicated that teachers had positive technology competence and confidence Technology used with over 40% of the observed student-centered instructional strategies Technology was used in every instance that project-based learning was observed Overall, teacher technological knowledge and efficacy, pedagogical knowledge, and a supportive school community appear to be indicators that impact technology integration

Table 3 (continued)

Study	Purpose	Sample/Method	Results
Huang & Waxman (1996)	To examine the amount of technology used by middle school students in mathematics and to investigate whether there are significant differences by grade-level, sex, and ethnicity	1,315 students from 220 classrooms in five middle schools in a multi-ethnic school district were observed Student demographics – 49.4% female and 50.6% male; 32% Caucasian, 26% African American, 23% Asian, and 20% Hispanic; 38% sixth-graders, 32% seventh-graders, and 30% eighth-graders School district received a grant to integrate calculators into mathematics instruction (every middle school student received a calculator) Observation instrument – Classroom Observation Schedule (COS) Approximately 50-minute systematic observation period	Descriptive results indicate that students used calculators about 25% of the time and computers < 1% of the time in their mathematics classes There were no significant differences in calculator use by student sex or ethnicity Students in seventh-grade used calculators significantly more than students in sixth- or eighth-grade

Table 3 (continued)

Study	Purpose	Sample/Method	Results
Inan, Lowther, Ross, & Strahl (2010)	To identify instructional strategies used by teachers to support technology integration and to examine relations between types of computer applications and teachers' classroom practices.	143 classroom observations of full (45-60 minutes) pre-schedules technology integration lessons at 39 participating schools Schools had received federal funding to implement school-wide technology initiatives Observation instruments – the School Observation Measure (SOM) and the Survey of Computer Use (SCU)	Findings revealed that classroom practices tend to be more student-centered when students use the computer as a learning tool such as the Internet, word processing, and presentation software Drill-and-practice activities revealed a negative relationship with student-centered learning
Judson (2006)	To observe teachers integrating technology and to correlate these observations with stated beliefs and attitudes of the teachers	32 K-12 classroom teachers volunteered from various school settings Teachers' beliefs and attitudes were measured with the Conditions that Support Constructivist Uses of Technology (CSCUT) survey To measure constructivist teaching when technology is	Survey findings revealed that most teachers identified strongly with constructivist teaching practices Analysis revealed that there were no significant relationships between classroom practices and teacher beliefs

Table 3 (continued)

Study	Purpose	Sample/Method	Results
Judson (2006) continued		integrated into instruction, the Focusing on Integrating Technology: Classroom Observation Measurement (FIT:COM) was used	
Lowther, Inan, Strahl, & Ross (2008)	To determine the degree to which the Tennessee EdTech Launch (TnETL) initiative accomplished the program goals of raising student achievement, improving teachers' skill levels in, and attitudes toward integrating technology with curriculum and state standards, and fostering greater use of research-based teaching practices while increasing academically focused instructional time and student attention and engagement	13 schools that were participating in the state technology program and 13 matched schools (PreK-12) 15 minute observations in 1,285 randomly selected classrooms Observation instruments – SOM, Observation of Computer Use (OCU) Teacher surveys – TTQ and TSA Student achievement – Tennessee Comprehensive Assessment Program (TCAP)	Students in the program schools out-performed or performed as well as students in the matched schools Students in program schools experienced a greater use of technology as a learning tool and were significantly more engaged in student-centered learning activities Teachers in program schools had more positive attitudes towards technology integration and significantly higher agreement that the use of technology positively influenced student learning and their use of student-centered practices

Table 3 (continued)

Study	Purpose	Sample/Method	Results
Lowther, Ross, & Strahl (2006)	To examine the degree to which instructional practices, use of technology, academically focused instructional time, and student attention and engagement differ on the basis of participation in a statewide technology program	13 schools that were participating in the state technology program and 13 matched schools 1,210 randomly selected classrooms from the program and matched schools Observation instruments – SOM, SCU, and RSCA	Findings indicated that when student use of technology was put into practice, the teacher employed more student-centered instructional practices
Ross & Lowther (2003)	To examine Co-nect schools on process and outcome measures consisting of the following: school climate, teaching methods, teacher buy-in, level of design implementation, and student achievement	Five elementary schools that were part of the Co-nect school reform design and four elementary comparison schools Observation instruments – SOM and SCU (SCU was only used when technology was being used - total of 98 classrooms) 388 Co-nect classrooms and 322 comparison classroom were observed School Climate Inventory (SCI) Comprehensive School Reform	Findings focusing on technology revealed that 22% of the Co-nect classrooms and 3% of the comparison classes were observed using technology Co-nect and comparison classrooms were similar in the quality and quantity of available computers (generally 1 to 6 per classroom) At the low SES comparison schools, computer use was never observed “Meaningful use” of computers

Table 3 (continued)

Study	Purpose	Sample/Method	Results
Ross & Lowther (2003) continued		Teacher Questionnaire (CSRTQ) Interviews with Co-nect teachers and principals Student Achievement data – Tennessee Comprehensive Assessment Program (TCAP) for five subjects over three years	was at least occasionally seen in 40% of the technology observations at the Co-nect classrooms Many of the observed computer activities were lower-level applications (i.e., drill/content/tutorial-type programs)
Waxman & Huang (1995)	To systematically observe the extent to which computer technology is used in elementary and middle school classrooms	200 classroom observations (approximately 40 minutes) were conducted in 116 elementary school and 84 middle school classrooms 16 elementary schools and 12 middle schools from a large, ethnically diverse, urban school district Observation instrument – Computer Usage Scale (CUS)	Findings revealed that there was no integration of computer technology in the elementary school classrooms and students were observed working with computers in the content areas only 2% of the time in middle school classrooms

Table 3 (continued)

Study	Purpose	Sample/Method	Results
Waxman & Huang (1996-1997)	To examine whether classroom interaction, selection of activities, instructional activities, organizational setting of the classroom, and student on task and off task behaviors in the classroom are significantly different according to the degree of implementation of technology in mathematics classrooms	2,189 students were randomly chosen and observed from 5 middle schools Student demographics – 49.4% female and 50.6% male; 32% Caucasian, 26% African American, 23% Asian, and 20% Hispanic; 38% sixth-graders, 32% seventh-graders, and 30% eighth-graders School district received a grant to integrate calculators into mathematics instruction Observation instrument – Classroom Observation Schedule (COS) Approximately 50-minute systematic observation period	Findings revealed that there are significant differences in classroom instruction by the amount of technology used Instruction in classrooms where technology was not frequently used tended to be whole-class approaches where students listened to or watched the teacher Instruction in classroom settings where technology was moderately used had much less whole-class instruction and much more independent work; students were also found to be on task significantly more in these classrooms than students in classrooms where technology was not used as frequently

The nine studies summarized in this section all used systematic classroom observation instruments for a large portion of their data collection. Five of the nine studies used the School Observation Measure (SOM) (Ross, Smith, & Alberg, 1999) and the Survey of Computer Use (SCU) (Lowther & Ross, 2000) now referred to as the Observation of Computer Use (OCU) (Lowther & Ross, 2001). Two of those five studies used the Rubric for Student-Centered Activities (RSCA) as well. Additionally, two other studies used the Classroom Observation Schedule (COS) (Waxman, Wang, Lindvall, & Anderson, 1983). Furthermore, the Computer Usage Scale (CUS) (Waxman & Huang, 1995) was used in one study while the Focusing on Integrating Technology: Classroom Observation Measurement (FIT:COM) (Judson, 2006) was used in another study. The number of classroom observations conducted for each of the nine studies ranged from nine to 1,285. Additionally, teacher questionnaires were also used in three of the studies.

Judson (2006) surveyed and observed 32, K-12 classroom teachers about their beliefs about instructional practices and technology use. Survey findings were consistent with previous research; however, classroom observations showed that there was no significant correlation between teachers' instructional beliefs and their approach of incorporating technology. Despite teachers beliefs in the importance of having a constructivist-based, student-centered classroom along with positive views towards technology, pre-scheduled observations of technology integrated lessons did not reflect those beliefs.

In 1995, Waxman and Huang observed 116 elementary school and 84 middle school classrooms using the Computer Usage Scale (CUS) observation instrument in order to examine the extent to which computers were used. Findings revealed that there was no integration of computers in the elementary school classrooms, and students were observed working with computers only 2% of the time in middle school classrooms. Even though minimal technology use was observed, it is worth noting, that the district was selected for this study because of the abundance of available technology in the schools and classrooms.

Huang and Waxman (1996) used the Classroom Observation Schedule (COS) to observe 1,315 middle school students in order to examine the amount of calculator and computer use in mathematics classrooms. Findings indicated that middle school students used calculators about 25% of the time and computers less than one percent of the time. Additionally, while there were no significant differences by student sex or ethnicity, students in seventh-grade were observed using calculators significantly more than students in sixth- or eighth-grade.

In another study, Waxman and Huang (1996-1997) used the COS to observe 2,189 middle school students in order to examine instructional differences by level of technology use in mathematics classrooms. Findings revealed that teacher-centered instruction tended to take place in classrooms where technology was not frequently used; however, more independent student work took place in classrooms where a moderate amount of technology was used. Additionally, students were found to be on task significantly more in classrooms where more technology was used.

Inan et al. (2010) conducted observations of pre-scheduled technology integration lessons in 143 classrooms at the K-12 level. They examined the relationship between certain instructional strategies and different types of computer applications by using the School Observation Measure (SOM) and the Survey of Computer Use (SCU) to collect the observation data. Their overall findings showed that when applications such as word processors, the Internet, and presentation software were used, instructional practices were more likely to be student-centered. Conversely, drill-and-practice activities revealed a negative relationship with student-centered learning.

