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Teacher Education and Technology Integration: How Do Preservice Teachers Perceive Their Readiness to Infuse Technology into the Learning Environment?

Anne Koch

TEACHER EDUCATION AND TECHNOLOGY INTEGRATION: HOW DO PRESERVICE TEACHERS PERCEIVE THEIR READINESS TO INFUSE TECHNOLOGY IN THE LEARNING ENVIRONMENT?

A Dissertation

Submitted to the School of Education

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In partial fulfillment of the requirements for

the degree of Doctor of Education

By

Anne S. Koch

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Presented by:

Anne S. Koch

Bachelor of Arts in Home Economics, Mercyhurst College, 1977
Master of Education, Slippery Rock University, 1998

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Approved by:

____, Chair
Misook Heo, Ph.D.
Assistant Professor, Duquesne University

____, Member
Joseph C. Kush, Ph.D.
Associate Professor, Duquesne University

____, Member
Derek Whordley, Ph.D.
Professor, Duquesne University

ABSTRACT

TEACHER EDUCATION AND TECHNOLOGY INTEGRATION: HOW DO PRESERVICE TEACHERS PERCEIVE THEIR READINESS TO INFUSE TECHNOLOGY INTO THE LEARNING ENVIRONMENT?

By

Anne S. Koch

December 2009

Dissertation supervised by Dr. Misook Heo

In the past twenty years, substantial investments have been made in educational technology at the K-12 level. While increased integration of technology in K-12 teaching is more likely to occur when prospective teachers are exposed to a variety of computer uses in the majority of their undergraduate courses prior to their teaching in schools, due to the limited exposure in the use of technology by university teachers as well as the fast paced changes, preservice teachers often are not prepared for integrating and using technology in the classroom. The purpose of this study was to evaluate the perceptions of preservice students in their ability to integrate technology into a learning environment based on university coursework and field experience. Preservice teachers, within an NCATE accredited teacher education program, were surveyed using the 2008 ISTE/NETS*T standards as a framework.

Results of the data analysis, across the four academic years based on curriculum, modeling of university professors, and integration of technology within the methods coursework of the Leading Teacher Program, suggested that there was no significant difference among grade levels in their perceived ability to integrate technology. Results of the data analysis of seniors revealed multiple areas of significant differences before and after their field experience: ability to use online content response journals, integrating technology into a learning environment, and total score of the survey. Additional data analysis also revealed that the perceptions of Early Childhood students' ability to integrate technology into a learning environment was significantly lower than that of Elementary and Secondary students within the same program. In addition, students who had well integrated modeling of technology in high school, revealed significantly higher perceptions of their ability to integrate technology into the learning environment.

The conclusions drawn from the results of this study provide an insight into technology savvy characteristics of preservice teachers within a teacher education program, which has technology as one of its core themes; technology modeling and program design within a teacher education program can have an impact on preservice teachers to have stronger perceptions about their ability to integrate technology.

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"With Him all things are possible."

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CHAPTER I

INTRODUCTION

The role of technology in K-12 classrooms has rapidly increased during the last decade. Since the early 1990's, the number of K-12 students with access to computers with an Internet connection mirrored society; as computer access and other technologies have become more commonplace in American households, the children in these households have demonstrated similar advances in educational achievement. This technological growth has allowed K-12 students to become increasingly engaged within our swiftly expanding and complex world. To prepare preservice teachers for this change, it is important for teacher training programs to better integrate technology in their curricula. Through this integration of technology, schools of education will enhance the skills necessary for future teachers, so that student learners in a K-12 classroom can receive appropriate instruction (Jonassen, 2003). Students within teacher preparation programs will then be assured of learning additional strategies needed to reach all learners. Unfortunately, teachers' abilities to use technology have not kept pace with the improvements in technologies available in K-12 classrooms (Sandholtz, 2001; West & Graham, 2007). In fact, more than two-thirds of students leaving preservice programs responded they are not prepared to use technology in classrooms (Francis-Pelton, Farragher, & Riecken, 2000)

Improving student learning and teacher qualifications are major national goals. The improvement of technology integration in K-12 instruction has become a "national imperative" in the United States (Brown & Warschauer, 2006). Unfortunately, current professional development involving technology is inadequate to address the needs of 21st

century teachers (Ansell & Park, 2003; Lawless & Pellegrino, 2007). Even within university settings where technology is abounds, many university professors still prefer antiquated means of developing lessons and use their computers as typewriters of the past (Cuban, 2001; Fabry & Higgs, 1997; West & Graham, 2007).

The successful integration of technology within the K-12 classroom will require two components. First, professional development, provided to teachers already within K-12 settings, needs to be increased. Teachers who effectively use technology in K-12 learning environments have been shown to have greater access to district staff development activities than did other computer users (Becker, 2000). Second, teacher preparation programs need to simultaneously expand the use of technology within their curricula to better prepare teachers of the future. Further, technology use within these teacher preparation programs needs to be supported by a faculty training program specifically designed to meet the developmental needs of faculty in various stages of technology knowledge (Sandholtz, Ringstaff, & Dwyer, 1997).

Problem Statement

Within the last decade, approximately 2.2 million teachers entered the teaching profession (Riley, 1998). Due to the limited exposure in the use of technology by university teachers as well as the fast paced changes, however, university teacher knowledge and preparation with technology continues to be reported as an obstacle in teachers integrating and using technology in the classroom (Ansell & Park, 2003; Lawless & Pelligrino, 2007; Smith & Robinson, 2003). Preservice preparation is an integral part of infusing technology into K-12 education. Since the primary goals of teacher preparation include increasing the comfort of preservice teachers with pedagogical resources, such as technology, instruction in technology is particularly important and needs to be included in higher education. Increased integration of technology in K-12 teaching is more likely to occur when prospective teachers are exposed to a variety of computer uses in the majority of their undergraduate courses (Wheatley, 2003). The introduction of technology into preservice teachers' learning, needs to include the infusion of technology into their academic coursework (Dexter, Doering, & Riedel, 2006).

Prior to leaving higher education, preservice teachers need to understand the uses and diverse benefits of using technology in a classroom environment (Bryant, Erin, Lock, Allen, & Resta, 1998; Dexter et al., 2006, Glazer, 2004; McCoy, 1999; Ropp, 1999). Two examples of how integration could occur include modeling of technology throughout the teacher education programs, specifically methods courses and field experience (Bullock, 2004; Hunt, 1997; International Society for Teacher Education, 1999; National Council for Accreditation of Teacher Education, 1997) and instruction in technology skills and the application in the classroom environment (Bullock, 2004; Northrup & Little, 1996; Smaldino & Muffoletto, 1997). Modeling and observation are key teaching tools for students. Within the preparation of preservice teachers, it is important to have university faculty model the teaching with technology so that prior to their student teaching experience, preservice teachers learn to integrate technology into their teaching (Dexter et al., 2006). This modeling has been shown to be especially important within methods courses (Adamy & Boulmetis, 2006). Especially when considering constructivist pedagogy, classroom practices that emphasize developing students' cognitive skills, the utilization of technology becomes invaluable (Becker, 2000). Unfortunately, teacher preparation programs have not adequately provided preservice teachers with these models (Banister & Vannatta, 2006; Brown, 2006; Brown, 2003; Smerden et al., 2000).

To date, most of the research that examined the integration of technology across teacher education programs has focused on individual components of the curriculum (Banister & Vannatta, 2006; Strudler & Wetzel, 1999). Specifically, technology integration research has looked primarily at preservice teacher satisfaction with individual courses or their evaluation of technology labs and facilities on campus.

Relatedly, teacher education programs have failed to focus on the systematic, sustainable integration of technology across teacher education programs (Brown & Warschauer, 2006; Strudler & Wetzel, 1999). It is important that higher educations become more adequately informed about the needs of the preservice teachers across all aspects of its curriculum when examining their use of technology within their programs (Brown & Warschauer, 2006). This is especially important during the student teaching and internship because these will provide preservice teachers with the first real life experiences that combine the knowledge of new technologies with the curriculum (Kulik, 2003; Smith & Robinson, 2003).

Purpose

The purpose of this study is to evaluate the perceptions of students on their ability to integrate technology into a learning environment based on the university coursework and field experience. The International Society for Technology in Education (ISTE) National Educational Technology Standards for Teachers (NETS*T) will be utilized as a framework to evaluate a teacher training program that is housed within a National Council for Accreditation of Teacher Education (NCATE) accredited institution. The governments of both federal and state systems have spent substantial amounts of money on school districts' technological advancements as the need arises for more technological literacy. It will be ascertained how well the technology needs of preservice teachers are being met in order to secure the necessary 21st century skills for the K-12 students of tomorrow.

NETS*T Performance Indicators for Teachers

The National Council for Accreditation of Teacher Education (NCATE) was created in 1954, as an independent organization representing the teaching profession, with the goal of accrediting universities that incorporated strategies such as this in a systematic and comprehensive manner. Subsequently, in 2000, ISTE published the NETS*T Performance Indicators for Teachers. These are guidelines that compliment the NCATE standards and the ISTE guidelines, while specifically addressing the preservice teacher, in a higher education program, with performance objectives that should be met for a 21st Century teacher.

Within the newly revised 2008 ISTE NETS*T Performance Indicators for Teachers, a framework has been provided for preservice education. These updated indicators focus on the implementation of technology in teaching, which are used by universities, state departments of education, and school districts across the nation (International Society for Teacher Education, 2008). Emphasis is given to the following five standards:

I. Facilitate and Inspire Student Learning and Creativity

II. Design and Develop Digital-Age Learning Experiences and Assessments

III. Model Digital-Age Work and Learning

IV. Promote and Model Digital Citizenship and Responsibility

V. Engage in Professional Growth and Leadership

As the trend towards globalization continues, it is important to align teacher education and technology integration with the NCATE/ISTE/NETS*T education standards to meet the demands of the 21st Century.

Research Questions

To accomplish the research goals within this study, the following research questions will be answered:

Research Question 1: Are there differences in perceptions regarding competencies in technology integration among preservice teachers of different academic years, measured by the ISTE/NETS*T Standards?

Research Question 2: Are there differences in preservice teachers' perceptions regarding competencies in technology integration towards the end of the student teaching experience?

Significance of Study

The overall benefit of this research will be to the university itself, as it will compare similar universities' technology integration programs through the framework found in the 2008 ISTE/NETS*T standards. Other teacher training programs will benefit the information about the degree of technology integration experience that preservice teachers will need to receive in order to become well prepared in the use of 21st century tools in the classroom.

Definition of Terms

Content Knowledge: A framework for teacher knowledge within a subject area (Koehler, M., & Mishra, P., 2008).

Constructivist Perspective: An "approach to cognitive development in which children discover virtually all knowledge about the world through their own activity. It is consistent with Piaget's cognitive developmental theory and Vygotsky's sociocultural theory" (Berk, 2000, p. 645)

Cooperating Teacher: In this study, an instructional leader within a school setting who oversees the student teaching experience of a teacher candidate.

Differentiated Instruction: A framework for teaching that offers multiple approaches to meeting individual learners' needs (Smith & Throne, 2007)

Digital Native: Student who represents one of the first generations to grow up with full access to technology (Prensky, 2001).

Digital Immigrant: One who has learned or adapted to the continuous use of technology in the world (Prensky, 2001).

Digital Literacy: Ability of one to adapt and use technology in education (Basham, J., Palla, A., & Pianfetti, E., 2005).

Highly Qualified Teacher: One who possesses full state certification, designed to have a positive impact on students (NCLB Act, 2002).

Learning Environment: Interactive participation, exploration, collaboration, authentic and multi-disciplinary tasks, assessment and teaching are all relative, to an instructional setting (Means, 1994).

1:1 (one to one) Refers to one computing device allocated to one person (van ‘t Hooft & Swan, 2007)

Pedagogy: Pedagogy is derived from a Greek word, paidagogos, meaning teacher of children and refers to an action that allows, or causes the learner to acquire new knowledge (Echard, 2007).

Preservice Teacher/Teacher Candidate: In this study it is an undergraduate student within an NCATE School of Education, preparing to become a teacher in a public or private K-12 setting.

Specialized Professional Association (SPA): A content specific area of NCATE, which accredits individual content areas of education. (National Council for Accreditation of Teacher Education, 2008)

Standards: Written expectations for meeting a specified level of performance (Echard, 2007).

Student Teaching: Preservice clinical practice for preservice teachers (National Council for Accreditation of Teacher Education, 2008).

Teacher Candidate/Preservice Teacher: In this study a student within an NCATE School of Education, preparing to become a teacher in a public or private K-12 setting.

Technological Literacy: In this study one who is able to understand and perform the instructional skills necessary for a K-12 classroom.

Ubiquitous Technology: Technology which has become so embedded in the environment that it disappears and supports the learning process instead of acting as a distraction from the actual endeavor (Weiser, 1991). Technology which has become human centered, less intrusive and always available rather than the focus of learning (Abowd & Mynatt, 2000; Norris & Soloway, 2004; Roschele & Pea, 2002; Roush, 2005).

Limitations

There are a few factors that might have affected the study but were not under the control of the researcher. The limitations are as follows.

First, the study will be conducted in a teacher education program that is NCATE accredited. It is thus possible that the preservice teachers of this program might have been exposed to the ISTE/NETS*T guidelines for their technology framework during their coursework.

Second, this study asks for student perceptions, not observable behaviors or artifacts. Actual life experiences during the program of study and field experience such as university matters and field placement might have influenced student perceptions.

Third, the survey is designed on the premise that the preservice teachers will answer truthfully about their perceptions. Although the surveys were designed to elicit truthful answers to questions, there is no guarantee that the answers given will be honest. Preservice teachers taking part in the survey may not take the survey seriously and not put much thought into the questions in order to give a truthful response to the questions being asked.

Delimitations

Due to the time constraints and limited resources, this research is delimited in several ways. First, the study will be conducted at a moderate-sized private university from Western Pennsylvania, where its students are from predominantly middle to upper class Caucasian families. The reader is cautioned regarding the generalizability of the results to populations that differ from this one.

Second, this research study is using only one set of standards, NCATE/ISTE/NETS*T, as the basis of reflection. Other standards, however, are available as guidelines and some are mentioned in Chapter II.

CHAPTER II

LITERATURE REVIEW

Education in 21st Century

Twenty-first Century Skills

The Partnership for 21st Century Skills, a leading advocacy organization for the transformation of education into the 21st century, has identified outcomes within a set framework for students to master in 21st century education. To actively engage in a digital economy, students will need to secure digital age proficiencies through the acquisition of 21st Century Skills (Partnership for 21st Century Skills, 2004). A framework for 21st Century education was developed by the Partnership for 21st Century Skills, to show the outcomes or skills needed for students to ensure they leave education as effective citizens, workers and leaders. Within this Framework for Learning in the 21st Century, the Partnership for 21st Century Skills (2004) has developed six key areas of learning that were emphasized as being 21st Century Skills. In order to succeed in work and life students should master:

- Core Subjects – Students will need to master core subjects in order to succeed in life. These core subjects are defined by The No Child Left Behind Act of 2001, as English, reading or language arts; mathematics; science; foreign languages; civics; government; economics; arts; history; and geography.
- 21st Century Content – For the success in communities and the workplace, content areas to be emphasized are global awareness; financial, economic, business and entrepreneurial literacy; civic literacy; health and wellness awareness.

- Learning and Thinking Skills – Students must know and understand how to keep learning and make effective choices throughout their lives with what they have learned. Critical thinking and problem solving skills, communication skills, creativity and innovation skills, along with collaboration skills, information and media literacy, and contextual learning skills are integral parts of the 21st century education.
- ICT Literacy - Information and communications technology literacy is the ability to use technology to develop content knowledge and skills through teaching and learning. ICT Literacy will include the use of technology to research, organize and communicate information; application of ethical issues surrounding the use of technology; digital technology use to access, integrate, and create information in a digital economy.
- Life Skills – Life skills include leadership, ethics, accountability, adaptability, personal productivity, personal responsibility, people skills, self direction and social responsibility. It is critical to incorporate these skills continuously into the pedagogy of teaching.
- 21st Century Assessments – A balance of assessments should be used, both standardized and teacher implemented, to offer students a powerful approach to master content and skills necessary for success. Assessment of 21st Century skills will need to include technology enhanced formative and summative assessments, in addition to a balanced portfolio reflecting student competency of 21st century skills.

The International Society for Technology in Education (ISTE) along with the State Educational Technology Directors Association (SETDA) mirror the Partnership for 21st Century Skills' beliefs in developing a student's 21st century skills. The three groups, ISTE, SETDA and Partnership for 21st Century Skills, represent leading U.S. companies, six leadership states, educational technology directors in all fifty states, 85, 000 technology professionals and 3.2 million educators throughout the United States, support the idea of 21st century skills (SETDA, ISTE, & Partnership for 21st Century Skills, 2007). These 21st Century Skills are taught using a comprehensive technology theme approach (SETDA, ISTE, & Partnership for 21st Century Skills, 2007). Although knowledge of core content is necessary, it is no longer sufficient for success (SETDA, ISTE, & Partnership for 21st Century Skills, 2007). Students need the 21st century skills of creativity and innovation, problem solving and critical thinking, communication and collaboration, digital media use and acquisition of information, in order to meet the growing needs of our 21st century workforce (National Alliance of Business, 2000; SETDA, ISTE, & Partnership for 21st Century Skills, 2007).

Twenty-first Century Workforce

> The current and future health of America's 21st Century Economy depends directly on how broadly and deeply Americans reach a new level of literacy – '21st Century Literacy'-that includes strong academic skills, thinking, reasoning, teamwork skills, and proficiency in using technology. (National Alliance of Business, 2000, p. 1).

There is a sense of urgency in the United States to improve the quality of K-16 education. With the passing of one of the largest pieces of educational legislation in history, No

Child Left Behind (NCLB), educational systems began working on closing the achievement gap and equipping students with needed 21st century knowledge and skills (Apte, Karmarkar & Nath, 2008; Ladson-Billings, 2006; Partnership for 21st Century Skills, 2009).

Our society has gone through many changes in economic transitions as a country. The economic and labor transitions are based on the type of workers that are found most commonly among the population. During the Agricultural Age, the common working person was some sort of farmer. According to the French economist, Jean Fourastie (1974), an economy consists of a "Primary sector" of commodity production, which would include farming, livestock breeding and mineral resources. Following this age would be the "Secondary sector" of manufacturing and industrialization. This Industrial Age in Western Europe and North America was the first transformation of an agrarian society to an industrial society in the world. In 1967 the production of material goods and delivery of material services accounted for nearly 54% of the United States' economic output (Apte et al., 2008; Karmarkar & Apte, 2007). This would mean the primary labor worker would be the factory worker. A "Tertiary sector" of service industries would soon follow after an Industrial Age. In 1997 the production of information products, such as computers, books, televisions and software, and the provision of information services, such as telecommunications, financial and broadcast services and education, accounted for 63% of the U.S. economic output (Apte et al., 2008; Karmarkar & Apte, 2007). This would be the evolution of the knowledge worker. Our educational system has kept up with the changes of the past, however we must question whether our educational system is poised to go into the 21st Century for the fourth sector, identified as the Conceptual

Age (Pink ,2005). This age requires the economics of strong left brain skills (reading, writing, math and science/content area subject matter) as well as right brain skills (aesthetics, critical thinking, creativity, value and play).