Direct observations were conducted in 1,210 PreK-12 classrooms, at 13 schools that had received a state technology grant along with extensive professional development and 13 matched schools (Lowther et al., 2006). Similar to Inan et al. (2006), Lowther et al. used the SOM and SCU observation instruments to collect data. The Rubric for Student-Centered Activities (RSCA) instrument was also used in this study. Again, similar to Inan et al. (2006), findings indicated that when student use of technology was put into practice, the classroom teacher employed more student-centered instructional practices. Additionally, classrooms at the schools that received the state technology grant were observed using technology more frequently and students more frequently had a high level of interest and attention in these schools (Lowther et al., 2006).

In 2008, Lowther, Inan, Strahl, and Ross reported additional findings from the previously discussed study, yet now with 1,285 classroom observations. The SOM and OCU (formerly referred to as the SCU) observation instruments were used for data collection. Findings revealed that students in the schools that participated in the technology program out-performed or performed as well on achievement tests as students in the matched schools. Additionally, similar to the previous study, students in program schools experienced a greater use of technology as a learning tool and were significantly more engaged in student-centered learning activities. Furthermore, teachers in program schools felt that the use of technology positively influenced student learning and their use of student-centered practices.

Grant, Ross, Wang, and Potter (2005) also used the SOM, SCU, and RSCA to conduct nine pre-arranged classroom observations in four fifth-grade classes in order to examine the use of two Apple iBook laptop carts. Findings indicated that technology was used over 40% of the time when student-centered instructional strategies were observed and 100% of the time when project-based learning was observed.

Ross and Lowther (2003) also used the SOM to observe 710 elementary classrooms and the SCU to observe 98 classrooms where technology was being used. The observations were part of a larger study evaluating five schools that were part of the Co-nect school reform design. In the study, observations took place at four comparison schools as well. While technology was not the primary focus in this study, findings revealed that 40% of the time that technology was observed in the Co-nect classrooms "meaningful use" of computers was at least occasionally seen. Many of the observed computer activities were lower-level applications (i.e., drill/content/tutorial-type programs).

In summary, this section addressed nine studies that used systematic classroom observations to examine technology use in classrooms. Of the nine studies, seven were conducted in order to evaluate various state and federally funded technology initiatives. These studies help to identify the type of instructional practices (e.g., student-centered or teacher centered) that often occur when certain types of technology are used in the classroom. Since many of these observations were conducted, however, during pre-planned technology integrated lessons, it is still difficult to conclude whether or not these same findings would occur in a natural setting.

Summary

This chapter reviewed the literature and research on technology use with young learners, technology and instruction, and classroom observation studies of technology use. These previous studies have provided a firm foundation for research on technology use in classrooms. Many of the studies reviewed, however, have primarily relied on self-report data or consisted of small samples that cannot be generalized to larger populations. Furthermore, the research, particularly in the area of classroom observations of technology use, is very limited. Currently, the research consists of a small number of both large- and small-scale studies that are almost exclusively focused on the evaluation of specific technology initiatives.

Overall, the studies reviewed in this chapter provided strong support for the present study, which builds upon the area of observational research by examining authentic classroom behaviors as they relate to technology use by teachers and students. This study focuses specifically on pre-kindergarten to fifth-grade classrooms from the same large public school district that is diverse by both SES and by student ethnicity. Additionally, differences by technology use and types of instructional practices are examined extensively. Finally, this study attempts to connect technology use in classrooms to students' academic engagement.

CHAPTER III

METHODS

Setting

The data used for this research was part of a larger study that focused on effective teaching and learning in the district. The study was conducted at 18 elementary schools located within a sizeable school district that encompassed 345 square miles and served 23,864 students in 2009-2010. The district was located in a metropolitan area in the south central region in the U.S. The ethnic breakdown of the district's students was: 44.4% Hispanic, 30.6% White, 19.1% African-American, 5.5% Asian, and 0.3% Native American. Additionally, 47.5% of the students were classified as coming from *economically disadvantaged* families; 41.5% are *at-risk*; and 13.9% have *limited English proficiency* (AEIS, 2010).

The district was home to 21 elementary schools, and the current study included classroom observations from 18 (86%) of those schools. The state in which data these schools are located annually assigns an overall campus achievement rating based on how the school collectively performed on the statewide standardized test of knowledge and skills. Out of the 18 elementary schools, 14 of the schools received campus achievement ratings of *Exemplary* (the highest achievement rating) and four received campus achievement ratings of *Recognized* (the second highest achievement rating) for the 2009-10 academic year (AEIS, 2010). Furthermore, for the purpose of this study, the 18 schools were categorized as either low SES, mid SES, or high SES. Schools with greater than 80% of their students classified as coming from economically disadvantaged families were considered low SES; between 30% and 80% were considered mid SES; and less than 30% were considered high SES. The percent of students considered economically disadvantaged and the campus achievement ratings are shown in Table 4.

Table 4

School Demographics – 2009-2010

School	Economically disadvantaged	Campus achievement rating
J	3.2%	Exemplary
I	4.8%	Exemplary
D	7.6%	Exemplary
A	24.6%	Exemplary
B	28.5%	Exemplary
H	29.3%	Exemplary
C	32.0%	Exemplary
M	32.5%	Exemplary
L	52.8%	Exemplary
K	60.1%	Exemplary
F	76.1%	Exemplary
G	77.3%	Exemplary
E	80.3%	Exemplary
R	80.5%	Exemplary
P	81.5%	Recognized
Q	92.1%	Recognized
N	93.3%	Recognized
O	94.5%	Recognized
Overall District	***47.5%***	***Recognized***

Note. From 2009-2010 Academic Excellence Indicator System (AEIS).

The district has recently composed a series of Strategic Plans for technology implementation within the district. The most recent plan, Technology Plan 2004-05, was the third in the series. The plan mandated that 100% of classrooms have Internet connection, a 4 to 1 student to computer ratio, and a 1 to 1 teacher to computer ratio. The goal for the plan was to build upon achievements of prior technology plans (e.g., the previous plans were so effective that the district became a leader in technology among public school districts in Texas), to integrate technology in curriculum and instruction, to provide greater staff development, to increase their own productivity, and to begin to provide access to the greater district community.

Participants

The participants were 710 students and 141 classroom teachers from 18 elementary schools. Of the 710 students, 369 were female (52.0%) and 341 (48.0%) were male. Student ethnicity in the current study sample (53.4% Hispanic, 14.4% White, 20.6% African-American, and 11.7% Asian) was generally reflective of the overall district population, with the exception of Asian students being slightly oversampled and White students slightly under represented. All student participants were enrolled in pre-kindergarten or kindergarten (*n*=177), first-grade (*n*=140), second-grade (*n*=134), third-grade (*n*=122), fourth-grade (*n*=70), and fifth-grade (*n*=67). (Note: pre-kindergarten and kindergarten classes were combined, due to small sample size). Of the 141 teachers, 136 were female and five were male. The distribution of grades taught was: 24.8% pre-kindergarten or kindergarten (*n*=35), 20.6% first-grade (*n*=29), 19.1% second-grade (*n*=27), 16.3% third-grade (*n*=23), 9.9% fourth-grade (*n*=14), and 9.2% fifth-grade (*n*=13). Classes averaged 17.2 students per class.

Instruments

Three observational instruments based on types of technology and technology use in elementary classrooms, as well as on previous classroom observation research (Waxman, 2003; Waxman & Padrón, 2004; Waxman, Tharp, & Hilberg, 2004), were specifically developed for this study (see Appendices A. B. and C). The *Student Behavior and Technology Use Observation Schedule*, adapted from the *Student Behavior Observation Schedule* (Waxman, Wang, Lindvall, & Anderson, 1988), was designed to systematically obtain information on students' classroom behaviors and technology use. It served as an instrument for documenting observed student behaviors in the context of ongoing classroom instructional-learning processes. Individual students were observed with reference to: (a) the setting in which the observed behavior occurred; (b) whether the student was on- or off-task, waiting for the teacher, or distracted; (c) the student’s interactions with teachers or other students; (d) the type of activity on which the student was working; (e) the nature of the student’s interaction with others; (f) the student’s use of specific types of technology items; (g) the educational use of the available technology; and (h) whether the language the student uses was either English, Spanish, or another language. Approximately five students were observed in each classroom for six to ten 30-second intervals during each 30-minute data collection period.

The *Teacher Roles and Technology Observation Schedule* was used to systematically obtain information on teachers’ classroom behaviors. It was adapted from the *Teacher Roles Observation Schedule (TROS)* (Waxman, Wang, Lindvall, & Anderson, 1990) and was a systematic observation instrument designed to document observed teacher behaviors in the context of ongoing classroom instructional-learning processes. Teachers were observed with reference to (a) their interactions with students; (b) the instructional setting in which the observed behavior occurred, (c) whether the instruction was of a direct, seatwork, or learner-centered orientation; (d) the nature of the interaction; (e) the purpose of the interaction; (f) the teacher's instructional practices which included uses of technology; and (c) what language was used. Each teacher was observed for six to ten 30-second intervals during each data collection period.

The *Overall Classroom and Technology Observation Measure* was a high-inference instrument used to examine: (a) teachers' general instructional practices, (b) student behaviors and activities, (c) the classroom environment/arrangement, and (d) the available technology and the extent to which it was observed in the classrooms visited. The Overall Classroom Observation tool was adapted from the *Classroom Observation Measure (COM)* (Ross & Smith, 1996), which measured the extent to which certain effective instructional processes or strategies were used or demonstrated during the class period. The COM has been used in a number of studies and found to be reliable and valid (Ross, Smith, Lohr, & McNelis, 1994; Ross, Troutman, Horgan, Maxwell, Laitinen, & Lowther, 1997). The COM also has been adapted and used in many recent studies (Waxman, Padrón, Franco-Fuenmayor, & Huang; 2009). The Overall Classroom Observation tool was used at the end of the class visitation to measure, on a 3-point scale (*not at all*, *some,* or *great*), the extent to which certain instructional processes or strategies were used or demonstrated during the class period.

Highly-trained researchers conducted all classroom observations. The mean inter-rater reliabilities across all observers for each observational instrument were: Teacher Roles and Technology Use Observation Schedule (0.97); Student Behavior and Technology Use Observation Schedule (0.98); and Overall Classroom and Technology Observation Measure (0.91). Table 5 refers to the research questions that guided this study along with the data sources, instruments, and data analysis that was used to address each of the research questions.

Data Analysis

For the present quantitative study, variables from the observational data (demographics, type and purpose of instruction, teacher and student technology use, etc.) were coded and electronically entered for analysis using Statistical Package for the Social Sciences (SPSS) software. Descriptive statistics were calculated and reported to answer questions about the types of technology teachers and students were using in their classrooms. Overall classroom counts for types of technology were also determined.

Table 5

Research Methodology

Research Questions	Data Sources and Instruments	Data Analyses
1. What types of technology are teachers using in their classrooms?	Teachers; Overall Classroom and Technology Observation Measure and Teacher Roles and Technology Use Observation Schedule	Descriptive statistics
2. What types of technology are students using in their classrooms?	Students; Student Behavior and Technology Use Observation Schedule	Descriptive statistics
3. Are there significant (p<.05) differences among technology use for teachers by grade-level and content area?	Teachers; Teacher Roles and Technology Use Observation Schedule	Multivariate analysis of variance (MANOVA)
4. Are there significant (p<.05) differences among technology use for students by grade-level, content area, and student ethnicity?	Students; Student Behavior and Technology Use Observation Schedule	MANOVA
5. Are there significant (p<.05) differences among technology use in classrooms by socio-economic status?	Classroom; Overall Classroom and Technology Observation Measure	MANOVA
6. Are there significant (p<.05) differences on technology use by type of instructional practices?	Teachers; Teacher Roles and Technology Use Observation Schedule	MANOVA
7. How does technology use in classrooms relate to students' academic engagement?	Students; Student Behavior and Technology Use Observation Schedule and Overall Classroom and Technology Observation Measure	Multiple regression analysis

Multivariate Analysis of Variance (MANOVA) was the primary data analysis procedure used in this study. A two-way MANOVA was conducted to investigate whether there were significant ($p<.05$) differences in technology use for teachers by grade-level and content area. In addition, a three-way MANOVA was conducted to investigate whether there were significant ($p<.05$) differences in technology use for students by grade-level, content area, and student ethnicity. Furthermore, a MANOVA was conducted to investigate whether there were significant ($p<.05$) differences in technology use for classrooms by socio-economic status. Additionally, a two-way MANOVA was conducted to investigate whether there were significant differences in technology use by type of instructional practice (direct instruction and learner-centered instruction). Post-hoc tests were performed to further examine significant main effects and possible interactions.

Additionally, the extent to which technology use influenced students' academic engagement was analyzed using multiple regression analyses. These procedures were used to examine the effects of technology use on students' academic engagement. Finally, field notes were recorded during observations in order to provide further explanation for classroom occurrences. The field notes, however, were used to provide examples but not included in the data analysis.

CHAPTER IV

RESULTS

The results are presented by the seven research questions posed for this study. The first two questions addressed the types of technology used by teachers and students in their classrooms. Next, the third and fourth questions examined significant differences among technology use for teachers and students by grade-level, content area, and student ethnicity. Question five explored significant differences among technology use in classrooms by socio-economic status. Subsequently, question six investigated significant differences on technology use by types of instructional practices. Finally, the last question examined whether technology use in classrooms is related to students' academic engagement.

Results Related to Type of Technology in Classrooms

Two research questions looked at the types of technology that teachers and students are using in their classrooms. Question one examines the types of technology that teachers were using, and question two looked at the types of technology that students were using. This section presents the types of technology that were available in classrooms as well as the results of both research questions.

Table 6 shows the types of technology that were available in the observed classrooms. The most frequently cited technology items were *desktop computer* (94.3%), *television* (55.3%), *document reader* (39.7%), and *interactive whiteboard* (36.9%). The least frequently cited items were *Skype* (0.7%), *flip camera/video camera* (0.7%), and *digital camera* (1.4%).

Table 6
Types of Technology Available in Observed Classrooms (*n*=141)

Type of technology	Percentage of classrooms
Desktop computer	94.3%
Television	55.3%
Document reader	39.7%
Interactive whiteboard	36.9%
Overhead projector (traditional)	30.5%
Laptop computer	29.1%
DVDs/CDs and headphones	19.9%
Tape player/radio	14.9%
Handheld game/device	4.3%
MP3 player	2.1%
Student timers	2.1%
Digital camera	1.4%
Flip camera/video camera	0.7%
Skype	0.7%

Source. Overall Classroom and Technology Observation Measure

Research question one. The first question examined the types of technology that teachers were using in their classrooms. Descriptive statistics from the Overall Classroom and Technology Observation Measure were used to answer this question. Table 7 shows the percentage of teachers who integrated specific types of technology into their classrooms. Overall, 44% of the 141 teachers were observed integrating technology at some point during the classroom observations. The most frequently observed technology items used by teachers at some point during the classroom observations were *interactive whiteboard* (23.4%) and *desktop computer* (20.1%). All other technology items were observed being used by less than 9% of teachers while *MP3 player* and *Skype* were never observed being used by a teacher in the observed classrooms.

Table 7
Types of Technology Used by Teachers in Classrooms (*n*=141)

Type of technology	Percentage of teachers
Interactive whiteboard	23.4%
Desktop computer	20.1%
Document reader	8.5%
Laptop computer	7.1%
Tape player/radio	3.5%
Television	3.5%
Overhead projector (traditional)	2.8%
DVDs/CDs and headphones	2.8%
Handheld game/device	2.1%
Student timers	0.7%
Digital camera	0.7%
Flip camera/video camera	0.7%
MP3 player	0.0%
Skype	0.0%

Source. Overall Classroom and Technology Observation Measure

Research question two. The second question asked what types of technology were students observed using in their classrooms. This question was answered using descriptive statistics from the Student Behavior and Technology Use Observation Schedule. Table 8 shows the percentage of students who were observed using specific types of technology in their classrooms. All technology items were observed being used by less than 8% of the students observed. The most frequently used technology items used by students were *desktop computer* (7.6%), *interactive whiteboard* (5.4%), *laptop computer* (3.2%), *document reader* (2.1%), and *DVDs/CDs and headphones* (1.1%). All other technology items were observed being used by 1% of students or less with *overhead projector (traditional)* and *Skype* never observed.

Table 8

Types of Technology Used by Students in Classrooms (*n*=710)

Type of technology	Percentage of students
Desktop computer	7.6%
Interactive whiteboard	5.4%
Laptop computer	3.2%
Document reader	2.1%
DVDs/CDs and headphones	1.1%
Tape player/radio	1.0%
Handheld game/device	0.6%
Digital camera	0.4%
MP3 player	0.4%
Television	0.4%
Student timers	0.1%
Flip camera/video camera	0.1%
Overhead projector (traditional)	0.0%
Skype	0.0%

Source. Student Behavior and Technology Use Observation Schedule

Results Related to Teacher and Student Technology Use

Two research questions examined statistical differences among teacher and student use of technology when looking at content area, grade-level, and student ethnicity. The first question addressed possible differences among teacher technology use practices by grade-level and content area, while the second question looked at possible differences among student technology use practices by grade-level, content area, and student ethnicity. The results of both research questions are discussed in this section.

Research question three. Question three asked whether there were significant (p<.05) differences among technology use for teachers by grade-level and content area. Differences were analyzed using data collected from the Teacher Roles and Technology Use Observation Schedule. Table 9 shows the mean percentage values for the five practices used to describe the ways in which teachers were observed using technology. Overall, teachers in the observed classrooms did not frequently use technology; however, the most frequently observed items were *uses technology to present material* (11.6%) and *assists students with technology* (2.6%). All other technology use practices were observed less than 1% of the time while *uses technology to create* was never observed. Standard deviations for the observed variables were high, suggesting a great deal of variation in the observed frequency of the teacher technology use practices from classroom to classroom.

Table 9

Mean Percentage Values of Teacher Technology Use Practices (*n*=141)

Technology use practices	Mean percentage	*SD*
Uses technology to present material	11.6%	25.3
Assists students with technology	3.6%	14.0
Uses technology to access the Internet	0.3%	2.7
Uses technology as a communication tool	0.1%	0.8
Uses technology to create	0.0%	0.0

Source. Teacher Roles and Technology Use Observation Schedule.

Crosstabs were conducted, and due to empty data cells, a two-way MANOVA examining technology use for teachers by grade-level and content area was not conducted. Instead, two one-way MANOVAs were used to analyze teacher technology use by grade-level and teacher technology use by content area. The first one-way MANOVA was used to determine whether there were any significant differences ($p<.05$) by grade-level. No statistically significant differences were found in teacher technology use practices by grade-level (see Table 10).