Policy makers and educators are suggesting that the transformation of an outdated educational system is imperative in order to meet the needs of a global society and our 21st century students (Partnership for 21st Century Skills, 2004). Today's learner has changed dramatically from decades ago in their approaches to learning, and teachers need to act as facilitators in a classroom where students take an active part in the process of creating or constructing their own knowledge (Larochelle, Bednarz, & Garrison, 1998). The children of today are becoming very comfortable using the various forms of technology that surround them on a daily basis. With this transformation in our educational system, we need to meet the demands of the 21st century learner. This transition begins with acknowledging the ability students to learn in different ways than those of previous generations. Every child in America needs 21st century knowledge and skills to succeed as effective citizens, workers and leaders in the 21st century (Partnership for 21st Century Skills, 2004). There is, however, a large gap between the knowledge and skills most students learn in school and the knowledge and skills they need in the typical 21st century communities and workplaces (Partnership for 21st Century Skills, 2004).

The wave of change in student learning and professional educators is reflective of the global economics shift. With this global economic environment, education plays a crucial role in stimulating economic growth for a region, state, or nation (Stevens & Weale, 2003). This success is based upon the skills and knowledge of its general workforce and its capacity to innovate new markets (Spires, Lee, Turner, & Johnson, 2008).

Partnership for 21^{st} Century Skills brings together business and education. Business leaders have viewed and kept pace with the changing world, however, the educational system has not kept up with what is needed to produce students who can actively engage in the 21^{st} Century as part of a skilled workforce (Partnership for 21^{st} Century Skills, 2004). In order to achieve success, students need to master traditional content subjects such as mathematics and science, while also gaining 21^{st} Century skills, such as critical thinking, innovation, creativity and communication skills (Gaston, 2009; Partnership for 21^{st} Century Skills, 2004).

In one research study on the perceptions of middle school students on school, technologies, and academic engagement found students wanting the schools to become more like the world they live in through technology (Spires et al., 2008). Along with this desire of students for educational change came the apparent need for business to reap the best from the education system. Collaborative partnerships among business and education have begun to help implement the development of 21^{st} Century Skills for the workforce of tomorrow. Business has become involved in education due to the effect of student achievement on the competitive nature of the 21^{st} century workforce. Business is aware that by the year 2010, over ten million jobs could be left unfilled because the available workforce will lack the skills to fill the positions (Business Civic Leadership Center, 2006). Intel Innovation in Education (Business Civic Leadership Center, 2006) is an example of how business combined with education to support the effective use of technology in the areas of science, mathematics and engineering. IBM (Business Civic

Leadership Center, 2006) launched a teacher education initiative due to the shortage of experienced math and science teachers. This business community partnered with teacher preparation programs to provide second career individuals with knowledge and skills to teach what the 21st Century Workforce needs in the areas of math and science. Oracle Corporation (Business Civic Leadership Center, 2006) used technology to promote learning in the high school business program classroom. The Oracle Academy enabled students, ages 16-19 to learn about database and programming from trained teachers. This provided the students with an enrichment experience and a solid foundation for entering college. It also benefited the teachers involved with professional development.

In addition to businesses taking the lead on initiating changes in education, 13 states (e.g., Arizona, Illinois, Iowa, Kansas, Louisiana, Maine, Massachusetts, Nevada, New Jersey, North Carolina, South Dakota, Wisconsin and West Virginia) have chosen to initiate the Partnership for 21st Century Skills and Technology at the state level rather than the district level. North Carolina has launched its first initiative to address technology in a systematic, defined timeline. Along with rigorous core subjects in content area, students will learn the skills of the 21st century that students need to become effective workers and leaders. Maine, Texas and Michigan have also launched separate initiatives to support the education for the 21st Century workforce.

The State Educational Technology Directors Association (SETDA), the International Society for Technology in Education (ISTE), and the Partnership for 21st Century Skills have come together to represent businesses, organizations, states, 85,000 technology professionals and 3.2 million educators in changing the nations' schools. No economic labor force can remain competitive without making use of technology with 21st century skills in mind. Unfortunately, in the United States, education is the least technology oriented enterprise in its ranking of technology use among 55 U.S. industry sectors (SETDA, ISTE, & Partnership for 21st Century Skills, 2007).

Technology in Education

The rapid expansion of technology has provided students with the opportunity to obtain information at any time and in any place. The way computers and future technologies will be used in people's lives depends on the trends of technology, people's needs and changes in their living and activities (Weiser, 1999). Changes in technology over the past decade came about due to these needs within our culture. The investments in these needs caused changes in technology that enabled changes in lifestyle (Weiser, 1999). These changes or trends with the societal use of technology are currently reflected in the students' learning needs within our academic system. Thus, in a cyclical sense, technological trends have allowed students to inherently use digital tools within the academic setting, and they became increasingly engaged in a rapidly expanding and complex world through technology.

Often termed Digital Natives (Prensky, 2005/2006), today's students appear to be readily adept at incorporating technologies into their approaches to learning. The manner which students have used technologies for interacting with information and communicating strongly suggests that students have been creating their own understanding and knowledge in new ways (Lin, 2007; Spires et al., 2008; van 't Hooft, Swan, Lin, & Cook, 2007). For example, 87% of children between the ages of 12 and 17 currently use the Internet on a regular basis (Hitlin & Rainie, 2005; The Children's Partnership, 2005). Similarly, over two-thirds of students these ages used the Internet at school, a 45% increase over data collected in 2001. Internet access is available in 94% of the classrooms in the United States (Wells, Lewis & Green 2006). Additionally, approximately 90% of U. S. teenagers believed that using technology helps them to do better in school (Hitlin & Rainie, 2005). An almost identical percentage of parents of these teens also agreed with this belief (Hitlin & Rainie, 2005). Hitlin and Rainie's report provided evidence of conceptual acceptance of the idea that technology can have a positive impact on student learning if well designed and well integrated (Hitlin & Rainie, 2005; Lazarus, Lipper & Wainer, 2005; Wenglinsky, 2006).

Digital technology is so prevalent in our society that we often forget that it even exists. It has taken an invisible focus in our lives but is nonetheless a very apparent and necessary part of society. Current trends in education imply that effective learning environments are places where an array of different technology devices, software and services are available for students to learn (van 't Hooft et al., 2007). Seemingly, when students and teachers have instant access to a variety of technology, learning can be increased.

A concept introduced by Weiser (1991) prior to the introduction of the world wide-web, ubiquitous computing, referred to technologies becoming part of everyday life yet having the eventual tendency to disappear. Although ubiquitous computing is not a reality in schools yet, as most classrooms are not fundamentally different from classrooms of 50 years ago (Papert, 1993), we have begun to move forward in our approaches to the use of technology in an educational learning environment (Becker, 2001; Cuban, 2001). In these changed learning environments, changes in teaching have also begun. Teachers became more student-centered (Apple Computer, Inc., 1995; Fung, Hennessy, & O'Shea, 1998: Honey & Henriquez, 2000; Norris & Soloway, 2004; Ricci, 1999; Swan et al., 2006), more constructivist (Rockman, 2003; Swan et al., 2006) and more flexible (van 't Hooft, Dias, & Swan, 2004; Zucker & McGhee, 2005).

Teachers in the classrooms are at the beginning a stage of using technology to adapt to how students are educated and what content is taught. Students are able to learn at their own pace with their individualized predominant learning style (Benjamin, 2005; Kara-Soteriou, 2009; Tomlinson, 2001). Technology has started to make a differentiated approach to learning possible. Differentiated Instruction is based on the premise that instruction should be adapted to each individual's learning style, interests and ability levels (Benjamin, 2005; Tomlinson, 2001;Tomlinson & Allen, 2000). Because students have varying abilities and learn in different ways, they need a variety of different digital tools to explore, create and communicate knowledge (Apple Computer, Inc., 1995; Bartels & Bartels, 2002; Danesh, Inkpen, Lau, Shu, & Booth, 2001; Hill, Reeves, Grant, Wang, & Han, 2002; Honey & Henriquez, 2000; Roschelle, Penuel, & Abrahamson, 2004). Technology has improved student motivation and renders: a) privacy to support the self esteem of those working below the level of the rest of the class, b) collaboration and communication skills, which are necessary in forming and maintaining learning communities, c) organization, a structured approach for both teachers and students to implement various activities during whole class instruction, d) learning styles and sensory learning; technology encourages visual, auditory, and social learning, and therefore encourages students of different abilities and interests to participate in the learning process, e) choices; internet and software address a wide range of skills and interests to show students success, f) authentic learning; technology addresses an important aspect of differentiated instruction with global problem solving skills (Kara-Soteriou, 2009). Technology has met the needs of 21st century classroom students whose learning style causes a need to be challenged, and has created a successful adaptation in curriculum to maximize learning for others (Benjamin, 2005).

Positive Effects of Technology in Education

Classroom teachers and educational administrators have encouraged technology use in K-12 classrooms for reasons including the belief that technology: a) makes schools more productive and efficient (Zucker & McGhee, 2005), b) creates active, real-life learning experiences for students (Kara-Soteriou, 2009), c) prepares students to work in a technology-rich environment (Apple Classroom of Tomorrow-Today, 2006; Bryant et al., 1998; Zucker & McGhee, 2005). These teacher and administrator views have paralleled increased financial commitments within school budgets for improved technologies. For example, there had been one computer for every 125 students in U.S. schools in 1981, but this ratio increased to one computer for every 18 students by 2000; the ratio was one computer for every five students by 2001 (Cuban, 2001); and by 2005 it was one for every 3.8 students (Wells et al., 2006). Since that time, the number of K-12 students with access to Internet available or equipped computers mirrored society. As computer access and other technologies have become more commonplace in American households, the children in these households have demonstrated similar advances in educational achievement.

The inclusion of technology in educational settings is beginning to show positive impacts on learning within our K-12 schools. With computer-based instruction and the use of specific software, students had a tendency to learn more in less time (Kulik, 1994) and have shown more positive attitudes when classes use computer-based instruction (International Society for Technology in Education, 2006). The latter was found to be especially true within the area of special education where subjects showed a percentile gain of 22% over the control group, when computers were used in the classroom (Kulik, 1994). In other studies,K-12 students in a technology rich environment showed achievement throughout all subject areas as well (International Society for Technology in Education, 2006; Sivin-Kachala, 1998). Research continued to find that ubiquitous technology “levels the playing field” for special needs and lower ability students (Hill et al., 2002; Honey & Henriques, 2000; Stevenson, 1998; Swan, van ‘t Hooft, Kratcoski, & Unger, 2005).

Other researchers (International Society for Technology in Education, 2006; Wenglinsky, 1998) revealed that the uses of computers for Computer Aided Instruction (CAI) helped students perform at a higher achievement level than those not receiving CAI. Students also learned 30% faster using CAI than in a traditional learning environment (International Society for Technology in Education, 2006; Wenglinsky, 1998).

Students’ attitudes and self-concept also improved, along with their achievement, for both regular and special needs students in a PreK-16 environment. Among students involved in ubiquitous technology initiatives or immersed in environments where technology is a natural part of learning, improved motivation was witnessed (Apple Computer, Inc., 1995; Ricci, 1999; Russell, Bebell, & . Higgins, 2004; Swan, van ‘t Hooft, et al., 2005; Swan, Cook, et al., 2006; Vahey & Crawford, 2002; Zucker & McGhee, 2005). Students have also become better organized (Ricci, 1999; Zucker &

McGhee, 2005) and more independent learners (Apple Computer, Inc., 1995; Zucker & McGhee, 2005).

Neutral or Negative Effects of Technology in Education

Although there are much evidence and research that show how technology is positively impacting our educational system, its neutral or negative aspects have also been documented. Technology has become a large part of our lives and until the mid 1980's the theory underlying educational technology was not widely debated. Most research in this area was based on cognitive-behavioral principles of learning that utilized a research methodology where technology-based methods of instruction were compared with non-technology-based methods to determine which one was better for learning and instruction (Roblyer & Knezek, 2003). However, beginning in the mid-80s, a shift began to occur in both theoretical orientations and research methodologies. By the mid 1990s, Internet access started to become widely available for educational purposes (Kozma, 1994).

The theoretical challenge came from educational psychologists who support a constructivist view of learning. Based on the works of Piaget and Vygotsky, constructivist learning is based on the belief that students "construct" their own learning rather than "memorize" information from a teacher. One of the earliest theorists to adopt this view was Papert (1980) whose writing influenced the Cognition and Technology Group at Vanderbilt (1991, 1993). The Cognition and Technology Group at Vanderbilt wrote about the importance of "cognitive scaffolding" and "situated cognition and cognitive apprenticeships" by Brown, Collins and Duguid (1989). Collectively, these theorists refocused instructional technology perspectives away from the impact of the technology being used to the impact of "anchored instruction" which technology could support (Roblyer & Knezek, 2003). These views relate to Kozma's view (1994) that technology use is most effective when it supports active student engagement with the curriculum.

Aligning with the constructivist theory is the belief that it is pedagogical methods, not technology per se that will have the greatest impact on student learning (Clark, 2001; Herrington, Reeves, Oliver, & Woo, 2004). Simply supplying students with technological tools without an understanding of how best to use them has been shown to produce minimal to no gains in student learning. The existence of one practice, principle, or concept that has benefited all students does not exist because of the differences in learning as well as diverse and heterogeneous student populations (Bates & Poole, 2003). Technology does not replace the need for high quality instructors or instructors who know how to use technology to best instruct students. It also doesn't replace or reduce the necessary communication with and between students (Bates & Poole, 2003).

Becker and Ravitz (1999) conducted a study of computer use and instructional practices and found that teachers who were frequent users of technology tend to use constructivist practices. Following a 1998 National Science Foundation report, Becker (1999) concluded that there is a relationship between constructivist pedagogy and Internet use. His study looked at frequency of Internet use and types of use by students and further considered the extent that teachers valued access in classrooms and the amount of access available. Although Becker found a relationship between constructivist pedagogy and Internet use, other studies have found little or no correlation (Harris & Grandgenett, 1999; Hunter, 2002). Specifically, Hunter (2002) examined Internet use in constructivist classrooms and failed to find any constructivist uses of the Internet, such as accessing primary sources, real-time data, and content area experts, among the participants.

Richard E. Clark (1983, 1985, 1991, 1994) pointed out that many research studies failed to utilize appropriate controls: he found that research studies comparing two instructional methods (with and without technology) typically failed to control for the fact that the two methods often used different teachers. Critics, like Clark, recognized that alleged improvements in instruction attributed to technology failed to account for parallel influences of teacher impact.

The importance of better-designed instructional technology methodology has expanded beyond academic disciplines to Federal government initiatives. For example, the U. S. Department of Education's (DOE's) Preparing Tomorrow's Teachers to use Technology (PT3) initiative clearly recognized that the effective integration of technology into education requires accountability. This is increasingly important as both educators and policy-makers insist that educational technology research provide data-based evidence that these funds have been well-spent (Cuban, Kirkpatrick, & Peck, 2001; Ringstaff & Kelley, 2002).

The majority of meta-analytic research comparing computer-enabled and computer-deficient classrooms has consistently shown that using technology in a classroom was better than not using it (Schmid et al, 2009). The use of technology, however, does not guarantee increased student achievement. The effectiveness of digital tools and highly qualified teachers should not be confused—technology works under certain conditions, and doesn't under others.

Schieber (1999) found that computer enrichment had a small negative effect on the quality of student writing. Students in nine classrooms, with a total of 199 students, used laptop computers in instruction and homework for the school year. Students in 15 other classrooms, with a total of 278 students, were exposed to the same curriculum, however these students did not own laptops or use them regularly. Scheiber compared writing samples from laptop and non-laptop classrooms after two years of laptop instruction. The writing scores were similar in the two groups.

Relatedly, the introduction of technology cannot be expected to produce an immediate impact; good instruction of any type takes time. Copolo (1992) examined the use of three-dimensional computer-simulated models of molecular structure in high school students. Subjects included 101, 11th graders assigned the classes to either an experimental group who used computer representations to study molecular structure or a control group who studied molecular structures from textbook representations. After nine days of instruction, students completed a test on molecular structures; 40 days later, they took a delayed retention test on the same topic. Analysis showed that students who learned from paper and pencil representations outperformed the computer simulation group on the immediate posttest and there were no differences between the groups on the delayed retention measure.

Proponents of educational technology (e.g., Cobb, 1997; Jonassen & Reeves, 1996) have argued that one of the most important characteristics of technology is the reduction of cognitive load in learners, thus freeing the learner’s cognitive processing capacity in the learner for more or better higher-order learning. There was evidence that some technologies may actually increase rather than reduce cognitive load, thus diminishing performance (Lowerison, Sclater, Schmid, & Abrami, 2006).

Wenglinsky (2006) in 1998 did a series of studies on fourth and eighth graders who took the National Assessment of Educational Progress (NAEP) tests. The results indicated that the quality of computer work being completed in the classroom was more productive than quantity of computer work in the outcome of these tests. Students in the study were found to receive a substantial benefit, no benefit or negative benefits depending on how their teachers chose to use the computers. By using the computers to help students solve problems and tapping higher-order thinking skills, the computers were purported to produce greater benefits in student performance. Unfortunately, Wenglinsky found that teachers were not using the computers in the most effective ways to solve problems, but for drill and practice and routine mathematical tasks. Therefore, although the technology was present, the full effects of the technology were not garnished due to the inability of the teacher to use it in the most effective manner.

Another downfall of using technology is the Digital Divide, the technological gap between the underprivileged members of society, especially the poor, rural, elderly and handicapped portions, and the wealthy, middle class living in suburban and urban areas of the United States (Marine & Blanchard, 2004). It opened an existing wound because those who do not have access to the Internet or technology in their homes or schools are becoming digitally illiterate. Interactions between people and technology influence how members of our society participate in the economic, political and social aspects of our country and the world (Marine & Blanchard, 2004). This gap continues to grow and has proven to be a very large problem that favors the privileged over the disadvantaged

(Clark & Gorski, 2001). In a study of U. S. History scores for the NAEP tests, Wenglinsky (2006) showed substantial evidence in two areas, economic status and time spent with computers outside of school, were strongly related to history achievement on these tests. Students with more affluent backgrounds performed better than less affluent students on the NAEP tests. The quantity of time spent on computers outside of school for schoolwork indicated how likely they were to score high on the assessment. The results also showed the more time they used computers in school, the lower their scores were on the NAEP, indicating that high quality use of computers happened outside the school.

There is great disparity among racial groups, as Blacks and Hispanics are less likely to have technology than White and Asian Americans (Economic and Statistics Administration, 2002). With a greater emphasis on technology integration into our education systems, one could hope to close the gap on digital illiteracy.

While it seems there are some explicit neutral or negative effects of technology and its use in education, the positive effects of technology have overpowered these. Some negative effects are the Digital Divide forming between the affluent and less affluent people of society, quality controls of the research being done, and teacher’s inability to integrate technology in the learning environment. More detailed, domain specific positive effects of technology in the learning environment will be explained in the next section.

Technology Integration

Technology integration refers to the use of technological tools in the classroom with an understanding of its relationship to pedagogy. It is more than just how software and hardware work as ancillary components to teaching. Technology integration is part of the pedagogical process and instructional delivery of a set curriculum. With technology integration, a teacher will use technology as a tool to promote and extend student learning on an every day basis.

Technology Integration in Mathematics Education

Student achievement within specific subject areas, as teachers have become more comfortable with the use of technology, has shown positive results. Within the subject area of mathematics, for example, two longitudinal studies provided evidence to that extent. An eight-year longitudinal study of SAT-I performance at New Hampshire's Brewster Academy found an increase in performance on a standardized achievement test. In the academy (high school), both technology and teaching reform had been made before the data collection, attributing the increase to the reform. In the second longitudinal study from West Virginia, substantial gains on the SAT-9 test of 950 fifth graders were found. The studied West Virginia school implemented the integration of curriculum and reinforcement of teacher instruction, along with the addition of technology and software before the data collection. In both of these longitudinal studies, an increase of achievement test scores was found after aligning teacher instruction with curriculum standards and software for mathematics and reading. Both studies showed increased scores in mathematics and reading on the two achievement tests, SAT-1 and SAT-9 (Bain & Ross, 1999; Bain & Smith, 2000; Mann, Shakeshaft, Becker & Kottkamp, 1999). When technology is used with the existing curriculum, achievement appeared to be inevitable.