Table 10

Summary Statistics for MANOVA Results for Teacher Technology Use by Grade-Level

Effect	Wilks' lambda	*F*	*df*	*p*
Grade-level	.891	.780	5, 135	.739

The four observed technology use practices were also examined in the second one-way MANOVA to determine whether there were any significant differences ($p<.05$) by content area. No statistically significant differences were found in teacher technology use practices by content area (see Table 11).

Table 11

Summary Statistics for MANOVA Results for Teacher Technology Use by Content Area

Effect	Wilks' lambda	*F*	*df*	*p*
Content area	.850	1.393	4, 136	.141

Research question four. Question four asked whether there were significant (p<.05) differences among technology use for students by grade-level, content area, and student ethnicity. Differences were analyzed using data collected from the Student Behavior and Technology Use Observation Schedule. Table 12 shows the mean percentage values for the five practices used to describe the ways in which students were observed using technology. Overall, students in the observed classrooms did not frequently use technology; however, the most frequently observed item by far was *basic skills/drill/practice* (15.2%). All other technology use practices were observed less than 2% of the time. Standard deviations for the observed variables were high, suggesting a great deal of variation in the observed frequency of the student use of technology from classroom to classroom.

Table 12

Mean Percentage Values of Student Technology Use Practices (*n*=710)

Technology use practices	Mean percentage	*SD*
Basic skills/drill/practice	15.2%	32.4
Individualized/tracked	1.5%	10.8
Word processing	1.4%	10.5
Creativity	0.7%	6.7
Problem solving	0.2%	2.9

Source. Student Behavior and Technology Use Observation Schedule.

Crosstabs were conducted, and due to empty data cells, a three-way MANOVA examining technology use for students by grade-level, content area, and student ethnicity was not conducted. Instead, three one-way MANOVAs were conducted to analyze student technology use by grade-level, student technology use by content area, and student technology use by student ethnicity. The five student uses of technology were examined in the first one-way MANOVA to determine whether there were any significant differences (p<.05) by grade-level. The results of the MANOVA yielded a significant difference among grade-levels (*Wilks' lambda*=.887, F(5, 704)=3.42, p<.000). In the follow-up MANOVA, student technology use by grade-level was statistically significant for *problem solving* at the p<.05 level, for *creativity* and *word processing* at the p<.01 level, and for *individualized/tracked* at the p<.001 level. There were no statistically significant differences for student use of technology by grade-level for *basic skills/drill/practice*. The effect sizes of the five technology use practices ranged from 0.60 to 0.98, indicating a medium to large effect of grade-level.

The *Tukey* post hoc results are reported in Table 13. For *problem solving*, the post hoc results revealed that students in fourth-grade used technology significantly more for problem solving than students in pre-kindergarten/kindergarten, first-grade, second-grade, or third-grade. In terms of *creativity* and *individualized/tracked*, students in fifth-grade used technology significantly more for these practices than students in all other grades (pre-k to grade 4). Finally, students in fifth-grade used technology significantly more for *word processing* than students in second-grade or fourth-grade.

Table 13

Summary Statistics for MANOVA Results on Student Technology Use by Grade-Level

	Grades								
	P/K	1	2	3	4	5	Overall		
Technology use practices	*M*	*M*	*M*	*M*	*M*	*M*	*M*	*F*	η_p^2
Basic skills/drill/practice	12.53	16.04	11.26	19.36	14.05	22.39	15.24	1.75	.60
Individualized/tracked	0.57^{b}	1.07^{b}	0.68^{b}	1.91^{b}	0.00^{b}	7.31^{a}	1.50	4.75***	.98
Word processing	0.80^{ab}	0.36^{ab}	0.00^{b}	4.10^{ab}	0.00^{b}	4.23^{a}	1.37	3.79**	.94
Creativity	0.42^{b}	0.00^{b}	0.89^{b}	0.27^{b}	0.00^{b}	3.98^{a}	0.70	3.88**	.94
Problem solving	0.00^{b}	0.00^{b}	0.00^{b}	0.00^{b}	1.43^{a}	0.37^{ab}	0.18	3.04*	.87

Notes. *Wilks' lambda*=.887, *F*(5, 704)=3.42, *p*<.000. Means with the same letter are not statistically different as determined by the *Tukey* post hoc test.
* *p*<.05, ** *p*<.01, *** *p*<.001.

A second one-way MANOVA was conducted in order to determine whether there were any significant differences (*p*<.05) by content area on the five student uses of technology. The results of the MANOVA revealed a significant difference among content areas (*Wilks' lambda*=.935, *F*(4, 705)=2.39, *p*<.001). In the follow-up MANOVA, student technology use by content area was statistically significant for *basic skills/drill/practice* and *creativity* at the *p*<.01 level. There were no statistically significant differences for student use of technology by content area for *problem solving*, *individualized/tracked*, or *word processing*. The effect sizes of the five technology use practices ranged from 0.25 to 0.95, indicating a small to large effect of content area. The *Tukey* post hoc results are reported in Table 14. For *basic skills/drill/practice*, the post hoc results revealed that students in science classrooms used technology significantly more for basic skills than students in English/language arts, social studies, or classrooms classified as other (e.g., learning centers of multiple content areas). Finally, students in social studies classrooms used technology significantly more for *creativity* than students in English/language arts, mathematics, or classrooms classified as other.

Table 14

Summary Statistics for MANOVA Results on Student Technology Use by Content Area

	Content Areas							
	ELA	Math	Science	SS	Other	Overall		
Technology use practices	*M*	*M*	*M*	*M*	*M*	*M*	*F*	η_p^2
Basic skills/drill/practice	13.11[b]	18.07[ab]	29.86[a]	14.89[b]	9.81[b]	15.24	3.76**	.89
Individualized/tracked	2.29	1.09	0.00	0.00	1.27	1.50	1.11	.35
Word processing	1.47	0.74	0.69	3.20	1.05	1.37	0.78	.25
Creativity	0.10[b]	0.70[b]	1.56[ab]	3.65[a]	0.00[b]	0.70	4.68**	.95
Problem solving	0.07	0.59	0.00	0.00	0.00	0.18	1.12	.36

Notes. *Wilks' lambda*=.935, *F*(4, 705)=2.39, *p*<.001. Means with the same letter are not statistically different as determined by the *Tukey* post hoc test.
** *p*<.01.

A final one-way MANOVA was conducted in order to determine whether there were any significant differences (*p*<.05) by student ethnicity on the five student uses of technology. The results of the MANOVA yielded a significant difference among student ethnicities (*Wilks' lambda*=.942, *F*(3, 706)=2.81, *p*<.000). In the follow-up MANOVA, student technology use by student ethnicity was statistically significant for *basic skills/drill/practice* and *creativity* at the *p*<.01 level. There were no statistically significant differences for student use of technology by student ethnicity for *problem solving*, *individualized/tracked*, or *word processing*. The effect sizes of the five technology use practices ranged from 0.12 to 0.92, indicating a small to large effect of student ethnicity. The *Tukey* post hoc results are reported in Table 15. In terms of *basic skills/drill/practice*, the post hoc results revealed that Hispanic students used technology significantly more for basic skills than White students. Finally, Asian students were observed using technology significantly more for *creativity* than African American students, Hispanic students, or White students.

Table 15
Summary Statistics for MANOVA Results on Student Technology Use by Student Ethnicity

	Student ethnicities						
	African American	Asian	Hispanic	White	Overall		
Technology use practices	*M*	*M*	*M*	*M*	*M*	*F*	η_p^2
Basic skills/drill/practice	11.75[ab]	11.27[ab]	19.47[a]	7.73[b]	15.24	5.06**	.92
Individualized/tracked	1.51	0.60	1.06	3.84	1.50	1.99	.51
Word processing	1.14	2.01	0.92	2.86	1.37	1.04	.28
Creativity	0.86[b]	3.10[a]	0.30[b]	0.00[b]	0.70	4.40**	.87
Problem solving	0.17	0.00	0.26	0.00	0.18	0.33	.12

Notes. *Wilks' lambda*=.942, *F*(3, 706)=2.81, *p*<.000. Means with the same letter are not statistically different as determined by the *Tukey* post hoc test.
** *p*<.01.

Results Related to Differences in Technology Use by Socio-Economic Status

Research question five. Question five asked whether there were significant (*p*<.05) differences among technology use in classrooms by SES. Differences were analyzed using data collected from the Overall Classroom and Technology Observation Measure. Table 16 shows the mean values for the five variables used to describe the ways in which technology was used in the classroom. Overall, the means for the technology items ranged from not observed to observed to some extent in the visited classrooms. The items with the highest means were *technology was accessible for student use* (*M*=2.01), *students used technology to learn basic skills* (*M*=1.61), and *teachers integrated technology into lesson* (*M*=1.60). Standard deviations for the observed variables were moderate to high, suggesting some variation in the use of technology from classroom to classroom.

Table 16
Mean Percentage Values of Classroom Technology Use Practices (*n*=141)

Classroom technology use	*M*	*SD*
Technology was accessible for student use	2.01	.72
Students used technology to learn basic skills	1.61	.79
Teacher integrated technology into lesson	1.60	.75
Students used technology to enhance problem solving/creativity	1.13	.46
Students used technology to access the Internet	1.11	.41

Source. Overall Classroom and Technology Observation Measure.
Notes. 1 = not observed, 2 = some extent, and 3 = great extent

The five classroom technology use variables were examined in a one-way MANOVA to determine whether there were any significant differences (p<.05) by SES. No statistically significant differences were found in classroom technology use by SES (see Table 17).