Another evidence of support for technology and achievement can be found in the SimCalc project. The SimCalc project was implemented at the University of

Massachusetts/Dartmouth to increase the skills of teachers, incorporate technology and align teaching with the National Council of Teachers of Mathematics (NCTM). This funded research by the National Science Foundation was a visual, simulation approach to learn complex mathematical concepts. Through the integration of professional development, technology, and curriculum objectives, 100 seventh grade teachers within a middle school education environment deepened their understanding of more complex mathematical tasks related to calculus (Roschelle, 2007). These teachers taught the development of the concepts of proportionality, linearity and rates of change to seventh and then eighth grade students. Conceptual understanding of mathematics, specifically algebra and geometry, effectively increased for elementary, middle and high school students when instruction is facilitated by teachers who are skilled in technology (Hillel, Kieran, & Gurtner, 1989; McCoy, 1999; Pea, 2004). With SimCalc, researchers found that a technology-enhanced curriculum accompanied by teacher professional development increased student learning (SRI International, 2002).

The iPod Touch was also effectively used to help middle school students learn about algebraic equations, slope and absolute value (Franklin & Peng, 2008). Students and teachers found that with the little time needed for the algorithmic applications, this gave more time for the actual conceptual understanding and critical thinking about the mathematics involved. The visual component of the iPod Touch, as with many other varying technologies, provided learning beyond the hours of the classroom. Students had the opportunity to revisit what they have learned in the classroom for review purposes.

Manipulatives in mathematics have long been used to support the theories of concept development. Concept development is based on theories that a child needs a continuous progression from concrete objects (manipulatives) to representations (visuals) to abstract symbols (numbers) in order to understand mathematical concepts (Bruner, 1960, 1986; Piaget, 1952). Virtual math manipulatives, which are technology based representations of manipulatives, were studied by Reimer and Moyer (2005). Their study was initiated to examine how much of an effect the virtual manipulatives would have on the mathematical understanding of an abstract concept. During a two week unit of study, 19 third grade students interacted with the virtual manipulatives to explore fractions. The effect of using these virtual manipulatives to examine the concept of fractions was evident in both content knowledge and procedural knowledge through a pre- and post-test design. Additional studies on the use of virtual manipulatives were found to have the same positive effect on various grade level students. In other studies involving the virtual manipulatives, 18 kindergarten children worked on pattern construction, second graders demonstrated specific math strategies with place value, and sixth graders explored adding and subtracting of integers (Bolyard & Moyer-Packenham, 2006; Moyer, Niezgoda & Stanley, 2005; Reimer & Moyer, 2005). The kindergarten students were observed to make more detailed and complex patterns using the virtual technology component than with traditional manipulatives or paper and pencil. A second grader's use of virtual manipulatives made it less tedious for them to navigate the traditional base ten blocks in the understanding of number concepts and operations, giving them more time for exploration and learning (Reimer & Moyer, 2005). A fourth study with the virtual manipulatives showed how sixth grade students were able to easily steer through the adding and subtracting of integers (Bolyard & Moyer-Packenham, 2006). The study showed that the students had significant gains in achievement by using the virtual manipulatives. From the findings of the above four virtual manipulative studies, four themes evolved: in using the virtual manipulatives, students immediately felt and demonstrated the ease of use over traditional paper and pencil tasks; the computer game structure made it engaging; students enjoyed the immediate feedback they received and the corrections that were forthcoming; pure enjoyment was the last theme (Reimer & Moyer, 2005).

Our world has changed and the students within it have changed. Technology is one component that can address the essential 21st Century Skill of mathematics as an important core subject.

Technology Integration in Science Education

Mathematics, science and technology complement each other within our educational system. As technology has proven to promote student achievement in mathematics, so it has done the same with science as well. Science is about investigating, exploring, questioning, analyzing, and reflecting (National Center for Education Statistics, 2001). There has been value shown in using digital technology, including computer based visualizations, for the teaching of science to middle and high school students (Gilbert, Justi, Aksela, 2003; Linn, Lee, Tinker, Husic & Chiu 2006; National Center for Education Statistics, 2001). For example, visualization tools, such as animations and simulations, have been used to present concepts that are usually very hard to grasp (National Science Foundation, 2001). Models and simulations have allowed students to see dynamic relationships and explore scientific behaviors that are difficult to comprehend using traditional means (Beichner, 1990; Brassell, 1987; Thorton, 1987; Mokros & Tinker, 1987). Research has also found that the use of handheld technology in science education allows students to focus on the task, thus raising their performance and enhancing students' learning while making projects more productive (Graham, 1997; Norris & Soloway, 2003).

In a Technology Enhanced Elementary and Middle School Science (TEEMS) II project (Linn, 2003; Lunetta et al., 2007; Metcalf & Tinker, 2004; Zucker et al., 2008), a positive impact on the teaching of inquiry based science through the use of digital technology was shown. In the project, probes and computers were used to enhance the teaching of science to students. This large-scale project, funded by the National Science Foundation, produced fifteen inquiry based science units to be used in over 100 classrooms in grades three through eight. The research was conducted during two consecutive years, 2004-2005 and 2005-2006, between individual grade levels. The primary research question was whether the students who used technology, probes and computers in an inquiry-based science lesson would learn more science than those who did not. Previous research (Adams & Shrum, 1990; Krajcik, 2001; Laws, 1997; Linn et al., 1987) has already found strong results within high school science classes, in that student learning of complex relationships was facilitated by using probeware. This in itself brought a positive sign that our educational system is projecting critical thinking with technology through problem solving in grades three through 12.

Analyses of U. S. Department of Education, Institute of Education Sciences data from the National Center for Education Statistics (NCES) showed a positive relationship in a student's achievement in science from the baseline testing in fourth grade through high school (National Center for Education Statistics, 2001). These students used computer learning games in fourth grade, simulation games in eighth grade, and computers to collect, download, and analyze data in the 12th grade. All analyses of data showed a positive relationship between science achievement and technology in each of these situations (National Center for Education Statistics, 2001).

A significant gain in the acquisition of content knowledge was witnessed in a high school science class where molecular biology concepts were taught using interactive animation, (Rotbain, Marlbach-Ad & Stavy, 2008). In addition to these gains, the students found advantages to work with the computer animations. The visualization of the animation, the ability to slow down the animation and the repetition of the animation helped individualize the learning of concepts. The interactivity of the animation with the immediate feedback of the technology and the diversification of the lesson broke the traditional lecture routine for the students (Rotbain et al., 2008). From these studies we can speculate that not only the amount of technology used within the science classroom has an effect on learning, but also how it is used in various situations plays a key role in student learning.

Technology Integration In Language Arts Education and Across the Curriculum

Visual literacy and technological skills are recognized as necessary 21st century skills that build a strong knowledge base for students (Partnership for 21st Century Skills, 2009). A number of studies have been carried out to investigate the effects of technology and software use on the cognitive acquisition of skills in young children. One study (Macaruso & Walker, 2008) reviewed the benefits of computer-assisted instruction (CAI) for six classrooms of kindergarteners in an urban school district. The study drew comparisons between those students who had CAI with their regular reading curriculum and those who did not have CAI. Results showed that the treatment group produced higher scores than the control group on the oral language concepts test (phonological awareness) as well as the subtests of literacy concepts and letters and listening comprehension.

Din and Calao (2001) investigated whether playing educational video games effected overall achievement of kindergarten students. Forty-seven preschool students from two classrooms within an urban district played educational games for 40 minutes per day during an 11 week time span, in addition to their regular reading curriculum. The experimental group gained significantly more than the control group in spelling and decoding skills. The instructional effectiveness of computer programs, designed to increase phonemic awareness, decoding and language skills, has shown a positive result. Computers have continued to be an increasing part of learning, and many educators believe technology plays an important part in schools (Fitch & Sims, 1992). Through the use of computer games and technology, young students have made progress in their acquisition of reading skills.

Byrnes and Wasik (2009) studied the effects of cameras and photography with preschool children in order to promote young children's language and literacy skills. Important learning experiences beyond vocabulary development, such as motivational effects, focus of individual child, development of stories and retelling of stories emerged through the introduction of a simple camera (Byrnes & Wasik, 2009). As shown in this study, photographs can be used to capture important aspects of science experiments and the revisiting of science activities (Byrnes & Wasik, 2009; Einarsdottir, 2005; Good, 2005/2006; Hoisington, 2002). The digital technology used with photography and the young children, kept them engaged in their learning process, which is important to their success (Mayer & Wittrock, 2006; Piaget, 1955). Children who had more varied experiences exhibited stronger vocabulary skills and were better prepared to learn how to read and comprehend what they read (Connor, Morrison, & Slominski, 2006; Wasik, 2006). Photographs that children took became helpful in establishing concepts and meaning within the classroom.

Craig and Paraiso (2007) conducted four action research studies for language acquisition. iPod was used as a tool to record and listen to their own and others' spoken word, with two middle schools and two elementary schools in urban and rural settings. Their findings reflected that iPods can support and improve English vocabulary, comprehension and writing skills when the device was used with English language learners (ELLs). Positive research results were found while using the iPod in both rural and urban school settings. Student writing and vocabulary development improved, along with student comprehension skills due to the flexibility of the iPod used inside and outside of the classroom (Craig & Paraiso, 2007; Goodwin-Jones, 2005; Thorne & Payne, 2005). Secondary school students have a tendency to be reluctant to read unless they can select books they can relate to (Robb, 2000; National Council of Teachers of English, 2004). The iPod helped support this diversity among readers. Motivation and engagement to read and write, through the use of technology, was a positive ancillary effect in the language arts classroom.

Handheld devices are another digital tool adaptable to the Language Arts classroom. Some educators believe that these small devices allow technology to reach its full potential in a classroom by making 1:1 computing possible for students (Shin, Norris, & Soloway, 2007). These small computers are capable of supporting many activities in a

K-12 classroom. Handhelds have been found to assist students in writing, editing, and revising stories, papers and taking class notes (Norris & Soloway, 2004;Vincent, 2003). They are quite effective organizational tools for scheduling and self management applications, along with management of classroom assignments for teachers (Norris & Soloway, 2003; Ray, 2003). Students can write, edit and send their finished projects to the teacher for feedback and grading.

The examples of technology use in K-12 language arts related courses listed in this section provide evidence that the adoption of technology has positive impacts on the students' interests and performance in reading and writing. The promotion of young adult literacy is of paramount importance today, if students are to meet the 21st century learning skills. From a learning perspective, an educational program, which includes technology, can aid the development of cognitive thinking skills, reasoning and problem solving and have a higher impact on motivation and attitudes, with better results than standard curricula (Jonassen, 1996; Lepper, 1985; Virvous, Katsionis, & Manos, 2005; Kulik, 1994; Sivin-Kachala, 1998).

The International Society for Technology in Education (ISTE) has promoted leadership and research in the educational field of technology for over 20 years. Over these many years one strong trend has emerged: when technology is adopted into instruction, there is a strong positive impact on student achievement (International Society for Technology in Education, 2008).

Technology Achievement Initiatives

Technology is most valuable in education when it is aligned with the curriculum of a school district and its assessment (CEO Forum and Technology, 2001). Within the

United States, as of 2001, well over 5.8 billion dollars had been infused into state budgets for the development of technology in K-12 schools (CEO Forum and Technology, 2001). In addition, corporations have also allocated funding on an international basis to ensure all students have access to technology. This has led many political entities to develop specific projects or initiatives with technology. The results of the initiatives have shown many positive findings in the use of technology and achievement.

The substantial effects of using technology as an instructional tool to enhance student learning in the subjects of Science (Gabel, 2004; Lehman, 1994; Njoo & deJong, 1993; Schecker, 1998; Norris & Soloway, 2004; Spitulnik, Krajcik, & Soloway,1997), Foreign Language (Garza, 1991; Gonzalez-Bueno, 1998; Hanna & deNooy, 2003; Met, 2004; Secules, Herron, & Tomasello, 1992), Math (Geban, Askar, & Ozkan, 1992), Writing (Beauvois, 1997; Goldberg, Russell & Cook, 2003), and Social Studies (Shaver, 2004) were again evidenced in the Harvest Park Laptop Immersion Program (Gulek & Demirtas, 2005).

The Laptop Immersion Program (LIP) started with sixth, seventh and eighth grade students in Harvest Park Middle School, located in a racially diverse suburban area. Although the students did not deviate from the set curriculum of the district, differences occurred in the methods of curriculum delivery for the 259 students within the program. Students used the laptops on a daily basis for the entire school year with the traditional curriculum of the district. After training on the computer there were multiple indicators of learning achievement with state and district test results, as well as overall grade point average of the students. The analyses of the results of the LIP showed that students who used laptops in this program tended to earn higher test scores and grades for certain subject areas over those who did not use laptops (Goldberg et al., 2003; Gulek & Demirtas, 2005). The LIP presented findings showing students who use computers when learning to write were not only more engaged and motivated, but produced a higher quality work, with lengthier written content especially at the secondary level of education (Gulek & Demirtas, 2005).

In the state of Victoria, Australia, an iPod Touch Research Project was developed for the Department of Education, Early Childhood Development. The project was initiated in three primary schools with sixth grade students. Due to the widening gap between use of mobile portable devices outside of school and inside the classroom, the iPod Touch Research Project was brought in to investigate how adaptive this technology would be to the classroom. Students rated themselves as being expert or confident in using technology such as the iPod Touch to record their speaking, to listen to their speaking and to write. Teachers observed that it can be used well across all subject areas, challenged their traditional teaching practices, and helped students learn in a way they were accustomed (Murray & Sloan, 2008). More concrete evidence of the advantages of the iPod Touch in the classroom continued to develop. As a digital tool within the classroom, the students using the iPod touch in a sixth grade classroom showed significant gains. At the beginning of the semester, 61% of the students were well below entry level for sixth grade writing. At the end of the year, only 17% were well below the entry level for sixth grade writing. Significant gains were demonstrated in the area of Speaking and Listening. At the beginning of the semester only 33% of the sixth grade students were at or above entry level. At the end of the year 61% were at or above entry level in the subject of Speaking and Listening. Ancillary effects of using the iPods in the sixth grade classroom were teacher satisfaction with the student progress, the ability for this technology to be embedded into the classrooms and student engagement and motivation while using a familiar piece of technology (Murray & Sloan, 2008).

Maine's Learning Technology Initiative (MLTI), as a part of the Partnership for 21st Century Skills, provided all seventh grade students in the state with a laptop creating a 1:1 technological scenario. The Center for Education Policy, Applied Research, and Evaluation at the University of Southern Maine found evidence that the initiative has impacted teachers, students and learning in many positive ways (Wintle & Berry, 2009). Students were motivated to learn, and learning is occurring more deeply with students acquiring the 21st century skills for tomorrow's workforce.

Freedom to Learn, Michigan's 1:1 computer initiative and part of the Partnership for 21st century skills, showed a measureable influence on students. Behavioral problems almost disappeared as students were creating their own individualized learning and finding it valuable for later life skills. Texas also initiated a laptop program for each student in the seventh grade in the state. Technological tools for 21st century skills, along with updated instructional methods by knowledgeable teachers, are being implemented in order to prepare students for a global, information based economy.

The Technology Integration in Teacher Training Programs

The successful integration of technology has been shown to enhance student learning (Partnership for 21st Century Skills, 2004). If an educator received a proper learning opportunity to use technology as a tool in his/her teacher education program, the chance for the educator to successfully integrate technology in his/her classroom is expected to increase (Partnership for 21st Century Skills, 2004). A study by the National

Assessment of Educational Progress (NAEP) examined the frequency of computer use in schools, access to computers in homes and schools, professional development of mathematics teachers in schools, and the kinds of instructional uses of computers in schools. The NAEP study found that the greatest problem in the use of technology in the schools was not how often the computers were used, but how they were used for instructional purposes by the teachers (Cradler, McNabb, Freeman & Burchett, 2002; Pelgrum & Plomp, 2002; Wenglinsky, 1998).

The importance of technology integration into preservice teacher education has been addressed by many researchers and practitioners (Apple Computer, Inc., 1995; Bryant et al., 1998). Among the possible applications in the preparation of preservice teachers for the integration of technology were the following recommended practices (Glazer, 2004: McCoy, 1999; Ropp, 1999):

- Modeling and Integration of Technology Model: Modeling of the integration of technology is apparent throughout the teacher education program, specifically methods courses, and field experience in technology infused environments (Bullock, 2004; Hunt, 1997; International Society for Technology in Education, 1999; National Council for Accreditation of Teacher Education, 1997).
- Instructional Model: Teaching technology skills through coursework within higher education institutions and how these skills apply in the classroom is the basis for this model (Bullock, 2004; Northrup & Little, 1996; Smaldino & Muffoletto,1997).

- Collaboration Model: This model would include field students, school districts, university faculty and cooperative teachers who infuse technology into their classrooms. Preservice students would learn to implement the practice of integrating technology through both college course work during the methods courses and the field placements where they teach. (Laferriere, Breuleux, Baker, & Fitzsimons, 1999; Pierson, 2004; Pierson & McNeil, 2000).
- Learning Generation Model: Innovation cohorts, including teacher education and liberal arts faculty, preservice students, practicing teachers and K-12 students, discuss the context, conception, and implementation of technology throughout the developmental stages of the technology integration program (Aust, Newberry, O'Brien, & Thomas, 2005).
- Learning Community Model: University supervisors create and participate in learning communities; preservice teachers participate in reverse mentoring for their master teachers; placement of preservice teachers into field experiences where they can have modeling for pedagogy and integration of technology (Sherry & Chiero, 2004).
- Collaborative Cohorts: The cohort and team method enhances technology integration into the methods coursework for students with disabilities. Preservice teachers are able to form relationships with university professors, school district staff and other preservice teachers (Smith & Robinson, 2003)

While social learning theorists have purported the importance of modeling and imitation on learning behaviors over the years to demonstrate needed behaviors (Bandura, 1969; Bandura & Walters, 1963; Lefrancois, 1982; West & Graham, 2007), preservice teachers have not been receiving effective models of technology integration within the university setting (West & Graham, 2007).

In addition to the lack of modeling opportunities, most of the basic instructional technology courses offered in many teacher education programs were found to focus more on teaching of the hardware and software tools than on the methods of technology integration in teaching practices (Graham, Culatta, Pratt, & West, 2004). In fact, the majority (73%) of introductory technology courses within 53 researched higher education institutions were found to use a lecture and lab format for teaching technology integration with no prerequisite courses (Graham, Culatta, Pratt, & West, 2005).

Making the situation worse, there appears to be a disconnect between preservice teacher training through coursework and their actual use of technology within the K-12 classroom (Marion, 2003; Murphy, Richards, Lewis, & Carmen, 2005). That is, while preservice teachers were required to use technology in their teacher education program, they failed to continue to do so during student teaching and once they obtained employment within K-12 schools. In describing this disconnect, Marion (2003) wrote,

> Faculty members in colleges of education play a vital role in training preservice teachers for technology integration. If the faculty in the colleges of education are not integrating technology or not demonstrating technology use for preservice teachers, then preservice teachers are going to continue to struggle with technology integration (p. 106).