Table 17
Summary Statistics for MANOVA Results for Classroom Technology Use by Socio-Economic Status

Effect	Wilks' lambda	*F*	*Df*	*p*
Socio-economic status	.957	.596	2, 138	.817

Results Related to Technology Use and Instructional Practices

Research question six. Question six asked whether there were significant (p<.05) differences on technology use in classrooms by type of instructional practices. By using the *teacher integrated technology into lesson* item from the Overall Classroom and

Technology Observation Measure, three levels of teacher technology use were determined: 1 = no technology use (*n*=79), 2 = moderate technology use (*n*=40), and 3 = great extent of technology use (*n*=22). Three one-way MANOVAs were conducted to examine differences in setting by level of teacher technology use, differences in instructional orientation by level of teacher technology use, and differences in the purpose of interaction by level of teacher technology use.

Table 18 shows the mean percentage values for the five classroom instructional setting variables. Classrooms were observed in *whole class* settings 55.5% of the time while *small groups* (19.1%), *students working individually* (12.6%), and *dyads* (2.8%) were seen much less frequently. Additionally, teachers were observed *traveling among students* 8.0% of the time. Standard deviations for the observed variables were high, indicating a great deal of variation in the observed settings from classroom to classroom.

Table 18

Mean Percentage Values of Classroom Setting (*n*=141)

Setting	Mean percentage	*SD*
Whole class	55.5%	42.0
Small group	19.1%	36.5
Individual	12.6%	26.8
Traveling	8.0%	19.5
Dyads	2.8%	12.9

Source. Teacher Roles and Technology Use Observation Schedule.

The five setting variables were examined in a one-way MANOVA to determine whether there were any significant differences ($p<.05$) by level of teacher technology use. No statistically significant differences were found for the setting variables by level of technology use (see Table 19).

Table 19
Summary Statistics for MANOVA Results for Classroom Setting by Level of Teacher Technology Use

Effect	Wilks' lambda	*F*	*df*	*P*
Teacher Technology Use	.877	1.81	2, 138	.059

Table 20 shows the mean percentage values for the observed instructional orientations. The most frequently observed instructional orientation by far was *direct instruction* (58.1%). All other instructional orientations were observed less than 10% of the time. Standard deviations for the observed variables were high, suggesting a great deal of variation in the observed frequency of the instructional orientations from classroom to classroom.

Table 20
Mean Percentage Values of Instructional Orientation (*n*=141)

Instructional orientation	Mean percentage	*SD*
Direct instruction	58.1%	39.1
Seatwork	9.9%	24.8
Learner-centered	5.8%	17.5

Source. Teacher Roles and Technology Use Observation Schedule.

The three instructional orientation variables were examined in a one-way MANOVA to determine whether there were any significant differences (p<.05) by level of teacher technology use. No statistically significant differences were found for the instructional orientation variables by level of technology use (see Table 21).

Table 21
Summary Statistics for MANOVA Results for Instructional Orientation by Level of Teacher Technology Use

Effect	Wilks' lambda	*F*	*Df*	*P*
Teacher Technology Use	.955	1.05	2, 138	.394

Table 22 shows the mean percentage values for the 19 practices used to describe teachers' purpose of interaction with students during the observed period. The most frequently observed items were *focus on content* (57.7%), *focus on process* (32.6%), and *focus on product* (30.5%). Teachers were also observed *praising student performance* (12.4%) and *correcting student behavior* (12.3%). All other classroom practices were observed less than 5% of the time. Standard deviations for the observed variables were high, suggesting a great deal of variation in the teachers' purpose of interaction from classroom to classroom.

Table 22

Mean Percentage Values of Teacher Purpose of Interaction (*n*=141)

Purpose of interaction	Mean percentage	*SD*
Focus on content	57.7%	36.3
Focus on process	32.6%	34.6
Focus on product	30.5%	88.7
Praise student performance	12.4%	20.9
Correct student behavior	12.3%	21.9
Assessment	4.8%	18.4
Correct student performance	4.5%	13.6
Praise student behavior	4.5%	11.9
Encourage students to succeed	4.0%	12.8
Redirect student thinking	3.6%	10.2
Encourage extended student responses	2.7%	8.9
Show personal regard for student	2.5%	9.5
Show interest in student work	2.4%	8.0
Encourage student self-management	1.3%	6.0
Encourage students to help each other	1.0%	5.3
Present multiple perspectives on topic	0.9%	6.4
Encourage students to question	0.7%	4.6
Connect content to other disciplines	0.6%	3.9
Connect content to global communities	0.6%	3.7

Source. Teacher Roles and Technology Use Observation Schedule.

In order to group the 19 instructional practices into factors, a factor analysis (using Varimax rotation) was conducted. The factor analysis revealed eight factors with eigenvalues greater than 1.00, accounting for 63.16% of the variance. The factor analysis, however, did not yield a meaningful, reduced number of factors. Consequently, a one-way MANOVA was conducted using all 19 instructional practices to determine whether there were any significant differences ($p<.05$) by level of teacher technology use. No statistically significant differences were found for the 19 teacher instructional practices by level of teacher technology use (see Table 23).

Table 23
Summary Statistics for MANOVA Results for Purpose of Interaction by Level of Teacher Technology Use

Effect	Wilks' lambda	*F*	*df*	*p*
Teacher Technology Use	.714	1.16	2, 138	.253

Results Related to Technology Use and Student Engagement

Research question seven. Question seven asked how technology use in classrooms relates to student engagement (e.g., on task, off task). This question will first be addressed by examining any significant differences in student engagement by level of student technology use. Then, significant differences in student engagement will also be examined by level of teacher technology use. By taking an average of the frequencies for the student technology use items from the Student Behavior and Technology Use Observation Schedule, three levels of student technology use were determined: 1 = no technology use (n=518), 2 = low technology use, less than 15% (n=106), and 3 = moderate technology use, greater than 15% (n=86). Next, a one-way MANOVA was conducted to examine any significant differences (p<.05) in student engagement by level of student technology use. No statistically significant differences were found for student engagement by level of student technology use (see Table 24).

Table 24
Summary Statistics for MANOVA Results for Students' Academic Engagement by Level of Student Technology Use

Effect	Wilks' lambda	*F*	*df*	*p*
Student Technology Use	.991	1.60	2, 707	.173

Additionally, differences in student activity types (e.g., discussing, reading, questioning) by level of student technology use were also examined. In order to group the 20 activity types into factors, a factor analysis (using Varimax rotation) was conducted. The factor analysis revealed nine factors with eigenvalues greater than 1.00, accounting for 56.95% of the variance. The factor analysis, however, did not yield a meaningful, reduced number of factors. Consequently, a one-way MANOVA was conducted using all 20 activity types to determine whether there were any significant differences ($p<.05$) by level of student technology use. The results of the MANOVA yielded a significant difference among the three levels of student technology use (*Wilks' lambda*=.857, $F(2, 707)=2.77$, $p<.000$). In the follow-up MANOVA, student activity types by level of technology use were statistically significant for *written assignment*, *distracted*, *answering teacher-posed questions,* and *learning/activity centers* at the $p<.01$ level and for *discussing*, *working kinesthetically*, and *free exploration/inquiry* at the $p<.05$ level. The effect sizes of the 20 student activity types ranged from 0.08 to 0.88, indicating a small to large effect of level of student technology use.

The *Tukey* post hoc results are reported in Table 25. In terms of *written assignment*, the post hoc results revealed that students who were not using technology and students who moderately used technology were observed performing written assignments significantly more frequently than students who had a low use of technology. Students who were not using technology were *distracted* significantly more of the time than students who had a low use of technology; however, students who were not using technology were observed *answering teacher-posed questions* significantly more than students who moderately used technology. Additionally, students who had a low use of technology were observed in *learning/activity centers* significantly more frequently than students who were not using technology. Students who used a technology moderately were observed *discussing* significantly more frequently than students had a low use of technology. Finally, students who used technology a moderate amount of the time were observed engaging in *free exploration/inquiry* significantly more than students who were not using technology. The post hoc results did not reveal significant differences for students observed *working kinesthetically*.

A final one-way MANOVA was conducted to examine significant difference on students' academic engagement by the level of teacher technology use (1 = no technology use, 2 = moderate technology use, and 3 = great extent of technology use). The results of the MANOVA yielded a significant difference among the three levels of teacher technology use (*Wilks' lambda*=.983, $F(2, 707)=3.06$, $p<.05$) on students' academic engagement. In the follow-up MANOVA, *on task* and *off task* variables were statistically significant at the $p<.01$ level. The effect sizes of the two engagement variables ranged from 0.80 to 0.88, indicating a large effect of level of teacher technology use.