It is often difficult for teacher training programs to begin to adopt or incorporate technology into existing classes because courses are already filled with necessary content and skills (Manning & Bowden-Carpenter, 2008), and programs often lacked necessary facilities and resources (Moursund & Bielefeldt, 1999). Inservice teachers as well as preservice teachers were less likely to utilize technology when they believe they were lacking the necessary skills (Angeli & Valanides, 2004; Hong & Koh, 2002). As inservice and preservice teachers increased their technology confidence, their willingness to use technologies in their classrooms increased (Bullock, 2004: Talsma, Seels, & Campbell, 2003; Wahab, 2009). Attempts to improve inservice teachers' attitudes toward technology utilization have been met with mixed success (Hernandez-Ramos, 2005)

Within the preservice teachers' coursework in most university settings, technology had a tendency to play a peripheral role. Although skill based training was necessary in most cases, this training alone was not enough to produce teachers who valued and felt comfortable with the integration of technology in a learning environment (Basham et al., 2005). In order to gain the necessary skills for technology integration, preservice teachers need to practice during actual classroom or field experiences. The placements of preservice teachers for student teaching experiences have been most beneficial when preservice teachers were matched with mentor teachers who effectively modeled technology integration (Brown, 2003). Bullock (2004) recommended five factors that need to be taken into account for preservice teachers to successfully integrate technology:

- Factors experienced within their training program and with their mentor teacher
- Factors influenced by the personal expectations and academic experiences of the preservice teachers
- Factors influenced by the student teaching site

- Factors influenced by the technical support or technological availability
- Factors influenced by attitudes fears and experiences held by the preservice teachers before their field experience

In order to meet the needs of preservice teachers, implementation of a fully refined curriculum needs to be addressed by the teacher education programs. It is also recommended that coursework and field experiences address the application of technology throughout all grade levels. A technology rich framework for instruction would be well suited for increasing factors necessary for addressing preservice teachers technology competencies.

Standards in Education

The Beginning History of Standards in Education

The origins of the standards movement in American Education were due to the economic climate brought by globalization. As the United States fell short in the offering of jobs to citizens with low or no education, it became clear that American workers needed to upgrade their education, knowledge and skills in order to compete in this newly emerging global economy (Barone, Hyatt, Kush, & Mautino, 2007). Most jobs, for most of the twentieth century in the United States, could be accomplished with an eighth grade level of education. A small minority needed more than that and even fewer needed the knowledge to do the work of professionals and managers. During this time of economic development, our country moved from a primary sector economy (raw materials) to a secondary sector economy (manufacturing), then to a tertiary sector economy (services). In the meantime, our educational system remained unchanged.

In the late 1970's and 1980's, American business began losing its market for goods and services to off – shored countries who were paying 1/10 to 1/100 of the wages that the United States was paying for people with an eighth grade education (National Governors Association, 1986). It became clear that the American system of education needed to be upgraded in order to continue to compete in this global economy. In an unusual move and change from previous practices, the states' governors devoted the 1986 meeting of the National Governors Association in Hilton Head, South Carolina, under the direction of the governor of Arkansas, William J. Clinton, to discuss ways to improve the quality of education in the United States. A standard driven reform model was formed by their commitment in dealing with the present state of education in the United States (National Governors Association, 1986). This was the foundational model, which has influenced standards for more than twenty years.

The standards-driven reform models, which the governors established at the National Governors Conference, 1986 were:

1. Business Model of Standards Driven Reform: This model would have the greatest impact on standards based education in the United States. The factors which emerged from this model were for educational communities to set goals; communicate those goals; convey how to reach the goals to the people who are making the products and services; take out the middle management; give the people the tools and training they need to do a good job; reward those who produce measured gains.
2. Educators' Accountability Model: This model and the Political Accountability model came from the European and Asian education

experiences. Clear academic standards would be needed in order to improve achievement in education and mandating a test that closely matched these standards would initiate the much needed change. The release of results would increase pressure on the educational institutions to do better.

3. Political Accountability Model: This model was an incentive type model based on the need to find a way to make professional educators do what they should have been doing all along. It was more of a system to provide rewards and punishments to those whose performance was undermining the achievement of schools.
4. Ministry of Education Model: The perspective was put forth in this model from the report to the National Center on Education and the Economy (1990). The Third International Mathematics and Science Study (TIMMS) affirmed this view with results indicative of other countries doing much better than the U.S. in educational achievement. These high performing countries have high and explicit standards that are the same for all students; national examinations aligned with the standards; curriculum frameworks that specify topics to be studied at each grade level; and instructional resources matched to the standards (National Center on Education and the Economy, 1990).

The efforts to restructure America’s schools for the demands of a knowledge based economy and to deal with the impact of globalization on America’s workforce have been redefining the mission of K-12 education and teacher preparation programs that support it. Soon after the 1986 National Governors’ Conference, in 1987, both the National Board for Professional Teaching (NBPTS) and the Interstate New Teacher Assessment and

Support Consortium (INTASC) were created for veteran teacher qualifications and for states to redefine assessments for the initial licensing of teachers. As the result of the mission to strengthen the teaching profession, INTASC and NBPTS agreed that the teaching profession requires accurate performance based standards and assessment strategies that describe what teachers do in authentic teaching situations (Interstate New Teacher Assessment and Support Consortium, 1992). An INTASC task force was created for teacher licensing and was chaired by Linda Darling-Hammond. The goal was to create board compatible standards that would envelope the knowledge, skills and dispositions needed for teachers to practice their profession effectively. The ten principles (Interstate New Teacher Assessment and Support Consortium, 1992), which emerged from this task force (Table 1), were based on the performance objectives centered around:

- Knowledge of subject matter and the skills involved in teaching,
- Formal and informal assessment strategies to determine how children learn best as individuals in a continuous manner,
- Understanding the idea of human diversity in learning and differentiated instructional practices,
- Establishment of a positive learning environment and classroom management,
- Knowledge of effective communication techniques,
- Value of instructional planning for subject matter and curriculum goals, and
- Understanding of being a reflective practitioner and growing professional.

This INTASC initiative represents a continuing progression from the National Governors Foundation in 1986.

Both national organizations and state governments, in hopes of strengthening K-12 education, have influenced our standards driven education system. In an effort to reshape teaching preparation and practice, the National Board for Professional Teaching Standards (NBPTS) organized its thirty standards around five major propositions (Darling-Hammond, 1999): 1) Teachers are committed to students and their learning, 2) Teachers know the subjects they teach and how to teach them 3) Teachers are responsible for managing and monitoring student learning, 4) Teachers think systematically about their practice and learn from experience, 5) Teachers are members of learning communities. These standards were used to guide the development of the INTASC standards and complement the NCATE standards. All three are interlocked with the NCATE professional associations, such as ISTE/NETS, to bring high quality teacher education.

Table 1

INTASC Principles

Principle	Description
1. Making content meaningful	The teacher understands the central concepts, tools of inquiry, and structures of the discipline(s) he or she teaches and creates learning experiences that make these aspects of subject matter meaningful for students
2. Child development and learning theory	The teacher understands how children learn and develop and can provide learning opportunities that support their intellectual, social, and personal development.
3. Learning styles/diversity	The teacher understands how students differ in their approaches to learning and creates instructional opportunities that are adapted to diverse learners.
4. Instructional strategies/problem solving	The teacher understands and uses a variety of instructional strategies to encourage students' development of critical thinking, problem solving, and performance skills.
5. Motivation and behavior	The teacher uses an understanding individual and group motivation and behavior to create a learning environment that encourages positive social interaction, active engagements in learning, and self-motivation.
6. Communication/knowledge	The teacher uses knowledge of effective verbal, nonverbal and media communication techniques to foster active inquiry, collaboration, and supportive interaction in the classroom.
7. Planning for instruction	The teacher plans instruction based upon knowledge of subject matter, students, the community, and curriculum goals.
8. Assessment	The teacher understands and uses formal and informal assessment strategies to evaluate and ensure the continuous intellectual, social, and physical development of the learner.
9. Professional growth/reflection	The teacher is a reflective practitioner who continually evaluates the effects of his or her choices and actions on others (students, parents, and other professionals in the learning community) and who actively seeks out opportunities to grow professionally.
10. Interpersonal relationships	The teacher fosters relationships with school colleagues, parents, and agencies in the larger community to support students' learning and well being.

NCATE Standards for Teacher Education

The National Council for Accreditation of Teacher Education (NCATE) was created in 1954, as an independent organization representing the teaching profession, with the goal of accrediting universities with teacher preparation programs. With every decade that has passed, NCATE has implemented new procedures and systems for accreditation, which include accountability and performance for institutions that prepare teacher candidates for instructional certification. The conceptual framework structures each unit or standard to complete an overall goal in preparation of future teachers.

The purpose of accreditation within a specific field such as teacher education is to shield the profession being accredited from deceptive practitioners, to provide a source of recognition from colleagues, and to enhance the professionalism of the unit (Roth, 1996). With accreditation through NCATE, increased program quality, emphasis on research-based practice and continuous improvement of the program through reflection and self-evaluation were witnessed (Roth, 1996). The INTASC principles and NCATE standards resemble the need for academic excellent within the area of teacher education.

In order to help institutions better prepare preservice teachers to meet the state licensing requirements, NCATE has aligned its unit and program standards with the above principles of the INTASC. The NCATE standards for performance based accreditation call for assessments aligned with standards or assessments appropriate for the standards. These NCATE standards also stipulate that professional, state and institutional standards should be reference points for teacher candidate assessments (National Council for Accreditation of Teacher Education, 2008). The 2008 NCATE Unit

Standards were designed to include in the conceptual framework the shared vision for each unit's effort in preparing educators to work in P-12 schools.

The standards for NCATE follow:

Standard 1: Candidate Knowledge, Skills and Professional Dispositions – Teacher candidates, or preservice teachers, know and demonstrate content knowledge and skills, pedagogical and professional knowledge, skills and professional dispositions.

Both NCATE and INTASC expect all teacher candidates to know the content of the subjects they teach, so to provide learning opportunities that will provide intellectual, social, and personal development of the K-12 student. Through knowledge of the content and ability to adapt instructional strategies to all levels of K-12 students, teacher candidates will show capabilities in teaching. In our fast paced society, teacher candidates need to apply instructional strategies to develop K-12 students' critical thinking skills, problem solving, and overall academic performance. Teacher candidates will know the ways children and adolescents learn and develop, through their understanding of the pedagogy and how it relates to teaching. With subject knowledge and skills to teach, NCATE and INTASC also expect teacher candidates to be able to appropriately and effectively integrate technology and information literacy in instruction to support K-12 student learning (National Council for Accreditation of Teacher Education, 2008).

Standard 2: Assessment system that collects and analyzes data on applicant qualifications, teacher candidate and graduate performance, and unit operations to evaluate and improve the performance of teacher candidates, the unit, and its programs.

NCATE expects the unit seeking accreditation to regularly assess and make decisions about teacher candidate, or preservice teacher performance based on multiple point assessments before program completion and in practice after completion of the programs. Decisions about teacher candidates' performance within a school of education are based on assessments at admission into the program, appropriate transition points, and at program completion. This NCATE assessment system collects professional information on teacher candidates. It is reflective of the education program and will ensure the unit's professional responsibility in making sure its graduates are of the highest quality.

Standard 3: The unit and school partners' design, implementation, and evaluation of field experiences and clinical practice. By this practice teacher candidates and other school professionals develop and demonstrate the knowledge, skills and professional dispositions necessary to help all K-12 students learn.

INTASC and NCATE expect the teacher candidate to have performance skills in being a reflective practitioner. Field experiences and clinical practice are integral parts of any program that allows the teacher candidate to demonstrate the knowledge, skills and professional dispositions learned over the course of the program. It is within this capstone experience that the teacher candidates apply and reflect on their ability to collaborate with other professionals, assume accountability for their classroom and are assessed through observation by others outside of the unit's faculty. This assessment is helpful for the teacher candidate, and is a demonstration of the competency within the program.

Standard 4: Diversity

The unit designs, implements, and evaluates curriculum and provides experiences for teacher candidates to acquire and demonstrate the knowledge, skills, and professional dispositions necessary to help all K-12 students learn. This program in turn will provide teacher candidates the necessary field experiences to work with diverse K-12 populations.

INTASC and NCATE support the need to help teacher candidates realize the many dimensions of culture to enhance the understanding of diversity. Within the field experience and clinical practice settings educators can apply their knowledge of diversity, including exceptionalities, to work with all K-12 students. An opportunity to interact with adults, children, and adolescents from their own and other ethnical/racial cultures throughout their college careers, develops their unique abilities within a diverse population.

Standard 5: Faculty Qualifications, Performance, and Development

Faculty are qualified and model best professional practices in scholarship, service and teaching, including the assessment of their own effectiveness as related to teacher candidate performance; they also collaborate with colleagues in the disciplines and schools. The unit will evaluate faculty performance and provides professional development.

Faculty in higher education and their partner schools are critical to the forming of Highly Qualified Teachers (HQT). Faculty within a unit is actively engaged as a community of learners and model best practices when instructing teacher candidates. They are committed to lifelong professional development and contribute to improving the teacher education profession. The faculty in higher education continues to develop their skills in using technology to facilitate their own professional development and help teacher candidates learn.

Standard 6: Unit Governance and Resources

The unit has the leadership, authority, budget, personnel, facilities, and resources, including information technology resources, for the preparation of teacher candidates to meet professional, state and institutional standards.

The governance and resources found in the NCATE Standards and the INTASC principles call on the unit and its facilities on campus, along with partner schools, to support the intellectual and professional growth of the preservice teachers. The unit assumes the role of the leader in the management of curriculum, instruction and resources for the preparation of high quality teachers. Partner schools that align themselves with the unit needs to support teacher candidates in meeting standards. They should also support the most recent developments in technology that allow faculty to model the use of technology and teacher candidates to practice its use for instructional purposes.

While the alignment of NCATE and INTASC has strengthened the teacher education practices, NCATE's Specialty Areas Studies Board approved national standards and competencies for twenty program areas. One such specialty professional association is the International Society for Technology in Education (ISTE). NCATE adopted ISTE as one of its programs of accreditation in response to the 1997 report, Technology and the New Professional Teacher: Preparing for the 21st Century Classroom. Within this NCATE Task Force report, a need was identified for the preparation of students in a teacher education program to provide a vision of technology through education and academic coursework. Developed by ISTE are the National Educational Technology Standards (NETS), which act as guidelines for how technology should be implemented throughout the curriculum in an educational setting. The NETS were originally release in three different forms:

- National Educational Technology Standards for Students (NETS*S), 1998, 2007
- National Educational Technology Standards for Teachers (NETS*T) 2000, 2008
- National Educational Technology Standards for Administrators (NETS*A) 2002, 2009

The National Education Technology Standards for Teachers (NETS*T) 2000 were published as guidelines that compliment the NCATE standards and the ISTE guidelines. These specifically address the preservice teachers in a higher education program, with performance objectives that should be met for a 21st Century teacher.

In 2008, ISTE released a revised set of standards focused on the preparation of preservice teachers called National Education Technology Standards for Teachers: Preparing Teachers to Use Technology. These standards provide a framework for schools of education on how to use technology to meet subject area standards. The 2008 ISTE/NETS*T standards are set up for the transition of U.S. schools from the Industrial Age to the Digital Age.

Standards are set up to influence present practices. If standards are to be adopted and implemented in our schools of education, it is likely that our nation will be better able to produce highly qualified teachers.

Standards for Technology Integration in Teacher Training Programs

NCATE requires leadership and resources, which include information technology resources, as one of its criteria standards for each unit to prepare preservice teachers. The need for preservice teachers to learn how to use technology prior to leaving higher education is described in the guidelines of the accrediting body, NCATE.

Although the NCATE standards provide scaffolding for over 600 teacher preparation programs in the United States through an accreditation process, the ISTE standards are meant to be guidelines for technology, and not specific directives. As the trend towards globalization continues, teaching technology to preservice teachers is intended to increasingly align with the NCATE/ISTE/NETS*T framework so to meet the demands of future teachers.

Through a survey of deans of the schools of education, NCATE coordinators, and faculty and staff members at accredited institutions, the NCATE unit standards are reviewed within a regular 6-year cycle. The NCATE unit standards were reviewed based upon their institution alignment among standards encompassing faculty members' focus on teacher candidate learning and use of technology in both teaching and learning (Mitchell & Yamagishi, 2007). In the final analysis of the survey, Mitchell & Yamagishi (2007) found that the deans and the NCATE coordinators, who completed the survey, were very much in favor of participation in NCATE, and that their teacher candidates benefit from attending their institutions because of the NCATE affiliation.

In an attempt to promote the ISTE/NETS standards, the State Educational Technology Directors Association (SETDA) and the International Society for Technology in Education (ISTE) collaboratively created a position paper that emphasized the importance of technology-based education. This document, *Maximizing the Impact: The Pivotal Role of Technology in a 21st Century Education System*, urged a greater emphasis on technology training and argued that K-12 schools are ill prepared to produce students for who will be able to successfully utilize technology within the rapidly expanding global economy (State Educational Technology Directors Association, 2007).

To date these goals have yet to be fully realized. Despite increasing calls for this reform, as well as accreditation mandates, many preservice teachers are still not exposed to a university curriculum that fully integrates model technologies into its curricula. As a result, preservice teachers join the workforce with underdeveloped or non-existent technological skills (Cornell, 1999: Glazer, 2004; Strudler, Handler, & Falba, 1998).

Quality Teacher Education Programs

Highly Qualified Teachers

With the adoption of federal education standards, most notably No Child Left Behind (NCLB), and its objective of putting a highly qualified teacher in every classroom, it became important to understand the impact of a higher education accreditation agency such as NCATE on the teacher education programs. NCATE is an evaluative system, geared toward the specific curriculum taught at the higher education level. Its belief in the quality of the performance of preservice teachers cannot be understated. In response to the Department of Education's goal of putting a Highly Qualified Teacher (HQT) in every classroom by the year 2007, NCATE is an essential component within an educational program. A Highly Qualified Teacher, as defined by The National Commission on Teaching and America's Future (NCTAF), as reported in *No Dream Denied: A Pledge to America's Children* (National Commission on Teaching and America's Future, 2003), are teachers who:

- Possess a deep understanding of the subject matter they teach,
- Evidence a firm understanding of how students learn,

- Demonstrate the teaching skills necessary to help all students achieve high standards,
- Create a positive learning environment,
- Use a variety of assessment strategies to diagnose and respond to individual learning needs,
- Demonstrate and integrate modern technology into the school curriculum to support student learning,
- Collaborate with colleagues, parents and community members, and other educators to improve student learning,
- Use reflection in their practice to improve future teaching and student achievement,
- Pursue professional growth in both content and pedagogy, and
- Instill a passion for learning in their students.

We assume that our educational programs, at colleges and universities, are preparing highly qualified teachers. There are many opinions on what constitutes a highly qualified teacher. One dissertation study (Echard, 2007) shows that a small percentage of elementary principals in Pennsylvania observe that, overall, new teachers are prepared to teach but need more help with pedagogical skills and more clinical practice with guided instructional experiences. The overall responses from Pennsylvania elementary principals show that teacher preparation is the most important consideration they have when hiring a new teacher.

The role of higher education and preservice teacher education programs continues to grow in creating a highly qualified teacher. Technology integration education is one component of a highly qualified teacher (National Commission on Teaching and America's Future, 2003). Federal research grants, such as, Preparing Tomorrow's Teachers to Use Technology (PT3) were used to prepare faculty at higher education institutions to use technology in instruction, thus providing modeling for preservice teachers. Modeling of technology through the higher education faculty was found to have a positive effect on the use of educational technology for the preservice teachers (Hall, 2006). Modeling has a strong effect on the preservice teachers and their ability to use technology in the classroom. Teachers who model digital tools to teach and learn provide these skills to their students within our 21st century schools (State Educational Technology Directors Association, 2007). With the increased emphasis on technology, ISTE made their own list of qualifications for a highly qualified teacher in 2008 with the NETS*T, and reiterated these standards as qualifications for a Highly Qualified Teacher in 2009. The ISTE, 2009, definition of a highly qualified teacher is one who can facilitate and inspire student learning and creativity; design and develop digital-age learning experiences and assessments; model digital-age work and learning; promote and model digital citizenship and responsibility; and engage in professional growth and leadership.