Table 25

Summary Statistics for MANOVA Results on Student Activity Types by Level of Student Technology Use

	Student Technology Use					
	No tech use (n=518)	Low tech use (n=106)	Moderate tech use (n=86)	Overall		
Student activity types	*M*	*M*	*M*	*M*	*F*	η_p^2
Listening/watching	35.16	39.55	30.13	35.21	1.52	.32
Written assignment	33.58[a]	21.06[b]	33.82[a]	31.74	5.19**	.83
Reading	9.86	6.78	7.36	9.10	1.00	.22
No activity/transition	6.74	9.38	6.24	7.07	1.37	.30
Distracted	7.08[a]	1.33[b]	2.40[ab]	5.65	6.00**	.88
Answering teacher-posed questions	6.59[a]	4.05[ab]	1.05[b]	5.54	5.86**	.87
Discussing	5.52[ab]	1.21[b]	7.11[a]	5.07	4.20*	.74
Working kinesthetically	5.86	1.57	4.38	5.04	3.15*	.61
Learning/activity centers	3.28[b]	9.20[a]	5.62[ab]	4.45	4.87**	.80
Assessment	2.91	2.59	3.88	2.98	0.20	.08
Using concrete learning materials that closely relate to daily life experiences	2.89	1.52	0.00	2.34	2.64	.53
Answering peer-posed questions	1.90	0.24	0.58	1.49	0.60	.15
Games/rule-based play	0.97	0.63	2.52	1.11	1.28	.28
Questioning	0.74	0.00	0.39	0.59	1.13	.25
Tutoring	0.69	0.47	0.00	0.58	0.70	.17
Dramatic play	0.46	0.94	0.00	0.47	0.69	.17
Free exploration/inquiry	0.25[b]	0.00[b]	1.94[a]	0.42	3.56*	.66
Constructive play	0.29	0.94	0.00	0.35	1.76	.37
Acting-out	0.35	0.00	0.00	0.25	0.80	.19
Presenting	0.20	0.16	0.00	0.17	0.33	.10

Notes. *Wilks' lambda*=.857, $F(2, 707)=2.77$, $p<.000$. Means with the same letter are not statistically different as determined by the *Tukey* post hoc test.
* $p<.05$ and ** $p<.01$.

The *Tukey* post hoc results are reported in Table 26. Students observed in classrooms where teachers used technology to a great extent were significantly more likely to be *on task* than in classrooms where teachers only integrated technology moderately or did not integrate it at all. Additionally, students in classrooms where teachers moderately used technology or did not use technology at all were significantly more likely to be observed *off task* than students in classrooms where teachers integrated technology to a great extent.

Table 26
Summary Statistics for MANOVA Results for Students' Academic Engagement by Level of Teacher Technology Use

	Teacher Technology Use					
	No tech use (*n*=396)	Moderate tech use (*n*=206)	Great extent tech use (*n*=108)	Overall		
Student engagement	*M*	*M*	*M*	*M*	*F*	η_p^2
On task	81.79[b]	78.52[b]	88.77[a]	81.90	4.88**	.80
Off task	13.38[a]	17.29[a]	7.08[b]	13.56	5.92**	.88

Notes. *Wilks' lambda*=.983, *F*(2, 707)=3.06, *p*<.05. Means with the same letter are not statistically different as determined by the *Tukey* post hoc test.
** *p*<.01.

Summary

The purpose of this study was to examine the use of technology with teachers, students, and the overall classroom in an authentic classroom setting. Findings from 141 classroom observations revealed that a great deal of technology was available in classrooms with *desktop computers*, *televisions*, *document readers*, and *interactive whiteboards* being the most frequently cited items. Teachers were primarily observed *using technology to present material* with *interactive whiteboards* and *desktop computers* being the most frequently used items. For teachers technology use, there were no statistical differences by grade-level or content area indicating that the use of technology by teachers did not vary greatly across grade-levels or content areas.

Overall, students were not frequently observed using technology. *Desktop computers* and *interactive whiteboards* were the only technology items that were observed being used by greater than 5% of students, and when students were using technology, it was almost exclusively for *basic skills/drill/practice*. Student were rarely observed using technology for *problem solving*, *creativity*, *individualized/tracked*, or *word processing*, yet, numerous significant differences were found in relation to students' use of technology by grade-level, content area, and student ethnicity.

Descriptive statistics revealed that a *whole class* setting and *direct instruction* with a *focus on content*, *process*, and *product* were the most frequently observed classroom instructional practices. *Learner-centered* instruction occurred less than 6% of the time; however, unlike previous studies, no statistically significant differences were found in relation to the extent of teacher technology use and classroom instructional practices. On the other hand, students observed in classrooms where teachers used technology to a great extent were found to be *on task* significantly more than students in classrooms where technology was only used a moderate amount or not used at all. This is a positive finding concerning technology use and its potential impact on student engagement.

Students observed were found to be *on task* the majority of the time (81.9%); however, no statistically significant differences were found for student engagement (e.g., on task, off task) by level of student technology use. Interestingly, students who were not observed using technology were *distracted* significantly more of the time than students who used technology to some extent. Also, students who used technology to some extent were observed in *learning/activity centers* significantly more than students who were not observed using any technology. Additionally, students who were observed using technology at least a moderate amount were observed *discussing* and engaged in *inquiry* significantly more than students who used technology only a small amount of the time. Conversely, students who were not observed using technology *answered teacher-posed questions* significantly more than students observed using technology at least a moderate amount of the time.

The results of the present study suggest that technology, for the most part, has not been adequately implemented into the observed classes. This is due to the overall low frequency of technology integration and the lack of higher level strategies being used with technology. Research suggests that classroom practices are more likely to be student-centered when students are using technology as a learning tool (e.g., Internet, word processing, presentation software) (Inan et al., 2010). The use of drill-and-practice activities, the primary way technology was used by students in the present study, has been shown to have a negative relationship with student-centered learning.

CHAPTER V

DISCUSSION, IMPLICATIONS, AND CONCLUSION

This chapter summarizes the results and discusses both implications and conclusions derived from the current study. This chapter is presented in five sections. Section one discusses the overall and significant findings in terms of teacher and student technology use, classroom technology use as it relates to SES, technology use and instructional practices, and technology use and student engagement. Section two compares the results from this study to prior research, with particular attention paid to the previous observational studies, as well as implications for future research. Section three presents implications for practice based on the results of the current study. Section four discusses study limitations. Finally, section five includes the overall study conclusions.

Discussion of Results

Systematic classroom observations for this study took place within 18 elementary schools of a high performing school district that was both ethnically and economically diverse. The district had a series of technology plans in place which mandated that 100% of classrooms have Internet connection, a 4 to 1 student to computer ratio, and a 1 to 1 teacher to computer ratio. This series of technology plans had in fact been so successful that the district became a leader in technology among public school districts in the state of Texas. Therefore, the purpose of this study was to examine the use of technology with teachers, students, and the overall classroom in an authentic classroom setting.

Teacher and student technology use. The findings revealed that a great deal of technology was available in the 141 observed classrooms with *desktop computers*, *televisions*, *document readers*, and *interactive whiteboards* being the most frequently cited items. Due to the observational nature of this study, it is possible that additional technology items were present but not placed in an area of the classroom that was easily visible to an observer (e.g., digital cameras, MP3 players, tablet devices). Overall, teachers were observed using technology in the classroom to some extent. More specifically, 44% of teachers were observed using technology at some point during the observations and *interactive whiteboards* and *desktop computers* were the most frequently used items. When teachers were using technology, they were almost entirely *using technology to present material*. An example of a typical classroom as noted by one observer, "The teacher used the interactive whiteboard to display a worksheet that the students had already completed and had the students verbally assist her in making the written corrections [on the interactive whiteboard] to the sentences." Teachers were almost never observed *using technology to access the Internet*, *as a communication tool*, or *to create.* Additionally, there were no statistical differences for teachers technology use by grade-level or content area indicating that the use of technology by teachers did not vary greatly across grade-levels or content areas.

Overall, students were not frequently observed using technology. *Desktop computers* and *interactive whiteboards* were the only technology items that were observed being used by greater than 5% of students. When students were using technology, they were almost always using it for *basic skills/drill/practice*. One observer in a third-grade English/language arts class noted, for example, “Two students were at the computers. One student was taking an AR [Accelerated Reader] and the other was playing a word game.” Students were almost never observed using technology for *creativity* or *problem solving*; however, while the overall use of technology for *problem solving* was very low (0.2% of the time), students in fourth-grade used it significantly more than students in pre-kindergarten/kindergarten, first-grade, second-grade, or third-grade. Additionally, students in fifth-grade used technology for *creativity* and *individualized/tracked* practices significantly more than students in all other grades. Finally, students in fifth-grade were also observed using technology significantly more for *word processing* than students in second-grade or fourth-grade. While these differences were statistically significantly, it is difficult to draw generalizable conclusions since these practices were not frequently observed (less than 2% of the time).

Statistically significant differences were also found for student use of technology in regard to content area. Science classrooms were observed using technology significantly more for *basic skills/drill/practice* than students in English/language arts, social studies, or classrooms labeled as other (e.g., learning centers, circle/calendar time). This finding was somewhat surprising due to the prevalence of word/letter computer games. Additionally, teachers at several of the elementary schools pointed out the use of the Accelerated Reader program as well as drill-and-practice preparation for the statewide standardized testing. An example of students using technology for basic skills in a science classroom was noted by one observer in a pre-kindergarten classroom, “Students were taking turns going up to the Promethean Board to name and point to the farm animals.” Furthermore, the findings revealed that students in social studies classrooms used technology significantly more for *creativity* than students in English/language arts, mathematics, or classrooms classified as other. Again, while this finding is significant, students were rarely observed using technology for *creativity* (0.7% of the time) so major conclusions cannot be made.