Darling-Hammond (2006) recommends that teacher education programs need to teach their teacher candidates how to reach diverse learners, instill the need for the students to become leaders in their profession, and emphasize the development of a considerable content knowledge base. This knowledge building was set up in a framework by Darling-Hammond & Bransford (2005) and exemplifies three attributes that beginning professional teachers need to exhibit: 1) Knowledge of learners and their development in social contexts, 2) Knowledge of subject matter and curriculum goals, and 3) Knowledge of teaching.

First of the framework is the knowledge of learners and their development in social contexts. Although theorists disagree on how students accrue knowledge, through either behavioral perspective or cognitive perspective, there are common thoughts on instructional principles for learning. Schunk (2004) postulates that although there are differences in theories for learning, the commonalities of acquisition of knowledge are that learners progress through stages/phases; material should be organized and presented in small steps; learners require practice, feedback and continuous review; social models facilitate learning and motivation; and motivational and contextual factors influence learning.

The second point in Darling-Hammond's framework, Knowledge of subject matter and curriculum goals, is one of a curricular vision that takes into consideration the planning and development of lessons to meet the cognitive needs of all students. Beginning teachers should be insightful in developing a deeper content knowledge for what they teach and infuse the necessary resources for a diverse K-12 student population. Within the curriculum being taught and specific to the vision of the teacher, diversity in instruction can be connected directly to the desired results (Tomlinson, 2001;Wiggins & McTighe, 2007). The desired results should stem from data about student learning. Teachers who have just finished a program of study in a teacher education program should be able to develop curricular plans with clear cut goals that reflect assessment on a continuous spectrum of learning.

Knowledge of teaching is the third component of Darling-Hammond's Vision of Professional Practice. According to Darling-Hammond (2005), teaching commands the understanding of pedagogical content knowledge of the subject area, knowledge of how to reach diverse learners, knowledge of assessment, and management of the classroom environment. In order for beginning teachers to be fluent with the tools of the classroom, accredited teacher education programs need to develop their emerging technological thinking into their curricular thinking. Technology is not meant to be an add-on to education. Technology acts as a support for good instruction and a tool to deliver the curriculum. When teachers are given their first classroom to teach, they must be well prepared to meet the needs of the 21st century student with the digital tools to enhance and support their learning. The need for educational technology has been well established. With increasing technology standards developed by NCATE and ISTE/NETS*T, it is essential for teacher education programs to incorporate computer technology for teaching and learning across the curriculum (Lim, 2005; Murphy et al., 2005).

NCATE/ISTE/NETS continues to emphasize the impact that technology has on our society: work, leisure, entertainment, household tasks, our role as citizens in a community, and how students learn in schools (American Association of Colleges for Teacher Education, 2008; National Council for Accreditation of Teacher Education, 2008). So to meet the needs of 21st century students, our institutions of higher learning will need to prepare highly qualified teachers to meet those needs.

Global Programs of Study

Perhaps the most comprehensive attempt at promoting technology integration has been the Apple Classrooms of Tomorrow (ACOT) study, which examined K-12 teachers as they integrated technology (Dwyer, Ringstaff, & Sandholtz, 1991; Sandholtz et al., 1997). With data collected over a ten-year period, the ACOT study identified five stages that teachers will progress through in a fully integrated, technology classroom. In the first stage, teachers put an effort to develop basic technical knowledge as they engage in basic and often mundane activities such as reading user manuals, connecting printers and other peripherals, and eventually attempt their initial utilization of technology integration (Dwyer et al., 1991; Sandholtz et al., 1997). In the second stage, teachers become more adept with the technology, and they make a transition into the Adoption stage. Within this stage, teachers begin to use technology to produce instructional materials and to support more traditional instructional activities. Fully integrated classrooms will cause teachers to move from the Adoption to the Adaptation stage. In this stage, teachers continue to use technology for personal productivity. They, however, begin to transition their focus from teacher productivity to student productivity. The Adaptation stage is further characterized by an increased emphasis on student content engagement with technology. In the fourth stage (Appropriation), teachers will begin to demonstrate a personal mastery of the technology and will continue to integrate technological approaches to engage students in active and interactive tasks. Ultimately, teachers in the final stage (Invention) will begin to create new, content-specific uses of technology. The notion of Invention is characterized by the continued evolution of teachers as they transition from users of existing technologies to "inventors" of new technologies. This reflects the highest level of technological integration and will enhance student learning not only by expanding content knowledge but also by modeling a higher order, pedagogical approach toward learning.

How technology is used or applied within a university setting will make the connection for preservice teachers between new and traditional methods of teaching. Methods of instruction at the university level will transfer to preservice teachers. This will be a means for gaining standards based instructional content. In 2007, Microsoft and ISTE launched the Partners in Learning initiative. This partnership had the goal to bridge the digital divide by providing less affluent areas of the globe basic access to technology (Weatherby, 2007). Through the Microsoft Partners in Learning initiative, governments, ministries of education, and other key officials in 101 countries were offered educational resources to teach Information and Communication Technology (ICT) skills to students, and to train teachers how to integrate technology into their specific subject areas (Weatherby, 2007). The basic premise of the partnership's vision is that technology in education is a strong catalyst to learning; and education changes individual lives, the well being of families, the strength of social communities and global nations.

In Denmark where technology has had a strong focus within the schools for years, the Partners in Learning initiative was well received. After adopting the project-based curriculum for the further integration of technology in Denmark's 2,400 primary and secondary schools, Microsoft and ISTE's partnership realized success in demonstrating that their project-based technology curriculum can be widely adapted and used in many different countries of the world (Weatherby, 2007).

United Nations Educational, Scientific and Cultural Organization (UNESCO) and Intel Corporation began collaborating on the development of curriculum to improve the use of ICT in classrooms worldwide (United Nations Educational, Scientific and Cultural Organization, 2004). The alliance between the government and private sector formed to improve teaching and learning through the effective use of technology in elementary, secondary, and higher education environments (Intel, 2005). The improvement of teaching and learning to enhance students' technological ability will become apparent in the development of a future 21st century work force.

ICT within the United Kingdom is taught through a national curriculum in order to illustrate standards, which assist teachers in making consistent judgments on student work and progress (Qualifications and Curriculum Authority, 2003). The application of ICT goes across the curriculum within all subject areas, as a requirement to develop a broader sense of digital understanding in the primary education. Within a group of practitioners and school leaders at a 21st Century Learning discussion, the emphasis was on allowing students to develop academically using the ICT framework, in order to gain the advantages of technology in the curriculum. At the National Research and Development Center for Adult Literacy and Numeracy within the Institute for Education at University of London, research identified effective teaching strategies for ICT skills for "tutors" in the areas of Literacy and Numeracy. Researchers found that tutors or teachers who used modeling of appropriate strategies using technology and active participation with ICT provided the greatest learning and motivational gains for adult students (National Research and Development Center for Adult Literacy and Numeracy, 2007).

Teacher training programs in China do not provide future teachers with the kinds of experiences necessary to prepare them to use technology effectively in their classrooms (Song et al., 2005). The government of China has put its efforts into preparing inservice college educators on the use of modern technology. Zhang (2002) found the integration of technology in education in China consisted of lower level technology use in drill and practice, Internet based resource use, computer management instruction systems, general education and framework software for teaching and learning. Using survey instruments from the International Society of Technology in Education (ISTE), research examined how proficient students in Eastern China were in incorporating the technology skills needed for 21st century education. Although the inservice college faculty were well prepared to use and teach with technology, there was a definite lack of digital literacy out in the field of education (Song et al., 2005). The availability of computers for K-12 students in China was thought to be a major problem in implementing technology in the classroom. One computer for every 99 students was compared with one computer for every four students in the United States (Zhang, 2002). The limitation of hardware gives the preservice and inservice teachers less opportunity to incorporate digital learning in the classroom. The research of Song et al. (2005) found that the Chinese preservice and inservice educators perceived their abilities to teach in the digital age as less than adequate.

Although the general challenge of increasing teacher capacity to work with ICT is essentially the same across the globe, we need to be mindful of how to plan for the use of our resources through professional methods such as organization and planning. The importance of preparing teachers who know how and when to teach using technology continues to gain international attention from private and governmental entities.

Duquesne University Leading Teacher Program

Through the collaborative efforts of School of Education faculty, school district personnel and community partners, the Leading Teacher Program (LTP) at Duquesne

University was created. This NCATE accredited university program design is based on the standards derived from INTASC, NBPTS and NCATE.

The learning experiences found within the LTP are based on the themes of Leadership, Diversity, and Technology (Duquesne University LTP Handbook, 2004). *Leadership* refers to the ability of one to direct a community. The leader is an inspiration to the community and is a lifelong learner who pursues continuous growth. *Diversity* within the LTP reflects the need for the exemplary teacher to become one who focuses on creating learning environments that reveal an understanding of the differences of students in abilities and other human differences. In addition to Leadership and Diversity, a leading teacher is one who recognizes the value of *Technology* and incorporates it into a learning environment. These three themes are instantiated within the coursework of the Leading Teacher Program.

The vision of Duquesne University's LTP, as it relates to the INTASC and NCATE standards, is further realized in the five domains: becoming a Learning Theorist, becoming a Curriculum Designer, becoming an Expert in School Context, becoming a Master Practitioner and becoming an Instructional Leader. First is the domain of becoming a Learning Theorist, which emphasizes an understanding of the pedagogy, cognitive and affective processes that will address the learning needs of people within the K-12 setting (Duquesne University LTP Handbook, 2004). Learning Theorists are those who understand how people learn so the implementation of a differentiated approach to learning can occur, and verbal, nonverbal and multi-media communication techniques are implemented in the instructional settings. Within the LTP, students are taught to be creative in their design of constructivist learning environments. Constructivism is a philosophical and psychological perspective on the nature of learning. Constructivists believe that individuals need to construct much of what they learn from their own experience; they need to understand in order to acquire knowledge (Bruning, Schraw, & Ronning, 1999; Schunk, 2004). When an instructor teaches, it is for a student to think for himself and to take an active or constructivist approach to obtaining knowledge (Brooks & Brooks, 1999; Bruner, 1966). A constructivism based learning environment is found where a student is actively engaged in their learning and can use an array of tools and resources to reach his goals and problem solve with the interaction of interpersonal, cultural and individual factors.

Next is the domain of becoming a Curriculum Designer with its emphasis on curricular decisions based on research and informed practice. A leading teacher can plan instruction and create learning experiences based on instructional theory and the audience she teaches. LTP education emphasizes the need for teachers who know curriculum, students and the subject matter they need to learn. The Curriculum Designer is one who makes the subject matter available in a meaningful way to all people without regard to differences. Large percentages of teachers in the U. S. are middle class, Caucasians, who may have difficulty in identifying their own cultural connections within the American culture, yet they are expected to design and implement curriculum with a cultural context (Salsbury, 2008). Educators are expected to teach diverse student populations, and preservice teachers need to be prepared to plan instruction with cultural context (Salsbury, 2008). Due to the influence over the years from people of many cultures, it is imperative preservice teachers know how to design a core curriculum, based on state standards, while incorporating cultural differences (Good & Brophy, 2008; National Council for the Social Studies Task Force, 1994; National Council for the Social Studies, 2007).

The third domain of the LTP is becoming an Expert in School Context. An expert in school context is one who understands the school system in an academic, behavioral, social and political way, with historical and emerging perspectives. The LTP program is designed to support the preparation of its graduates through the building of a community of practitioners that support learning in the school.

Becoming a Master Practitioner is the fourth domain of the LTP and pertains to one who uses multiple instructional strategies, technology, academic training and reflection to teach and evaluate student and their own professional progress. In the LTP, instruction in the use of various instructional strategies, resources that include technology resources, along with their knowledge of content to enhance and support student learning is developed over the course of the program. Teacher education appears to influence the use of these practices in a classroom environment. With formal preparation teachers are better able to use these instructional strategies and resources that respond to student learning styles and encourage higher achievement (Bullock, 2004; Hansen, 1988; Hunt, 1997; International Society for Technology in Education, 1999; National Council of Teachers of English, 1997; Perkes, 1967-1968; Skipper & Quantz, 1987).

Becoming an Instructional Leader is the fifth domain of the LTP and emphasizes the teacher as a leader in relation to the community. An instructional leader is one who understands how to initiate and manage changes in a classroom and both the school community and the surrounding social community. Tools and resources are made available to the graduates of the LTP to allow them to become instructional leaders of the 21st century if they should choose to do so.

Table 2 below summarizes the five domains of the LTP program and how they relate to the NCATE, INTASC, and NBPTC Propositions.

Table 2

Five domains of LTP program

LEADING TEACHER PROGRAM domains	NCATE Standards	INTASC Principles	NBPTC Major Propositions
I. Learning Theorist	#1, 2, 3, 4, 5	#2,6,5	#1,2,3,4,5
II. Curriculum Designer	#1, 2, 4, 5	#1, 2, 7	#1,2,3,4,5
III. Expert in School Context	#1, 2, 3, 4, 5	#5, 10	#1,3,4,5
IV. Master Practitioner	#1, 2, 3, 4	#3,4,6, 8, 9	#1, 4, 5
V. Instructional Leader	#1, 2, 3, 4, 6	#5, 9, 10	#5

Chapter Summary

Throughout this chapter, student achievement, the differentiation of instruction and 21st Century Skills have been viewed with their relationship to the use of technology in an educational setting. Characteristics of highly qualified teachers have been given from multiple standpoints within our educational system. Many standards from INTASC, NCATE, NCTAF and NCLB, point to the importance of the university faculty and quality teacher education programs to support the needs of preservice teachers. In addition, the joining of business and education across our nation and the world to infuse technology into education has shown positive results. This merger between business and education exemplifies the need for the acquisition of 21st century skills needed for all students to be a literate part of the 21st century workforce.

While recent technology implementation has brought much attention from educational researchers and practitioners, technology should not be mistaken as the one component that teaches students or causes learning to happen in K-12 students. The realization is that learning occurs due to effective teachers (Palloff & Pratt, 2000). With the evidence of positive achievement gathered with experienced teacher use of technology, definitions of what makes a quality teacher and specific standards which set the framework for highly qualified teachers, we should insist that our preservice teachers are given ample opportunities to learn and practice the integration of technology in education. It is through our higher education institutions that the preservice teachers will learn how to integrate technology seamlessly into their teaching and address the diverse needs of all students and the workforce of tomorrow.

CHAPTER III

METHODOLOGY

Overview

This study evaluated preservice teacher perceptions of how well a teacher-training program integrates technology throughout its curricula, coursework and field experience. The International Society for Technology in Education (ISTE) National Educational Technology Standards for Teachers (NETS*T) were utilized as a framework to evaluate the preservice teacher perceptions within a National Council for Accreditation of Teacher Education (NCATE) accredited institution. Specifically, preservice teachers, at each of the four years of their program of study, were asked to assess how well they were able to plan and design technology infused lessons. These preservice teachers were asked to rate their ability to plan and design lessons, based on the curricula and experiences within their teacher training program and field experiences.

Research Questions

To accomplish the research goals within this study, the following two research questions were answered:

Research Question 1: Are there differences in perceptions regarding competencies in technology integration among preservice teachers of different academic years, measured by the ISTE/NETS*T Standards?

Research Question 2: Are there differences in preservice teachers' perceptions regarding competencies in technology integration during the student teaching experience?

The answers to these research questions demonstrated to what extent the Leading Teacher Program (LTP) instantiates one of its themes, Technology, into the coursework.

This was reflected in the preservice teachers' perception of competencies with the integration of technology into a learning environment.

Hypotheses

$H_{0.1}$: There will be no difference in perceived competencies of technology integration among preservice teachers of different academic years, measured by the ISTE/NETS*T standards.

$H_{0.2}$: There will be no difference in preservice teachers' perceived competencies in technology integration with the experience of student teaching.

Setting

The study was conducted in the School of Education of a moderate-sized, Catholic university in western Pennsylvania. The School of Education is one of ten schools located within the university that had a total undergraduate enrollment of approximately 5,800 students in 2008 and a total enrollment of approximately 10,000 students. Approximately 1,000 students received their Bachelor's degree during the 2008-2009 school year. Additionally, the university employs approximately 450 full-time faculty and an additional 450 part-time faculty. The university is fully accredited by the Middle States Accreditation Committee.

Within the School of Education, the teacher preparation program is referred to as the (Leading Teacher Program) LTP. The LTP was designed to prepare educational leaders for the 21st century, through learning experiences based on a conceptual framework of five domains: Learning Theorist, Curriculum Designer, Expert in School Context, Master Practitioner and Instructional Leader and three themes of Leadership, Diversity and Technology (Duquesne University LTP Handbook, 2004).

Participants

Freshmen, sophomore, junior and senior students, enrolled within the School of Education during Spring 2009 semester, were recruited as volunteers to participate in this study of preservice teacher perceptions. Total School of Education registrants for the spring of 2009 included 369 students: 77 freshmen, 79 sophomores, 77 juniors, and 136 seniors. With the assumption of normal distribution, 5% margin of error, 95% confidence interval and 50% of response distribution, a total sample size of 189 was recommended, and 278 actually participated in the study.

Current data indicated that within the School of Education, approximately 75.2% of the student population was female and 24.8% was male at the time of testing. Additionally, 96.8% indicated their ethnic background to be White, .7% as Black, .4% as Hispanic, .4% as Asian and .4% as other. Participants included both elementary- (K-6) and secondary-education (7-12) preservice teachers within the Leading Teacher Program.

Instruments

A survey instrument was developed by the researcher based upon the ISTE/NETS*T 2008 standards. The survey instrument consisted of four sections: demographic questions, educational experience, student teaching experience, and technology competency questions (Teacher Candidate Performance Indicators Survey). Permission from ISTE to use their standards in the form of a survey was approved for this study by ISTE in the form of a letter and can be found in Appendix F.

The demographic portion of the instrument asked participants to provide their gender, ethnic background, and year of enrollment in their program of study. The educational experience questions asked the total number of elective technology courses taken and area of teaching specialization (e.g., early childhood, elementary, secondary). Student teaching experience questions, which only the senior students who completed their student teaching experience in the Spring, 2009 semester will answer, asked for technology availability information within their placements, as well as, their cooperating teachers' skills in infusing technology into coursework. The technology competency section of the survey (Teacher Candidate Performance Indicators Survey) consisted of 25 questions that were derived from the five sections of the 2008 NETS*T Standards. Each of the questions asked participants to rate their perceived proficiency based upon the following 4-point Likert rubric that corresponds to the assessment rubric of the 2008 NETS*T Standards:

- Beginning – describes behaviors expected of teacher candidates in teacher education who are just beginning to use technology to improve teaching and learning.
- Developing – describes behaviors expected of teachers who are becoming more adept and flexible in their use of technology in an educational setting.
- Proficient- describes behaviors expected of teachers who are using technology efficiently and effectively for improving student learning.
- Transformative – describes behaviors that involve exploring, adapting, and applying technology in ways that fundamentally change teaching and learning; addresses the needs of an increasingly global and digital society.

The five content areas of the scale each included five questions, that correspond to the five designated 2008 NETS*T Standards:

- Facilitate and Inspire Student Learning and Creativity, including the use of technology through knowledge of subject matter, teaching and learning, and technology uses to advance student learning.
- Design and Develop Digital-Age Learning Experiences and Assessments, address the planning, design, development and evaluation of authentic learning experiences to maximize content learning.
- Model Digital-Age Work and Learning, examines performance abilities in modeling innovative professional abilities found in a global and digital society.
- Promote and Model Digital Citizenship and Responsibility, addresses the ability to understand the local and global societal issues in a digital culture and knowledge of the legal and ethical behavior in their professional practice.
- Engage in Professional Growth and Leadership, asks participants to reflect on their professional practice and exhibit leadership in their school and professional community.