Finally, statistically significant differences also occurred when examining student use of technology and student ethnicity. Hispanic students were observed using technology significantly more for *basic skills/drill/practice* than White students. While using technology for basic skills is not generally viewed as the most effective use of technology, prior research has revealed that individual technology usage can be particularly beneficial for Hispanic, English language learners (ELLs) (Park, 2008; Waxman et al., 2007). Additionally, Asian students were observed using technology for creativity significantly more than African American students, Hispanic students, or White students. Again, while this finding is statistically significant, students were infrequently observed using technology for *creativity* (0.7% of the time) so generalizable conclusions cannot be made.

Classroom technology use and SES. The schools visited in this study were very diverse in terms of the percentage of students coming from families who were economically disadvantaged. Therefore, each school was categorized as low SES, mid

SES, or high SES depending on percentage of students labeled economically disadvantaged. Previous studies have found significant SES related differences concerning how technology is used in the classroom (Judge et al., 2006; Hohlfeld et al., 2008). This prior research revealed that students attending lower SES schools used technology more frequently for basic skills instruction (e.g., content software, reading software) and students attending higher SES schools used technology more for production software or Internet purposes. In the current study, however, no statistically significant differences were found in relation to classroom technology use and SES.

Technology use and instructional practices. Descriptive statistics revealed that a *whole class* setting and *direct instruction* with a *focus on content*, *process*, and *product* were the most frequently observed classroom instructional practices. *Learner-centered* instruction occurred less than 6% of the time. Previous studies have concluded that teachers who prefer constructivist, learner-centered instructional approaches are more likely to integrate technology into their classrooms (Hermans et al., 2007; Wozney et al., 2006). Other research, however, has also contradicted this finding indicating that there is not a significant relationship between technology use and teacher beliefs (Judson, 2006). Teacher beliefs about technology were not measured in the present study; however, no statistically significant differences were found in relation to the extent of teacher technology use and classroom instructional practices.

Technology use and student engagement. Students observed in the present study were found to be *on task* the majority of the time (81.9%). Previous research has found students to be on task significantly more in classrooms where technology was at least moderately used (Waxman & Huang, 1996-1997). In the present study, no statistically significant differences were found for student engagement (e.g., on task, off task) by level of student technology use; however, students who were not observed using technology were significantly more *distracted* than students who used technology to some extent. Also, students who used technology to some extent were observed in *learning/activity centers* significantly more than students who were not observed using technology. One classroom observer in a fourth-grade math class noted, “The teacher was working with a small group while other students rotated through different stations, such as computer math drill, SMART Board, and workbooks.”

Additionally, students who were observed using technology at least a moderate amount were observed *discussing* and engaged in *inquiry* significantly more than students who used technology only a small amount of the time. Conversely, students who were not observed using technology *answered teacher-posed questions* significantly more than students observed using technology at least a moderate amount of the time. Finally, students observed in classrooms where the teacher used technology to a great extent were found to be *on task* significantly more than students in classrooms where technology was only used a moderate amount or not used at all. This finding supports the results of Waxman and Huang’s (1996-1997) earlier study.

Implications for Research

Despite the fact that technology use in education has been an area of much research, the number of systematic observation studies is actually quite limited. In

Chapter II (Tables 1-3), prior studies were discussed in relation to technology and young children, classroom instructional practices and technology, and classroom observation studies of technology use. This section will address how the findings from the present study build upon previous studies as well as remark on implications for future research.

Waxman and Huang (1995) conducted classroom observations in elementary and middle school classrooms in order to examine the extent to which computers were used. At the time of their study, findings revealed that there was no integration of computers in elementary school classrooms, and students were observed working with computers only 2% of the time in middle school classrooms. Interestingly, the district where the observations took place was selected because of the abundance of available technology in the schools and classrooms. While the findings for the present study show that technology use in classrooms has increased over the past decade and a half, it is still not being used to a great extent. Similar to Waxman and Huang's (1995) study, the district where the observations took place in the current study has a great deal of technology available.

In another study, Waxman and Huang (1996-1997) observed middle school students in order to examine instructional differences by level of technology use, specifically, in mathematics classrooms. The findings revealed that teacher-centered instruction tended to take place in classrooms where technology was not frequently used; however, more independent student work took place in classrooms where a moderate amount of technology was used. In the present study, no statistically significant differences were found when examining the extent to which teachers integrated technology into the lesson and classroom instructional practices (e.g., teacher-centered, student-centered). The findings from Waxman and Huang's (1996-1997) study also showed that students were found to be on task significantly more in classrooms where more technology was used. While the present study did not specifically focus on mathematics classrooms or middle school grade-levels, students were found to be on task significantly more when teachers were using technology to a great extent.

Direct observations were conducted in PreK-12 classrooms, at schools that received a state technology grant along with extensive professional development and matched schools (Lowther et al., 2006). The findings indicated that when students were observed using technology, teachers employed more student-centered instructional practices. Additionally, classrooms at the schools that received the state technology grant were observed using technology more frequently and students more frequently had a high level of interest and attention in these schools. In 2008, Lowther, Inan, Strahl, and Ross reported additional findings from the previous Lowther et al. (2006) study. The findings revealed that students in the schools that participated in the technology program out-performed or performed as well on achievement tests as students in the matched schools. Unlike these previous studies, the purpose of the present study was not to examine or evaluate a specific grant or technology program but instead to observe technology being used in an authentic classroom setting.

Inan et al. (2010) conducted observations of pre-scheduled technology integration lessons in K-12 classrooms in order to examine the relationship between certain instructional strategies and different types of computer applications. The findings showed that when applications such as word processors, the Internet, and presentation software were used, instructional practices were more likely to be student-centered. Conversely, drill-and-practice activities revealed a negative relationship with student-centered learning. In the current study, students used technology almost entirely for drill-and-practice activities; however, students using technology to some extent were significantly more likely to be in learning/activity centers than students who were not observed using technology.

Grant, Ross, Wang, and Potter (2005) conducted a small number of pre-arranged classroom observations in fifth-grade classes in order to examine the use of two laptop carts. Findings indicated that technology was used over 40% of the time when student-centered instructional strategies were observed and 100% of the time when project-based learning was observed. The use of laptop carts was not specifically examined in the present study, but observers noted the use of laptop carts in several classrooms. In one fifth-grade social studies classroom, for example, “About half of the students in the class are using mini-laptops from a laptop cart to research on the Internet and create brochures about their research topics.”

Ross and Lowther (2003) observed elementary classrooms as part of a larger study evaluating schools that were part of the Co-nect school reform design and comparison schools. While technology was not the primary focus in this study, findings revealed that 40% of the time that technology was observed in the Co-nect classrooms “meaningful use” of computers was at least occasionally seen. Many of the observed computer activities were lower-level applications (i.e., drill/content/tutorial-type programs). Similarly, in the present study, students were observed using technology for drill-and-practice activities the majority of the time.

Future research must continue to build upon this very limited area of observational research. Currently, much of the research on technology use with early childhood and elementary classrooms is based on self-report, survey and interview data if conducted on a larger scale. Observations have been used in small case studies but need to be implemented in more large-scale studies as well. Additionally, these studies need to specifically focus on early childhood and elementary classrooms because a great deal of the current research focuses on general K-12 environments. Observation instruments need to be able to include specific best practices for using technology with young learners.

Additionally, more systematic observation research needs to occur in natural, authentic settings. Much of the current research involves the evaluation of certain state and federally funded technology initiatives. Therefore, the observations have generally taken place during pre-scheduled technology integration lessons. More research needs to focus on how technology is typically used in the classroom and how it relates to certain instructional practices, student engagement, and even student achievement.

Future observational research should also focus on the use of specific types of technology. Judge and colleagues' (2006) research presented data that suggested that frequent use of reading software had a significant negative correlation with reading achievement. The current study did not focus on specific types of software but students were observed using technology for basic skills the majority of the time. More specifically, Hispanic students were observed using technology for basic skills significantly more than White students. The use of technology and specific software needs further investigation because certain uses of technology might enhance instruction and learning, but there is always the possibility that certain uses will have the opposite effect.

Implications for Practice

This section will discuss implications for practice as related to the findings from the current study. Results from the present study suggest that technology has not been adequately implemented, for the most part, into the observed classrooms. When technology was implemented, teachers were primarily using it to present material and students were using it almost entirely for basic skills activities. Additional research is needed to identify the best ways to teach teachers how to effectively implement technology. In the current study, an observer noted a brief conversation about technology professional development with a second-grade teacher:

> *Teachers have to attend three hours of technology training a year. They are allowed to choose which one they want to go to. [The teacher] attended the SMART Board training because they just recently got one but other options involve things like PowerPoint.*

Hattie (2009) looked across numerous meta-analyses on technology use and found that teachers need, at minimum, 10 hours of professional development training on technology use over a concentrated time period (e.g., a few weeks) to have a substantial effect on classroom technology use.

Professional development for in-service teachers and teacher preparation programs need to integrate technology in order to adequately prepare teachers to use technology in their classrooms (Gimbert & Cristol, 2004). Teachers are more likely to take an active role in the use of technology, if they feel confident with their skills for technology implementation. The need for teachers to play an active role in the formation of an effective technology-enhanced learning environment was a common theme throughout much of the literature on using technology with young children. It is clear that having a certain type of technology equipment (e.g., IWB) does not automatically create student-centered learning environments. Additionally, the presence of technology in the classroom does not prevent the possible barriers (e.g., lack of time and inadequate technology skills) to technology use.