The instrument has been designed based on the above five content areas of the 2008 NETS*T standards. As a result, the scale produced five content areas scores as well as an overall composite score. Because the survey was developed specifically for this research study, no reliability or validity data currently exist. However, split half and Cronbach alpha reliabilities for each of the five subscales and for the overall, total score of the scale were computed as a part of the present study.

Specifically, the split half reliability was calculated by dividing the scale questions into equivalent halves. Subsequently a Pearson correlation was computed between the two halves of the test and using the Spearman Brown formula. Additionally, Cronbach alpha reliabilities of the scale were computed, by randomly splitting the already computed split halves into additional sets to determine the resulting correlations among questions.

Participants completing their student teaching were asked to complete the survey twice: 1) they responded to each of the 25 questions, considering only their coursework and 2) they responded to the same questions, considering only the experiences gained during their student teaching. A copy of the survey instrument can be found in Appendix D and Appendix E.

Procedure

All students enrolled in the School of Education during the Spring 2009 semester were asked to voluntarily participate in the study. The study involved two survey formats: computerized as well as paper and pencil. Some of the students were given paper and pencil surveys, and other students were asked to use a computer based survey. Both surveys were identical in content.

The paper and pencil surveys were brought to classes held within the School of Education. The instructor introduced the researcher and then left the classroom so that no student felt coerced into completing a survey due to the presence of the instructor. The researcher explained the nature of the research study and gave directions on how to participate in the survey. Students verified that they were at least 18 years of age. Students within this class were informed that all information would be anonymous and confidential and that their participation for this survey completion was strictly on a voluntary basis and would not have an impact on their grade in the course. Students were directed to place their finished surveys into a manila envelope whenever they were finished completing it. The researcher then left the room until all completed surveys were placed in the envelope and a student sealed the envelope closed. A student from the class let the researcher know when all participating student surveys had been placed in the envelope.

Once the surveys had been put into the envelope and sealed the researcher took them to a secure site in the researchers' home. Sealed surveys were kept within a fireproof, locked file cabinet.

For the computer based test, student emails were sent containing the survey website by the Office of Student Teaching Students received this email which informed them of the nature of the study and asking for their voluntary participation. Adhering to the IRB regulations, students were informed that their participation was voluntary. A copy of this invitation letter is included in Appendix G. This letter of invitation included directions for how to participate in the survey and an URL address for the online survey site. Survey Monkey housed the online survey and was a private and secure site for the collection of data. The data was transferred in encrypted format and was saved in a firewall maintained site. Students were also informed that all information would be anonymous and confidential and that their decision to participate, or not, would have no bearing upon their standing within the program.

When participants accessed the online survey site, the first page of the survey provided them with information regarding the purpose of the study and information that again described their rights as potential research subjects. Participants were informed that their participation was strictly voluntary; they could choose to opt out of participation;

their decision not to participate would not impact the evaluation of their performance in their courses; all information would remain confidential; individual responses would not be reported; and all reported responses would be analyzed as aggregated data. Participants were also asked to affirm that they were over the age of 18. After reading this initial information, participants were then requested to press a continue button that would reflect their informed consent. Participants were then directed to the actual survey questions. The survey took less than 20 minutes to complete.

A second email message was subsequently sent to all students, ten days after the initial email, as a follow-up request to participate in the research study. Because the researcher was not aware of which subjects had or had not responded, due to the need for anonymity, this follow-up email was sent to all students. All surveys were completed near the end of the 2008-09 school year so participants could more accurately provide information based upon a full year of coursework and in the case of the seniors, following the completion of their student teaching.

Data Analysis

Responses to the surveys were analyzed using both descriptive and inferential statistics. The Statistical Package for the Social Science (SPSS 16.0) for the Macintosh was utilized for all data analyses. Descriptive statistics included means, standard deviations, and ranges across all four grade levels of participants. Additional demographic data was disaggregated across gender, ethnic background, etc. Group comparisons were made using Between-Subject Analyses of Variance (ANOVA). These Between-Subject ANOVAs examined possible differences in perceptions of competencies in using technology integration across the four years of students within the

LTP. The instrument itself was broken down into five groups according to content. The Between Subject Analyses of Variance (ANOVA) was used to examine the possible differences among the content specific areas of the 2008 ISTE NETS*T standards.

The second analysis, a Paired Sample t-Test, compared senior students' perceived competencies of technology integration from two aspects of their program of study: their coursework and student teaching experience. Based on their student teaching experience, the senior students' beginning perceptions of competency was compared to their final perceptions of competency while specifically looking at change during the student teaching experience itself.

CHAPTER IV

RESULTS

The collection of data for this study took place during the final weeks of spring term of 2009. The study specifically investigated student perceptions on their ability to integrate technology into a learning environment based on the 2008 ISTE/NETS*T standards. Undergraduate students within the Duquesne University Leading Teacher Program (LTP) were asked to fill out a survey, either online or paper and pencil, giving their perception of their ability to integrate technology. Seniors within the LTP were asked to complete two surveys giving their perceptions as a student within the LTP prior to student teaching and another survey after the completion of student teaching.

Undergraduate students were asked to evaluate their ability to integrate technology based on a scale of 1 through 4. Scores of 1 indicated the student's perception was *beginning* in the ability to integrate technology, 2 indicated the student's perception was *developing* in the ability to integrate technology, 3 indicated the student's perception was *proficient* in the ability to integrate technology, and 4 indicated the student's perception was *transformative* in the ability to integrate technology. The scale was interpreted at the beginning of each survey so that students could get a strong understanding of each level (1-4).

This chapter presents the statistical analyses used in the study as well as the results of these procedures. This chapter will first present descriptive statistics of each of the variables studied as well as by subgroups, and will then present statistical comparisons across grade levels. A more detailed discussion and specific recommendations for practice and future research will be presented in the final chapter.

Descriptive Statistics

The total number of participants whose data were used was 278. Of this number, 69 were male (24.8%) and 209 were female (75.2%). Participants ranged in age from 19 to 45. Six students identified themselves as international students. Student participation came from four online classrooms and six face-to-face classrooms. The majority of the students (98.2%) identified themselves as taking classes on a full-time basis. Ethnic identification was provided by the students and is presented in Table 3, with two students giving no response and one stating other category, which was not identified in the survey. Additionally, frequency distribution of the teaching focus of the students and the setting in which they would like to teach upon graduation are presented in Tables 4 and 5.

Table 3

Racial/Ethnic Background of the Total Sample.

	Frequency	Percent
Asian	1	.4
Black	2	.7
White	269	96.8
Hispanic	1	.4
Multiracial	2	.7
Other	1	.4
No Response	2	.7
Total	278	100

Table 4

Teaching Focus of the Total Sample.

	Frequency	Percent
Elementary	104	37.4
Secondary	110	39.6
Early Childhood	3	1.1
Special Education	1	.4
Dual Certification	60	21.6
Total	278	100

Table 5

Geographic Teaching Preferences of the Total Sample.

	Frequency	Percent
Urban	27	9.7
Rural	12	4.3
Suburban	137	49.3
Undecided	102	36.7
Total	278	100

Hypothesis One

An examination of Tables 6 through 10 indicates a pattern of similar responses across each of the four grade levels. Students provided responses across all possible ratings (1 – 4) for each of the 25 questions. However, the majority of scores averaged near the 2.50 to 2.60 range for each of the questions, across all four grade levels. Additionally, the standard deviations were uniformly small, averaging around .75, indicating a relatively tight, homogenous distribution of scores. When considering this information, it appears that as early as the end of their freshman year, students already have formed perceptions of their abilities to integrate technology. These already developed perceptions are moderately above average. This pattern continues throughout the remainder of their coursework and extends through the conclusion of their student teaching.

Table 6

Descriptive Statistics for Freshmen Students

Question Number	Min.	Max.	Mean	SD
One	2	4	2.71	.58
Two	1	4	2.53	.65
Three	1	4	2.61	.71
Four	1	4	2.66	.68
Five	1	4	2.68	.74
Six	1	4	2.63	.66
Seven	1	4	2.52	.74
Eight	1	4	2.66	.72
Nine	1	4	2.58	.71
Ten	1	4	2.60	.74
Eleven	1	4	2.53	.77
Twelve	1	4	2.68	.74
Thirteen	1	4	2.74	.68
Fourteen	1	4	2.65	.75
Fifteen	1	4	2.73	.66
Sixteen	1	4	2.79	.70
Seventeen	1	4	2.66	.63
Eighteen	1	4	2.68	.67
Nineteen	1	4	2.63	.68
Twenty	1	4	2.71	.71

Table 6 *(continued).*

Question Number	Min.	Max.	Mean	SD
Twenty One	1	4	2.58	.71
Twenty Two	1	4	2.61	.71
Twenty Three	1	4	2.65	.73
Twenty Four	1	4	2.71	.64
Twenty Five	1	4	2.69	.62
Standard I	6	20	13.19	2.92
Standard II	5	20	12.98	3.29
Standard III	5	20	13.32	3.26
Standard IV	5	20	13.47	3.09
Standard V	5	20	13.24	3.12
Total	27	100	66.21	14.48

Notes. N = 62

Min. = Minimum Score

Max = Maximum Score

SD = Standard Deviation

Table 7

Descriptive Statistics for Sophomore Students

Question Number	Min.	Max.	Mean	SD
One	1	4	2.57	.77
Two	1	4	2.51	.74
Three	1	4	2.30	.89
Four	1	4	2.43	.72
Five	1	4	2.64	.84
Six	1	4	2.57	.77
Seven	1	4	2.48	.85
Eight	1	4	2.56	.77
Nine	1	4	2.48	.90
Ten	1	4	2.53	.84
Eleven	1	4	2.48	.81
Twelve	1	4	2.65	.79
Thirteen	1	4	2.60	.85
Fourteen	1	4	2.58	.83
Fifteen	1	4	2.43	.87
Sixteen	1	4	2.58	.86
Seventeen	1	4	2.47	.80
Eighteen	1	4	2.64	.84
Nineteen	1	4	2.44	.93
Twenty	1	4	2.49	.81

Table 7 *(continued)*.

Question Number	Min.	Max.	Mean	SD
Twenty One	1	4	2.29	.81
Twenty Two	1	4	2.42	.71
Twenty Three	1	4	2.45	.84
Twenty Four	1	4	2.49	.77
Twenty Five	1	4	2.66	.82
Standard I	5	20	12.44	3.18
Standard II	5	20	12.62	3.55
Standard III	5	20	12.74	3.45
Standard IV	5	20	12.62	3.69
Standard V	5	20	12.31	3.45
Total	28	98	62.74	15.65

Notes. N = 77

Min. = Minimum Score

Max = Maximum Score

SD = Standard Deviation

Table 8

Descriptive Statistics for Junior Students

Question Number	Min.	Max.	Mean	SD
One	1	4	2.51	.75
Two	1	4	2.49	.75
Three	1	4	2.46	.78
Four	1	4	2.44	.73
Five	1	4	2.70	.72
Six	1	4	2.69	.72
Seven	1	4	2.61	.71
Eight	1	4	2.60	.71
Nine	1	4	2.62	.70
Ten	1	4	2.67	.69
Eleven	1	4	2.56	.68
Twelve	1	4	2.77	.66
Thirteen	1	4	2.68	.69
Fourteen	1	4	2.60	.64
Fifteen	1	4	2.54	.79
Sixteen	1	4	2.49	.76
Seventeen	1	4	2.64	.68
Eighteen	1	4	2.56	.73
Nineteen	1	4	2.54	.78
Twenty	1	4	2.52	.68

Table 8 *(continued).*

Question Number	Min.	Max.	Mean	SD
Twenty One	1	4	2.47	.73
Twenty Two	1	4	2.52	.70
Twenty Three	1	4	2.47	.71
Twenty Four	1	4	2.49	.73
Twenty Five	1	4	2.60	.69
Standard I	5	20	12.45	3.28
Standard II	5	20	13.03	3.27
Standard III	5	20	13.00	3.23
Standard IV	5	20	12.61	3.40
Standard V	5	20	12.41	3.37
Total	26	100	63.51	15.27

Notes. N = 88

Min. = Minimum Score

Max = Maximum Score

SD = Standard Deviation

Table 9

Descriptive Statistics for Senior Students (Coursework)

Question Number	Min.	Max.	Mean	SD
One	1	4	2.72	.71
Two	1	4	2.55	.65
Three	1	4	2.34	.87
Four	1	4	2.55	.80
Five	1	4	2.87	.80
Six	1	4	2.81	.85
Seven	1	4	2.57	.83
Eight	1	4	2.64	.79
Nine	1	4	2.60	.80
Ten	1	4	2.64	.76
Eleven	1	4	2.60	.71
Twelve	1	4	2.79	.72
Thirteen	2	4	2.85	.66
Fourteen	1	4	2.74	.68
Fifteen	2	4	2.74	.68
Sixteen	1	4	2.81	.77
Seventeen	1	4	2.74	.64
Eighteen	1	4	2.81	.65
Nineteen	1	4	2.64	.67
Twenty	1	4	2.68	.73

Table 9 *(continued).*

Question Number	Min.	Max.	Mean	SD
Twenty One	1	4	2.49	.69
Twenty Two	1	4	2.55	.75
Twenty Three	1	4	2.60	.65
Twenty Four	1	4	2.68	.59
Twenty Five	1	4	2.72	.65
Standard I	5	19	12.02	4.55
Standard II	5	20	12.22	5.02
Standard III	5	19	12.65	4.58
Standard IV	5	20	12.61	4.63
Standard V	5	20	12.02	4.40
Total	28	95	61.51	22.07

Notes. N = 51

Min. = Minimum Score

Max = Maximum Score

SD = Standard Deviation

Table 10

Descriptive Statistics for Senior Students (Student Teaching)

Question Number	Min.	Max.	Mean	SD
One	1	4	2.81	.70
Two	1	4	2.72	.80
Three	1	4	2.58	.85
Four	1	4	2.56	.83
Five	1	4	2.70	.80
Six	1	4	2.83	.77
Seven	1	4	2.71	.77
Eight	1	4	2.71	.77
Nine	1	4	2.67	.82
Ten	1	4	2.63	.73
Eleven	1	4	2.62	.76
Twelve	1	4	2.73	.90
Thirteen	1	4	2.81	.77
Fourteen	1	4	2.57	.77
Fifteen	1	4	2.74	.80
Sixteen	1	4	2.74	.80
Seventeen	1	4	2.73	.78
Eighteen	1	4	2.74	.73
Nineteen	1	4	2.62	.73
Twenty	1	4	2.71	.68

Table 10 *(continued).*

Question Number	Min.	Max.	Mean	SD
Twenty One	1	4	2.57	.70
Twenty Two	1	4	2.62	.73
Twenty Three	1	4	2.62	.73
Twenty Four	1	4	2.67	.72
Twenty Five	1	4	2.67	.72
Standard I	5	20	12.23	5.01
Standard II	5	20	12.00	5.37
Standard III	5	20	11.89	5.30
Standard IV	5	20	11.73	5.52
Standard V	5	18	11.74	5.12
Total	24	94	59.85	24.99

Notes. N = 51

Min. = Minimum Score

Max = Maximum Score

SD = Standard Deviation

Table 11

Descriptive Statistics for Total Sample

Question Number	Min.	Max.	Mean	SD
One	1	4	2.61	.72
Two	1	4	2.52	.70
Three	1	4	2.43	.82
Four	1	4	2.51	.73
Five	1	4	2.71	.77
Six	1	4	2.66	.75
Seven	1	4	2.55	.78
Eight	1	4	2.61	.74
Nine	1	4	2.57	.78
Ten	1	4	2.67	.76
Eleven	1	4	2.54	.74
Twelve	1	4	2.72	.73
Thirteen	2	4	2.70	.73
Fourteen	1	4	2.63	.73
Fifteen	2	4	2.59	.77
Sixteen	1	4	2.64	.79
Seventeen	1	4	2.62	.70
Eighteen	1	4	2.65	.74
Nineteen	1	4	2.55	.79
Twenty	1	4	2.58	.73

Table 11 *(continued).*

Question Number	Min.	Max.	Mean	SD
Twenty One	1	4	2.45	.75
Twenty Two	1	4	2.52	.71
Twenty Three	1	4	2.53	.74
Twenty Four	1	4	2.58	.70
Twenty Five	1	4	2.66	.71
Standard I	5	20	12.54	3.45
Standard II	5	20	12.76	3.72
Standard III	5	20	12.94	3.57
Standard IV	5	20	12.81	3.67
Standard V	5	20	12.50	3.56
Total	28	100	63.53	16.65

Notes. N = 278

Min. = Minimum Score

Max = Maximum Score

SD = Standard Deviation

Reliability

The questions asked within this study were based upon ISTE/NETS*T standards and do not reflect the typical items that would be present in a questionnaire. However to increase the fidelity of the findings, an internal consistency, Cronbach Alpha reliability coefficient was computed on the total sample of respondents (N= 273). Results produced a Cronbach Alpha reliability of .969 indicating extremely high internal consistency. Cronbach Alpha reliability looks at whether subjects answer questions in a similar manner throughout the completion of the scale, (e.g., are scores on the odd items similar to scores on the even items) and reflects the stability of the response patterns. The current coefficient was quite large and indicates that respondents were extremely consistent in their responses, a finding that supports the computation of each of the subsequent analyses.

Additionally, a test-retest reliability coefficient was calculated on the ISTE/NETS*T standards pre- and post-test scores completed by the 47 seniors. The resulting coefficient was .825 that also reflects strong reliability. However, it is important to note that that because it was hoped that attitudes would change (increase) during the student teaching experience, this coefficient may appear somewhat low. This is to be expected; a test-retest coefficient that was much larger would have indicated a similarity of scores reflecting no change across time and a lower correlation coefficient would be reflective of too much change.

The first hypothesis examined whether significant differences in the perceptions of the ability to integrate technology into teaching existed across any of the grade levels. Because four grade levels were examined in the present study, an Analysis of Variance (ANOVA) was performed for each of the five ISTE/NETS*T standards and for the total questionnaire score. Results of these ANOVAs are presented in Tables 12 through 17.

Table 12

*Analysis of Variance Results: ISTE/NETS*T Standard One*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	41.67	3	13.89	1.17	.32
	Within Groups	3257.46	274	11.89		
	Total	3299.14	277			

Table 13

*Analysis of Variance Results: ISTE/NETS*T Standard Two*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	26.27	3	8.76	.63	.60
	Within Groups	3806.59	274	13.89		
	Total	3832.85	277			

Table 14

*Analysis of Variance Results: ISTE/NETS*T Standard Three*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	16.83	3	5.61	.44	.73
	Within Groups	3512.00	274	12.82		
	Total	3528.84	277			

Table 15

*Analysis of Variance Results: ISTE/NETS*T Standard Four*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	34.98	3	11.66	.87	.46
	Within Groups	3690.53	274	13.47		
	Total	3725.51	277			

Table 16

*Analysis of Variance Results: ISTE/NETS*T Standard Five*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	49.35	3	16.45	1.31	.27
	Within Groups	3454.14	274	12.61		
	Total	3503.50	277			

Table 17

*Analysis of Variance Results: ISTE/NETS*T Standards Total*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	701.40	3	233.80	.84	.47
	Within Groups	76071.83	274	277.63		
	Total	76773.21	277			

An examination of the ANOVA results presented in Tables 12 through 17 indicates no significant differences among grades levels, for any of the five ISTE/NETS*T standards or for the total questionnaire score. These findings support the first null hypothesis that no differences would exist in perceptions of students' ability to integrate technology into the learning environment. Specifically, Freshmen, Sophomores, Juniors and Seniors are comparable in their perceptions of their ability to integrate technology into the learning environment.

Hypothesis Two

An examination of Tables 9 and 10 indicates a pattern of similar responses between senior students' perceptions of their ability to integrate technology after coursework and after their student teaching experience. Students provided responses across all possible ratings (1 – 4) for each of the 25 questions both before and after student teaching. Again, the majority of scores averaged near the 2.50 to 2.60 range for each of the questions, for both coursework and student teaching experience. Consistent with the results obtained regarding the lack of differences in grade level perceptions, this information shows senior students perceptions, for the most part, remained the same before and after student teaching. Similar to the responses of freshmen, sophomores and juniors, senior level students indicated above average perceptions both before and after student teaching.

The second hypothesis examined whether significant differences in the perceptions of the ability to integrate technology into teaching existed before and after student teaching. Because senior students completed two versions of the questionnaire, a series of paired sample t-tests were performed for each of the 25 questions derived from the ISTE/NETS*T standards. Results of these analyses are presented in Table 18.

As shown in Table 18, 23 of the 25 questions produced non-significant differences between coursework and student teaching experience. Two questions produced significant differences: Question 3 (I am able to organize an online reflective journal for content area, so that a collaborative effect can be shown.) and Question 7 (I am able to develop technology-enriched learning environments that enable all students to pursue their individual curiosities and become active participants in setting their own educational goals, managing their own learning, and assessing their own progress).

Table 18

Comparisons Between Perceptions of Ability to Integrate Technology Derived from Coursework and Student Teaching Experience

Question Number	t-value	Significance
One	-.78	.44
Two	-1.48	.15
Three	-2.57	.01*
Four	.00	1.00
Five	1.06	.29
Six	-1.07	.29
Seven	-2.29	.03*
Eight	-1.64	.11
Nine	-1.30	.20
Ten	-.68	.50
Eleven	-.36	.72
Twelve	.00	1.00
Thirteen	.00	1.00
Fourteen	1.29	.21
Fifteen	.21	.84
Sixteen	.22	.83
Seventeen	-.77	.45
Eighteen	.72	.47
Nineteen	-.24	.81

Table 18 *(continued).*

Question Number	t-value	Significance
Twenty	-.68	.50
Twenty One	-1.04	.30
Twenty Two	-1.15	.26
Twenty Three	-.47	.64
Twenty Four	.00	1.00
Twenty Five	.00	1.00
Standard I	-.92	.36
Standard II	-.08	.94
Standard III	1.00	.32
Standard IV	1.25	.22
Standard V	.10	.93
Total	.28	.78

Notes. N = 43

Degrees of freedom = 42

Tables 19-21 present frequency distributions of respondent's usage of social networking sites (e.g. Facebook, MySpace,etc.), sending and receiving text messages, and using the Internet. As would be expected in a sample of college-aged, digital natives, each of the technological resources were reported to be used on a *very often* basis.

Table 19

Frequency Distribution of Use of Social Networking Sites

	Frequency	Percent
No Response	3	1.1
Never	13	4.7
Sometimes	33	11.9
Often	65	23.4
Very Often	164	59.0
Total	278	100

Table 20

Frequency Distribution of Sending and Receiving Text Messages

	Frequency	Percent
No Response	3	1.1
Never	3	1.1
Sometimes	7	2.5
Often	50	18.0
Very Often	215	77.3
Total	278	100

Table 21

Frequency Distribution of Use of the Internet as an Academic Resource

	Frequency	Percent
Never	3	1.1
Sometimes	12	4.3
Often	64	23.0
Very Often	199	71.6
Total	278	100

Tables 22-25 present frequency distributions of student's perception of how well they felt technology was integrated by Leading Teacher Program faculty and how well equipped their classrooms were. An examination of these data indicates a perceived difference in technological integration across the three types of instructors that they students had encountered. Specifically, almost three-fourths of the students indicated that technology was often or very often integrated by LTP instructors who taught required School of Education courses. Slightly less integration was reported for instructors of elective School of Education courses where 40% integrated technology sometimes and approximately 57% demonstrated integration often or very often. The lowest reported integration of technology occurred in courses completed outside of the School of Education, where 4% reported that it never occurred and 64% reported that it occurred sometimes. Finally, School of Education classrooms were also reported to be appropriately equipped for technological integration with less then one-third of the respondents reporting that their classrooms were never or only sometimes appropriately equipped.

Table 22

Frequency Distribution of Technology Integration by Faculty in Required School of Education Courses

	Frequency	Percent
Never	0	0
Sometimes	77	27.7
Often	145	52.2
Very Often	53	19.1
No Response	3	1.1
Total	278	100

Table 23

Frequency Distribution of Technology Integration by Faculty in Elective School of Education Courses

	Frequency	Percent
Never	4	1.4
Sometimes	113	40.6
Often	112	40.4
Very Often	46	16.5
No Response	3	1.1
Total	278	100

Table 24

Frequency Distribution of Technology Integration by Faculty in Courses Completed Outside of the School of Education

	Frequency	Percent
Never	12	4.3
Sometimes	178	64.0
Often	72	25.9
Very Often	13	4.7
No Response	3	1.1
Total	278	100

Table 25

Frequency Distribution of How Often School of Education Classrooms were Equipped to Integrate Technology

	Frequency	Percent
Never	2	.7
Sometimes	78	28.1
Often	127	45.7
Very Often	68	24.5
No Response	3	1.1
Total	278	100

Tables 26-27 examine how well technology was integrated in the high school curricula completed by these teacher candidates. Table 26 looks at the technology integration made by high school instructors, and Table 27 examines how well equipped these classrooms were. Overwhelmingly, 60% of the high school instructors reportedly integrated technology into their lessons, and approximately 50% of the classrooms were sometimes equipped. As would be expected, these digital natives did not receive their first exposure to technology when they enrolled in the Leading Teacher Program. Rather, the majority of these students had received an exposure to modeled technology integration earlier on in their academic careers.

Table 26

Frequency Distribution of High School Instructors Integrating Technology into Their Teaching

	Frequency	Percent
No Response	3	1.1
Never	22	7.9
Sometimes	166	59.7
Often	63	22.7
Very Often	24	8.6
Total	278	100

Table 27

Frequency Distribution of How Often High School Classrooms were Equipped for Integrating Technology

	Frequency	Percent
No Response	3	1.1
Never	14	5.0
Sometimes	143	51.4
Often	78	28.1
Very Often	40	14.4
Total	278	100

Table 28 presents the overall perception of how well students felt that technology was integrated into the Leading Teaching Program. The results are positive with approximately two-thirds of the respondents giving the LTP the two highest ratings on the scale (Above Average and Very Much). Similarly, less than one percent of the respondents indicated a belief that technology was integrated poorly (Very Little) into the program.

Table 28

Frequency Distribution of the Overall Perception of How Well the Leading Teacher Program Prepared Teacher Candidates for Integrating Technology

	Frequency	Percent
No Response	3	1.1
Very Little	2	.7
Somewhat	15	5.4
Average	77	27.7
Above Average	128	46.0
Very Much	53	19.1
Total	278	100

Evaluation of Technology Integration in Student Teaching Experiences

Tables 29-40 provide data describing how well students perceived that technology was integrated into their student teaching experiences. Students reported that less than 4% of their cooperating teachers never integrated technology into their lessons and all students indicated that they were able to incorporate technology into their lesson plans to at least some degree. More specifically, roughly one-third of cooperating teachers reportedly used technology “Sometimes” while one-third of the students were able to integrate technology on their own “Often.”

Similar percentages were reported for the use of the Internet as a classroom resource, however approximately two-thirds of the students reported no utilization of SmartBoards. The integration of digital technologies including digital still cameras, digital movie cameras, and podcasting were also reported to occur relatively infrequently during the student teaching experience.

Interestingly, the discussion of the integration of technology into student teaching was reportedly discussed sporadically when University supervisors met with cooperating teachers. Specifically, students indicated that technology was never discussed in these meetings 15.7% of the time and discussed “Very Often” during 5.9% of these meetings (Table 37).

Table 29

Frequency Distribution of How Often Cooperating Teachers Integrated Technology into Their Lessons

	Frequency	Percent
Never	2	3.9
Sometimes	20	39.2
Often	11	21.6
Very Often	10	19.6
No Response	8	15.7
Total	51	100

Table 30

Frequency Distribution of How Well Equipped Student Teachers Perceived They Were Able to Integrate Technology into Their Lessons

	Frequency	Percent
Never	0	0
Sometimes	13	25.5
Often	17	33.3
Very Often	13	25.5
No Response	8	15.7
Total	51	100

Table 31

Frequency Distribution of Student Teachers' Use of the Internet as an Academic Resource

	Frequency	Percent
Never	2	3.9
Sometimes	12	23.5
Often	18	35.3
Very Often	11	21.6
No Response	8	15.7
Total	51	100

Table 32

Frequency Distribution of Student Teachers' Use of SmartBoards as an Academic Resource

	Frequency	Percent
Never	20	39.2
Sometimes	4	7.8
Often	6	11.8
Very Often	13	25.5
No Response	8	15.7
Total	51	100

Table 33

Frequency Distribution of Student Teachers' Use of Digital Still Cameras as an Academic Resource

	Frequency	Percent
Never	16	31.4
Sometimes	13	25.5
Often	10	19.6
Very Often	3	5.9
No Response	9	17.6
Total	51	100

Table 34

Frequency Distribution of Student Teachers' Use of Digital Movie Cameras as an Academic Resource

	Frequency	Percent
Never	34	66.7
Sometimes	6	11.8
Often	3	5.9
Very Often	0	0
No Response	8	15.7
Total	51	100

Table 35

Frequency Distribution of Student Teachers' Use of Podcasting as an Academic Resource

	Frequency	Percent
Never	32	62.7
Sometimes	8	15.7
Often	3	5.9
Very Often	0	0
No Response	8	15.7
Total	51	100

Table 36

Frequency Distribution of How Often Student Teachers' Lesson Plans Incorporated Technology

	Frequency	Percent
Never	0	0
Sometimes	17	33.3
Often	15	29.4
Very Often	11	21.6
No Response	8	15.7
Total	51	100

Table 37

Frequency Distribution of How Often Technology was Discussed When University Supervisors Came to Student Teaching Sites

	Frequency	Percent
Never	8	15.7
Sometimes	13	25.5
Often	19	37.3
Very Often	3	5.9
No Response	8	15.7
Total	51	100

Table 38 indicates that two-thirds of the students reported completing their student teaching in suburban settings, approximately 16% in urban settings and 2% in rural settings. Within these settings, approximately one-half of the students were unsure if their school had received a technology award or grant. An equal percentage (52.9%) of student teachers did report, however, an awareness of their schools offering some type of workshop or in-service training on technology (Table 39).

Table 38

Frequency Distribution of Student Teaching Settings

	Frequency	Percent
Urban	8	15.7
Rural	1	2.0
Suburban	34	66.7
PDS	0	0
No Response	8	15.7
Total	51	100

Table 39

Frequency Distribution of Student Teachers' Awareness of Student Teaching Sites Receiving Technology Awards or Grants

	Frequency	Percent
Yes	7	13.7
No	10	19.6
Unsure	26	51.0
No Response	8	15.7
Total	51	100

Table 40

Frequency Distribution of Student Teachers' Awareness of Student Teaching Sites Offering Workshops or Inservice Training on Technology

	Frequency	Percent
Yes	27	52.9
No	12	23.5
Unsure	4	7.8
No Response	8	15.7
Total	51	100

Supplemental Analyses

Following a review of the previously presented demographic information as well as student perceptions regarding technology integration into their educational experience, two supplemental analyses were performed to examine possible differences in these perceptions. These results are presented in Tables 41 and 42.

Students compared perceptions of how well technology was integrated into their coursework across their areas of teaching focus. Table 41 indicates that statistically significant differences in these perceptions did occur on ISTE/NETS*T Standard One, Two and for the Total. A post-hoc Scheffe analysis revealed that students who indicated their teaching focus as Early Childhood produced significantly lower ratings than any of the other groups.

A similar pattern emerged when students were grouped based upon how well they perceived technology was integrated into their high school curriculum (Table 42). Again, results indicated statistically significant differences among these groups on ISTE/NETS*T Standard One, Two and for the Total. A post-hoc Scheffe analysis indicated that students who described their high schools as well integrated with technology, also produced significantly higher ratings of technology integration within the Leading Teacher Program than any of the other groups.

Table 41

Analysis of Variance Results: Teaching Focus

*(a) ISTE/NETS*T Standard One*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	125.78	4	31.45	2.71	.03
	Within Groups	3173.36	273	11.62		
	Total	3299.14	277			

*(b) ISTE/NETS*T Standard Two*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	147.69	4	39.95	2.74	.03
	Within Groups	3685.16	273	13.50		
	Total	3832.85	277			

*(c) ISTE/NETS*T Standard Three*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	86.87	4	21.72	1.72	.15
	Within Groups	3441.97	273	12.61		
	Total	3528.84	277			

Table 41 *(continued).*

*(d) ISTE/NETS*T Standard Four*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	108.20	4	27.05	2.04	.09
	Within Groups	3617.31	273	13.25		
	Total	3725.51	277			

*(e) ISTE/NETS*T Standard Five*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	110.23	4	27.56	2.22	.07
	Within Groups	3393.26	273	12.43		
	Total	3503.50	277			

*(f) ISTE/NETS*T Standard Total*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	2735.93	4	683.98	2.52	.04
	Within Groups	74037.28	273	271.20		
	Total	76773.21	277			

Table 42

Analysis of Variance Results: High School Technology Integration

*(a) ISTE/NETS*T Standard One*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	122.85	3	40.95	4.11	.007
	Within Groups	2699.70	271	9.96		
	Total	2822.55	274			

*(b) ISTE/NETS*T Standard Two*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	129.78	3	42.26	3.65	.01
	Within Groups	3209.37	271	11.84		
	Total	3339.15	274			

*(c) ISTE/NETS*T Standard Three*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	67.42	3	22.47	2.06	.11
	Within Groups	2953.98	271	10.90		
	Total	3021.40	274			

Table 42 *(continued).*

*(d) ISTE/NETS*T Standard Four*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	70.50	3	23.50	2.02	.11
	Within Groups	3157.68	271	11.65		
	Total	3228.18	274			

*(e) ISTE/NETS*T Standard Five*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	64.69	3	21.57	1.97	.12
	Within Groups	2965.21	271	10.94		
	Total	3029.91	274			

*(f) ISTE/NETS*T Standard Total*

		Sum of Squares	df	Mean Square	F	Sig.
Class	Between Groups	2130.91	3	710.30	3.09	.03
	Within Groups	62401.11	271	230.26		
	Total	64532.02	274			

Summary

The study was conducted to determine how students within an NCATE accredited teacher education program evaluated their perceived abilities to integrate technology into a learning environment based on university coursework and field experience. Through the survey based on the ISTE/NETS*T standards, a Specialized Professional Association of NCATE, it would be determined how well the technology needs of preservice teachers were being met in order to secure the necessary 21st century skills for the K-12 students. Four levels of undergraduate students were compared, and in addition, senior students' coursework and student teaching experience were compared to provide determinations for the two hypotheses stated in Chapter 1.

Additional testing was completed to determine if there were any significant findings based on extraneous findings from the survey. One of the safest of all post hoc tests, the Scheffé test, showed a statistically significant difference appearing on two occasions. The first significant difference was between students who did have technology integration in their previous academic environments (e.g. high school) and those who did not have this technology integration in relation to their perceived abilities of technology integration in the LTP. The second significant difference was among Early Childhood majors within the LTP and other majors within the LTP (e.g. Elementary, Secondary, Dual Certification, Special Education). A more detailed summary and a discussion of the findings are presented in the next chapter.

CHAPTER V

CONCLUSIONS

Discussion

Purpose of the Study

The purpose of this study was to evaluate the perceptions of preservice students in their ability to integrate technology into a learning environment based on university coursework and field experience. The International Society for Technology in Education's (ISTE) 2008 National Educational Technology Standards for Teachers (NETS*T) were utilized as a framework to evaluate perceptions of the preservice teachers, from a National Council for Accreditation of Teacher Education (NCATE) accredited school of education, on their ability to integrate technology in a K-12 learning environment, The survey instrument used in the study directly incorporates the five standards of the ISTE/NETS*T standards (International Society for Technology in Education, 2008).

NCATE is a standards-based national organization that ensures quality in teacher education in over 700 higher education teacher preparation programs nationwide (National Council for Accreditation of Teacher Education, 2008). ISTE is a specialized professional association (SPA) of NCATE and works specifically in the area of technology education assessment in higher education. The 2008 NETS*T standards were introduced by ISTE to provide a framework for university schools of education, preservice teachers and professional educators to develop 21st century digital skills. NCATE/ISTE/NETS*T continue to emphasize the impact that technology has within our society and how children will learn in a global society (American Association of Colleges for Teacher Education, 2008; National Council for Accreditation of Teacher Education, 2008). For this reason, the ISTE/NETS*T standards were used to construct the survey and then presented to the teacher candidates of an NCATE accredited university.

Chapter IV presented demographic information for all variables including means, standard deviations, and ranges. In addition, inferential statistics, including t-tests and Analyses of Variances (ANOVAs) were calculated to examine each of the research hypotheses.

Demographic Findings

As would be expected in a School of Education, within a private university, demographic data indicated that the majority of respondents were white, female students. These results are consistent with statistics on professional classroom teacher demographics available from the National Education Association (National Education Association, 2006), Pennsylvania Department of Education (Pennsylvania Department of Education, 2006) and the National Council for Educational Statistics (National Center for Education Statistics, 2006). Respondents' primary teaching focus was also consistent with PDE (2006) trends, as participant responses were primarily in the Secondary and Elementary areas. As a result, the first conclusion of this study is that the demographic characteristics of the current sample mirror the larger national and statewide populations and subsequent conclusions will be generalized to these populations.

Further inspection of the demographic data showed that approximately half of the students desire to teach in a suburban setting (49.3%), and less then 10% of the students aspire to teach within an urban setting upon graduation. Additionally, approximately one-third of the students were undecided in their preference for a preferred employment setting, upon graduation, most likely because the sample included students from all four years of University program of study. While the primary goal of this study was not to examine potential employment settings, the current results are interesting in light of research that indicates that urban schools have trouble finding qualified teachers due to low pay, lack of resources and difficult working conditions (Hersh, 2009).

Psychometric Properties of the Questionnaire

Clearly when scales or questionnaires measure internal traits or dispositions it is important for the researcher to demonstrate that the selected scale produce scores that are consistent across multiple administrations and that truly and accurately measure the construct for which they were intended. With regards to the present study, the questionnaire items did assess student self-perceptions; the questions were directly taken from the five ISTE/NETS*T standards and therefore directly evidence both face and content validity.

However, given the fact that student self-perceptions were examined and secondly that seniors completed two similar versions of the scale, reliability coefficients were examined to ascertain that the overarching construct of satisfaction with technological integration was being examined consistently throughout the scale. Results presented in Chapter IV demonstrated extremely high internal consistency, a finding that supported the computation of each of the subsequent analyses.

Hypothesis One

Obviously before any inferential statistics could be completed and interpreted with any degree of certainty it was essential to first demonstrate that the methodology employed adequate sampling procedures to allow the findings to be generalized to larger populations, and that the instrument used was adequate for the intended purpose of the study.

The first hypothesis subsequently examined possible differences in perceived competencies of technology integration across preservice teachers of different academic years. While one might expect that the recognition and awareness of technology integration might increase as the students matured and progressed throughout their programs of study, it is important to remember that the present sample was specifically targeted because technology integration was one of the basic themes or tenets underlying the foundation of the program. As a result, a null hypothesis was determined to be the more correct characterization of student trends ($H_{0.1}$: There will be no difference in perceived competencies of technology integration among preservice teachers of different academic years, measured by the ISTE/NETS*T standards).