Through further analysis of numerous meta-analyses of technology use in schools, Hattie (2009) presents six areas that help to achieve effective technology use: (a) diversity of teaching strategies; (b) professional development training in the use of technology as a teaching and learning tool; (c) numerous opportunities for learning; (d) the student, not teacher, is in “control” of learning; (e) peer learning is fully utilized; and (f) feedback is fully utilized. In terms of diversity of teaching strategies, Hattie (2009) found that technology was most effective when used as a “supplement” not a “substitute” for teacher instruction. Additionally, technology can provide numerous opportunities for learning. Computer tutorials were shown to have the greatest effect but even basic skills activities, the primary way technology was used by students in the present study, were shown to have a positive effect particularly when they were learner controlled, worked towards a goal, and provided an instant response of "correctness". Finally, Hattie (2009) found peer learning to be the optimal setting for students using technology. In the present study, students were only observed working with peers 2.8% of the time.

Additionally, in the present study, findings revealed that students were found to be on task significantly more frequently when teachers integrated technology to a great extent; however, only 15% of teachers were observed integrating technology to a great extent. Hattie (2009) found that well-managed classrooms where students were on task had a positive effect on student engagement and student learning. Ertmer and Ottenbreit-Leftwich (2010) stated that today in the 21^{st} century, "effective teaching requires effective technology use" (p. 256). They went on to say that teacher change is necessary and after extensively reviewing the literature on technology use and professional development the four suggested variables to accomplish teacher change include: knowledge, self-efficacy, pedagogical beliefs, and subject and school culture.

In terms of knowledge, teachers need to have both knowledge of the technology equipment and knowledge of using that equipment for planning, implementation, and evaluation processes (Ertmer & Ottenbreit-Leftwich, 2010). Additionally, teachers need self-efficacy in using technology for instructional purposes. Teachers primarily gain this confidence by having successful experiences with the implementation of technology. Furthermore, according to Ertmer and Ottenbreit-Leftwich (2010), it is necessary to take into consideration teachers' pedagogical beliefs. The role that pedagogical beliefs plays on technology use in classrooms has been a controversial issue in previous research; however, Ertmer and Ottenbreit-Leftwich (2010) believe that teachers are more likely to use technology in classrooms when they value the role technology has with student learning outcomes. The final variable in terms of accomplishing teacher change with technology integration is the school culture. The school culture is largely determined by the school leadership; therefore, it is important for the school leadership to include technology integration in their characterization of "good" teaching.

Study Limitations

All types of research have limitations to some extent. This section will discuss limitations that are present in observational research as well as limitations that are specific to this study. The first limitation is the obvious, intrusive nature of observational research. When an observer enters a classroom, both students and the teacher are aware that someone is watching and recording their behaviors. This presents a potential threat to validity because the students and teacher might alter their behaviors when an observer is present. Observers make every effort to be as unobtrusive as possible, but the issue still exists.

Another study limitation is the limited amount of time that each classroom was observed, and the fact that each classroom was only observed once. As a result, it is not possible to make comparisons over time or to know if what were observed that day is typical classroom technology use. Therefore, it is necessary to observe a large enough number of classrooms in order to achieve reliable and valid measures of instruction and in this case technology use (Waxman et al., 2004).

Additionally, Waxman and colleagues (2004) pointed out that critics of systematic observational research have concerns about why certain items are selected for observation and others are not. This leads to another potential limitation which is that observers are limited, for the most part, to recording only those variables that are present on the observation instrument. In the present study, observers were encouraged to record field notes in order to provide further explanation for certain classroom occurrences. The field notes, however, were used to provide examples but not included in the data analysis.

Conclusion

The purpose of this study was to systematically observe pre-kindergarten to fifth-grade classrooms to examine the use of technology with teachers, students, and the overall classroom in an authentic classroom setting. Overall, the results of the present study suggest that technology has not been adequately implemented into the observed classes. Technology was available but was not used to a great extent. When technology was implemented, teachers were primarily observed using it to present material and students were observed using it almost exclusively for basic skills activities.

As previously stated, this low-level of technology integration occurred in elementary schools of a high performing school district which had a technology plan in place, a low student to computer ratio, and 100% of the classrooms had Internet access.

It was even noted that the series of technology plans in the district had been so "successful" that the district became a leader in technology among public school districts in the state of Texas.

The previous statement is somewhat concerning considering that only 15% of teachers were observed integrating technology to a great extent. However, students in these classrooms were observed on task more frequently than students in classrooms where technology was observed less or not at all. On the other hand, students were observed off task significantly more in classrooms where either no technology integration was observed or where it was only observed a moderate amount. These findings support and build upon previous observational studies. There is still a need, however, for strong, empirical research to be conducted to further examine the use of technology in elementary classrooms.

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APPENDIX A

Note: Only those items used for analysis in the current study are included in this instrument.

Teacher Roles and Technology Use Observation Schedule

School ____________________ Teacher ____________________ Teacher Sex _______ Grade Level _______

# of students in class_____ Observer__________ Date________ Time Began________ Time Ended________ Content Area ______________

(30 second time intervals)	1	2	3	4	5	6	7	8	9	10	Total
SETTING (check one)											
1. Whole class											
2. Small group (more than 2 student)											
3. Dyads (2 students)											
4. Individual											
5. Traveling											
INSTRUCTIONAL ORIENTATION (check one)											
1. Direct instruction (e.g., lecture)											
2. Seatwork (e.g., worksheets, textbooks)											
3. Learner-centered (e.g., cooperative learning, project-based, inquiry)											
PURPOSE OF INTERACTION (check all that are observed)											
1. Focus on content (e.g., subject area content)											
2. Focus on process											
3. Focus on product (e.g., outcome)											
4. Connect content to other disciplines											
5. Connect content to global communities											
6. Present multiple perspectives on topic											
7. Redirect student thinking											
8. Show interest in student work											
9. Show personal regard for student											
10. Encourage students to help each other											
11. Encourage students to succeed											
12. Encourage students to question											
13. Encourage extended student responses											
14. Encourage student self-management											
15. Praise student behavior											
16. Praise student performance											
17. Correct student behavior											
18. Correct student performance											
19. Assessment											
INSTRUCTIONAL PRACTICES (check all that are observed)											
1. Uses technology to present material											
2. Assists students with technology											
3. Uses technology as a communication tool											
4. Uses technology to create											
5. Uses technology to access the Internet											

APPENDIX B

Note: Only those items used for analysis in the current study are included in this instrument.

Student Behavior and Technology Use Observation Schedule

School ________________ Teacher _______________ Grade Level_________ Student Sex ______ Student Ethnicity___________

Observer__________________ Date _________ Time Began__________ Time Ended__________ Content Area __________

(30 second time intervals)	1	2	3	4	5	6	7	8	9	10	Total
SETTING (check one)											
1. Whole class											
2. Small group (more than 2 students)											
3. Dyad (2 students)											
4. Individual											
MANNER (check one)											
1. On-task											
2. Off-task											
ACTIVITY TYPES (check all that are observed)											
1. Written assignment											
2. Assessment											
3. Discussing											
4. Reading											
5. Tutoring											
6. Working kinesthetically											
7. Answering teacher-posed questions											
8. Answering peer-posed questions											
9. Questioning											
10. Presenting											
11. Learning/activity centers											
12. Constructive play (blocks, Legos)											
13. Dramatic play (inventive, symbolic)											
14. Games/rule-based play (e.g., board games, puzzles, child-created)											
15. Free exploration/inquiry											
16. Using concrete learning materials that closely relate to daily life experiences											
17. Listening/watching											
18. Distracted											
19. Acting-out (behavior)											
20. No activity/transition											
TECHNOLOGY (check all that are observed)											
1. MP3 player/iPod											
2. Tape player/radio											
3. Interactive whiteboard/SMART Board											
4. Flip camera/video camera											
5. Digital camera											
6. DVDs/CDs & headphones											
7. Skype/video communication											
8. Laptop computer											
9. Desktop computer											
10. Television											
11. Document reader											
12. Overhead projector (traditional)											
13. Handheld game/device											
14. Student timers											
EDUCATIONAL USE OF TECHNOLOGY (check one)											
1. Basic skills/drill/practice											
2. Problem solving (e.g., SimCity, Yukon Trail, Carmen Sandiego)											
3. Creativity (e.g., Sketchpad, KidPix)											
4. Individualized/Tracked (e.g. Accelerated Reader)											
5. Word Processing											

APPENDIX C

Note: Only those items used for analysis in the current study are included in this instrument.

Overall Classroom and Technology Observation Measure

School ____________________ Teacher ____________________ Grade Level__________

Observer______________ Date______________ Time Began___________ Time Ended__________ Content Area_________________

At the end of the complete classroom observation, indicate (i.e., check) to what extent each of the following activities was used or demonstrated during the observation period.

Rating Scale:

1	2	3
Not observed at all	Some extent (once or twice)	Great extent (3 or more times)

		1	2	3
INSTRUCTION				
1. Teacher integrated technology into lesson				
STUDENT				
1. Students used technology to enhance problem solving/creativity				
2. Students used technology to learn basic skills (e.g., tutorials, drill & practice)				
3. Students used technology to access the Internet				
CLASSROOM ARRANGEMENT/ENVIRONMENT				
1. Technology was accessible for student use				
TECHNOLOGY	**#**			
1. MP3 player/iPod				
2. Tape player/radio				
3. Interactive whiteboard/SMART Board				
4. Flip camera/video camera				
5. Digital camera				
6. DVDs/CDs & headphones				
7. Skype/video communication				
8. Laptop computer				
9. Desktop computer				
10. Television				
11. Document reader				
12. Overhead projector (traditional)				
13. Handheld game/device				
14. Student timers				

**** Please write field notes on back of page ****

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