As indicated in Chapter IV, results of the present study supported the first hypothesis: there were no significant differences among grades levels, for any of the five ISTE/NETS*T standards or for the total questionnaire score. As predicted, Freshmen, Sophomores, Juniors and Seniors evidenced very similar perceptions of their ability to integrate technology into the learning environment, based upon the coursework they had completed. The most likely explanation for this finding was that as early as the end of their freshman year, students had already been exposed to considerable technological integration within their coursework. The integration of technology into coursework, by professors, subsequently continued throughout their next three years and extended through the conclusion of their student teaching. It appears that the claim of the Leading Teacher Program (LTP) that technological integration is a cornerstone of the philosophy underlying the program is clearly supported by the student stakeholders who are receiving this education.

The integration of technology within the LTP was also demonstrated in additional ways. Specifically, approximately 50% of the students reported this integration was “often” modeled by LTP faculty and an additional 20% reported that it occurred “very often.” Slightly less, but still notable statistics were reported for faculty who taught elective courses within the LTP, with students reporting that approximately 40% of these faculty integrated technology “often” and 16% reporting that it occurred “very often.” A significant decline in faculty technology integration was reported however by faculty teaching outside of the School of Education. Specifically, students reported that such integration occurred “sometimes” in nearly two-thirds of their classes and only “very often” in less than 5% of these classes. In addition, students reported that 70% of their LTP classrooms were often or very often equipped to integrate technology.

Visibly, the importance of modeling and imitation on learning, promoted by educational researchers (Bandura, 1969; Bandura & Walters, 1963; Lefrancois, 1982; West & Graham, 2007) is being implemented within the LTP. In addition to modeling, students within the LTP appear to be secure in their own use of technology and their ability to integrate technology. Students within the LTP have been exposed to Instructional Technology coursework as early as their freshman year and have subsequently developed the knowledge and skills to comfortably incorporate this technology into their educational environment. Research studies have consistently shown that when preservice teachers increase their technological confidence and believe they possess the necessary skills, their willingness to use technology in the classroom increases (Angeli & Valanides, 2004; Bullock 2004; Hong & Koh, 2002; Talsma et al., 2003; Wahab, 2009). It seems apparent that the modeling of technology by the faculty as well as the underlying Instructional Technology coursework within the LTP is producing a valuable influence on the perceptions of their preservice teachers. This success is in marked contrast to traditional teacher preparation programs who have not adequately provided effective models or sufficient experiences with technology integration (Brown, 2003; Rowley, Dysand, & Arnold, 2005; Smerden et al., 2000; Waddoups, Wentworth, & Earle, 2004).

Hypothesis Two

The second hypothesis of this study examined whether the perceptions regarding technological integration held by these teacher candidates, based upon their coursework, were altered following their student teaching experience. Clearly student teaching offered additional opportunities to experience technological integration beyond the university setting. However, again, because the present study delimited participants to those enrolled in a training program that identified technological integration as one of it's primary themes, it was predicted that no significant changes in perception would occur. Specifically, the second hypothesis was: There will be no difference in preservice teachers' perceived competencies in technology integration with the experience of student teaching.

Results again supported the hypothesis as 23 of the 25 survey questions produced non-significant differences between coursework and student teaching experience. The remaining two questions produced significant differences: Question 3 (I am able to organize an online reflective journal for content area, so that a collaborative effect can be shown) and Question 7 (I am able to develop technology-enriched learning environments that enable all students to pursue their individual curiosities and become active participants in setting their own educational goals, managing their own learning, and assessing their own progress). In both instances the mean scores were significantly higher following the student teaching experience, (e.g. Question 3 Coursework $M = 2.34$ - Question 3 Student Teaching $M = 2.58$; Question 7 Coursework $M = 2.57$ - Question 7 Student Teaching $M = 2.71$).

This finding has important implications for the faculty associated with the LTP as well as for faculty associated with other teacher training programs. Specifically, while the vast majority of self-perceived technology integration skills were thought to be already well developed by these students, upon the completion of the student teaching experience these students acknowledged that they were even more adept at a) organizing reflective journals and b) developing technology rich environments that allow their students to increase their curiosity and become more active participants in their own learning. When considering the content of these two questions it is clear that this increased confidence was the direct result of the applied, hands-on nature of the student teaching experience. That is, while the teacher candidates "believed" they were capable of engaging in these activities at the end of their coursework, they grew to become "confident" so they could promote these activities following real-world experiences that allowed them the chance to see the direct results of their efforts.

Models of exemplary practices for the integration of technology within university training programs have consistently supported these findings. Specifically both the Collaboration Model (Laferriere et al., 1999; Pierson, 2004; Pierson & McNeil, 2000) and the Learning Community Model (Sherry & Cicero, 2004) stress the importance of the integration of technology in coursework *as well as* the careful placement of preservice teachers into field experiences. When preservice teachers experience both modeling of pedagogy and applied integration of technology they are considerably more likely to successfully extend these experiences to their classrooms following graduation (Sherry & Cicero, 2004).

Practices Associated with Student Teaching Supervision

Although the LTP curriculum (including both content and pedagogical courses) is clearly designed to enhance student technology abilities, there currently exists no mechanism to match or individualize placements for students for field or student teaching based on available technology opportunities. Research (Brown & Warschauer, 2006) suggests that the use of technology by the preservice teachers is strongly associated with observing proficient mentor teachers who model technology-enriched instruction. While the placement of student teachers within a classroom where the cooperating teacher could specifically model individualized, remedial activities, it remains unlikely that this procedure will occur given that technology integration is only one of the many characteristics that are considered when identifying a student teaching site. This factor likely explains why the perceptions of the student teachers in their ability to integrate technology remained consistent from the beginning to end of their student teaching experience.

When specifically asked how well equipped they felt they were at integrating technology within their student teaching, the responses were relatively evenly distributed across “sometimes,” “often” and “very often.” However when asked how often cooperating teachers integrating technology into their lessons, 40% of the students responded “sometimes” and approximately 4% responded “never.” Clearly students emerging from the LTP are engaging in technological integration more frequently then teachers already in the field; an encouraging factor for the LTP. However the types of integration remain quite basic, with 40% of the students indicating they did not have access to a Smart Board, two-thirds indicating they never used a digital movie camera, and over 60% reporting they did not create podcasts during their student teaching experience.

While student teacher placements can obviously not be based solely on characteristics associated with technological integration, a program like the LTP that identifies this integration as an essential pedagogical component must be certain that these opportunities do indeed extend into the student teaching experience. This goal will most likely be achieved if technological integration is discussed as part of the regularly scheduled meetings between university supervisors, cooperating teachers, and the student teachers. Results from the present study indicate that these discussions did in fact occur, although not at a consistent level. Specifically, university supervisors were reported to consistently discuss technological usage with cooperating teachers during less than half of their visits. The infrequency of these discussions occurred despite the fact that the student teachers reported that the vast majority of their lesson plans (over 80%) reflected technological incorporation. It appears that the student teachers engaged in the practice of technological integration on a regular basis, despite the fact that the topic was not discussed on a regular basis during site visits from LTP faculty. Although there has been progress in the integration of technology in teacher education programs, evidence suggests that the issues noted in the LTP with preservice teachers and technology integration are comparable to broader trends (Adamy & Boulmetis, 2006; Brown, 2003; Brown & Warschauer, 2006; Hernandez-Ramos & Giancarlo, 2004).

Although students consistently expressed positive perceptions of the technological integration that occurred within the LTP, additional factors beyond the curriculum of the program and the modeling displayed by the faculty, must be considered. Specifically, these students were clearly digital natives (Prensky, 2001) as evidenced by their use of technology outside of the classroom. Over 80% of the students reported using social networking sites on a frequent basis, over 95% send and receive text messages on a regular basis, and use the Internet for academic reasons. Internet use and computer comfort have been found to be the strongest predictors of later technological expertise (Morahan-Martin & Schumacher, 2007). This expertise develops, however, in an indirect manner (Lambert, Gong, & Cuper, 2008; Lorenzo & Dziuban, 2006). Although it would appear that these digital natives are likely to use technology in all aspects of their lives, there remains an important difference between technological usage for personal and professional purposes. The utilization of technology within a personal context does predict an increased likelihood of technology usage in a professional setting but it does not guarantee that it will be used well (Lambert et al., 2008). This reflects the importance of the pedagogical training that these digital natives receive in teacher preparation programs such as the LTP. Specifically, in order to transfer this technological knowledge, students must learn and understand the relationship between technology and its usefulness in the process of teaching and learning (Lambert, 2005). Not only is it necessary for students to learn this direct relationship, they must also experience and gain confidence in using technology tools in a classroom (Mims, Polly, Shepherd, & Inan, 2006). In addition, preservice teachers must learn how to use these tools to promote the higher order thinking skills K-12 students will need in the 21st Century (Brown & Warschauer, 2006; Partnership for 21st Century Skills, 2009).

Supplemental analyses

The modeling of technology integration by the LTP faculty certainly influenced their students in a positive manner and will contribute to increased utilization following graduation. However, the modeling of technology integration was found to be occurring before the students entered college. Students indicated that 60% of their high school instructors integrated technology "sometimes" and over 30% displayed this integration "often" or "very often." Similar responses were reported regarding how well equipped their high school classrooms were. Interestingly, students who described their high schools as well-integrated with technology, also produced significantly higher ratings of technology integration within the Leading Teacher Program than any of the other groups. This may be a case of the rich getting richer. That is, students who had positive technology experiences in high school may come to college and are more aware of the technological offerings that are available to them. The modeling of technology, the classroom resources, the pedagogical instruction, etc. may be equally available to the students who were not impressed with their high school technology integration; however, they may pay less attention to these opportunities because their previous experiences were not as beneficial. Additional research may help to clarify this distinction.

Beyond the influences of high school experiences, one factor that did influence student perceptions after beginning in the LTP was their area of teaching focus.

Specifically, students who indicated their teaching focus was Early Childhood produced significantly lower ratings of technology integration than any of the other groups. There is no empirical research to date that would explain this finding. Perhaps simply by the nature of working with very young children, technology is less preferred than face-to-face interactions. Alternatively, it is possible that the LTP instructors who teach within the program have personal preferences that limit the technological experiences they provide. Regardless, additional research can help to determine if this finding is limited to the LTP or if this tendency extends to additional Early Childhood programs.

Limitations of the Study

While this study does have important implications for both the LTP, as well as, the larger community of teacher training programs, several limitations need to be considered. First, the sample that was examined was intentionally delimited to a moderately sized, private university. It is possible that the characteristics derived from the present sample may not generalize to preservice teachers who attend larger institutions or public universities. The smaller class sizes typically associated with private universities may have impacted participant perceptions to an unknown degree.

Similarly, the selection of a teacher-training program such as the LTP was a deliberate choice given that the integration of technology was one of the underlying themes of the program. This decision may have contributed to the positive perceptions of technology integration expressed by the preservice teachers; thus, the current findings may not extend to other universities where such integration is perhaps available but not as explicitly emphasized. Teacher training programs that offer a generic educational emphasis or that have chosen to focus on alternative content areas such as special education or urban education, for example, may not integrate technology to the same degree as was evidenced by the preservice teachers within the LTP.

In addition, there was no knowledge or control over the prior high school experiences of the university students and the amount of modeling of technology they had prior to beginning the program at Duquesne University. It is reasonable to believe that the modeling in high school may have given some students more positive perceptions of how to integrate technology in a classroom environment.

A third limitation was that the current study relied exclusively on student self-perceptions of technology integration; no measure of actual skills was assessed. Obviously an examination of attitudes should normally precede research that attempts to measure direct integration as the identification of specific attitudinal pros and cons will help better define the skills that are being targeted. Additionally it is reasonable to believe that preservice teachers who hold positive attitudes toward technology will be more likely to ultimately integrate these technologies; however, this assumption requires an inference that was not directly examined within the present research design.

Another limitation of the current study was there was no indication of how many technology electives the students chose to take during their experiences in the LTP. Although not required by the LTP, students could take elective coursework in Instructional Technology, and with this additional Instructional Technology coursework those preservice teachers who did take additional technology electives may hold more positive attitudes on how well they could integrate technology into a learning environment.

Finally, the present study relied exclusively on preservice teachers currently completing coursework within the LTP, with no attempt made to evaluate the attitudes on practicing teachers who were graduates of this program. Again, it can be expected that because positive self-perceptions were held by students within all four years of the program that these attitudes would continue following graduation; however, this conclusion cannot be made with certainty given this characteristic of the study.

Suggestions for Future Research

Given these limitations the following suggestions for future research are offered. First, additional research with teacher training programs within public institutions and that are housed in universities with larger enrollments is suggested. This research will better ascertain how much the characteristics associated with the LTP do or do not extend to other bodies of higher education. Relatedly, it is recommended that additional research examine the attitudes towards technology held by preservice teachers who are enrolled in teacher training programs where technology is not as explicitly emphasized. Perhaps the findings of the present study are unique to this particular institution or perhaps these attitudes will extend to more heterogeneous teacher training programs.

It is also recommended that additional research begin to examine instances of actual technology integration. Classroom artifacts and electronic portfolios are two examples of data that could look at actual technology integration. Similarly, future research that looks at the actual integration of technology by students after they have entered the workforce is necessary to determine whether the positive attitudes held by preservice teachers such as were examined in the present study, actually produce increased integration. Hopefully this progression will be found to occur; however, it remains possible that students may leave their training programs with positive expectations only to find a workplace lacking in resources or supports.

In addition to coursework integration of technology, university professor modeling of technology integration and stand alone coursework within the LTP, it would best behoove the university to investigate matching cooperating teachers with well prepared technology preservice teachers. It seems critical that with the emphasis in the area of coursework on the integration of technology, along with the infusion of technology as a theme within the LTP, that a continuation of technology integration is continued in the field experience. With this it is hoped further research can be completed that would lead increased integration of technology in a learning environment.

It remains unclear whether technology integration is in fact differentially integrated in early childhood, elementary, and secondary training. The limited integration expressed by early childhood majors in the present study was unexpected and future research is necessary to determine the extent to which these differences may be occurring.

Final Conclusions

Challenging past traditions in education will not be a task that is easy for a teacher educator to assume. With the introduction of technology into our K-12 schools to enhance students' higher order thinking skills and problem solving associated with learning, technology integration now lies in the capabilities of our teacher leaders in higher education. It is thus recommended for teacher education programs to adopt new technologies, so that the consistency of an excellent education with a highly qualified teacher can be maintained throughout our educational system. The challenge of implementing technology into a preservice teacher program will be time worth spent, as the relationship between student achievement and use of technology has already begun to prove positive in nature.

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Appendix A.

NCATE Standards.

NCATE Standards

Standard 1: *Candidate Knowledge, Skills, and Professional Dispositions*

Candidates preparing to work in schools as teachers or other school professionals know and demonstrate the content knowledge, pedagogical content knowledge and skills, pedagogical and professional knowledge and skills, and professional dispositions necessary to help all students[5] learn. Assessments indicate that candidates meet professional, state, and institutional standards.

Standard 2: *Assessment System and Unit Evaluation*

The unit has an assessment system that collects and analyzes data on applicant qualifications, candidate and graduate performance, and unit operations to evaluate and improve the performance of candidates, the unit, and its programs.

Standard 3: *Field Experiences and Clinical Practice*

The unit and its school partners design, implement, and evaluate field experiences and clinical practice so that preservice teachers and other school professionals develop and demonstrate the knowledge, skills, and professional dispositions necessary to help all students learn.

Standard 4: *Diversity*

The unit designs, implements, and evaluates curriculum and provides experiences for candidates to acquire and demonstrate the knowledge, skills, and professional dispositions necessary to help all students learn. Assessments indicate that candidates can demonstrate and apply proficiencies related to diversity. Experiences provided for candidates include working with diverse populations, including higher education and P–12 school faculty, candidates, and students in P–12 schools.

Standard 5: *Faculty Qualifications, Performance, and Development*

Faculty are qualified and model best professional practices in scholarship, service, and teaching, including the assessment of their own effectiveness as related to candidate performance. They also collaborate with colleagues in the disciplines and schools. The unit systematically evaluates faculty performance and facilitates professional development.

Standard 6: *Unit Governance and Resources*

The unit has the leadership, authority, budget, personnel, facilities, and resources, including information technology resources, for the preparation of candidates to meet professional, state, and institutional standards.

Appendix B.

ISTE NETS Standards and Performance Indicators 2000

ISTE NETS STANDARDS AND PERFORMANCE INDICATORS (2000)

I. TECHNOLOGY OPERATIONS AND CONCEPTS

Teachers demonstrate a sound understanding of technology operations and concepts. Teachers:
A. demonstrate introductory knowledge, skills, and understanding of concepts related to technology (as described in the ISTE National Educational Technology Standards for Students).
B. demonstrate continual growth in technology knowledge and skills to stay abreast of current and emerging technologies.

II. PLANNING AND DESIGNING LEARNING ENVIRONMENTS AND EXPERIENCES

Teachers plan and design effective learning environments and experiences supported by technology. Teachers:
A. design developmentally appropriate learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners.
B. apply current research on teaching and learning with technology when planning learning environments and experiences.
C. identify and locate technology resources and evaluate them for accuracy and suitability.
D. plan for the management of technology resources within the context of learning activities.
E. plan strategies to manage student learning in a technology-enhanced environment.

III.TEACHING, LEARNING, AND THE CURRICULUM

Teachers implement curriculum plans that include methods and strategies for applying technology to maximize student learning. Teachers:
A. facilitate technology-enhanced experiences that address content standards and student technology standards.
B. use technology to support learner-centered strategies that address the diverse needs of students.
C. apply technology to develop students' higher-order skills and creativity.
D. manage student learning activities in a technology-enhanced environment.

IV. ASSESSMENT AND EVALUATION

Teachers apply technology to facilitate a variety of effective assessment and evaluation strategies. Teachers:
A. apply technology in assessing student learning of subject matter using a variety of assessment techniques.
B. use technology resources to collect and analyze data, interpret results, and communicate findings to improve instructional practice and maximize student learning.
C. apply multiple methods of evaluation to determine students' appropriate use of technology resources for learning, communication, and productivity.

V. PRODUCTIVITY AND PROFESSIONAL PRACTICE

Teachers use technology to enhance their productivity and professional practice. Teachers:
A. use technology resources to engage in ongoing professional development and lifelong learning.
B. continually evaluate and reflect on professional practice to make informed decisions regarding the use of technology in support of student learning.
C. apply technology to increase productivity.
D. use technology to communicate and collaborate with peers, parents, and the larger community in order to nurture student learning.

VI. SOCIAL, ETHICAL, LEGAL, AND HUMAN ISSUES

Teachers understand the social, ethical, legal, and human issues surrounding the use of technology in PK–12 schools and apply that understanding in practice. Teachers:
A. model and teach legal and ethical practice related to technology use.
B. apply technology resources to enable and empower learners with diverse backgrounds, characteristics, and abilities.
C. identify and use technology resources that affirm diversity.
D. promote safe and healthy use of technology resources.
E. facilitate equitable access to technology resources for all students.

Appendix C.

ISTE NETS-T Standards and Performance Indicators (2008)

ISTE NETS-T Standards and Performance Indicators 2008

1. Facilitate and Inspire Student Learning and Creativity
Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face to face and virtual environments. Teachers:

- Promote, support, and model creative and innovative thinking and inventiveness
- Engage students in exploring real world issues and solving authentic problems using digital tools and resources
- Promote student reflection using collaborative tools to reveal and clarify students' conceptual understanding and thinking, planning, and creative processes
- Model collaborative knowledge construction by engaging in learning with students, colleagues, and others in face to face and virtual environment

2. Design and Develop Digital-Age Learning Experiences and Assessments
Teachers design, develop, and evaluate authentic learning experiences and assessments incorporating contemporary tools and resources to maximize content learning in context and to develop the knowledge, skills, and attitudes identified in the NETS-S. Teachers:

- Design or adapt relevant learning experiences that incorporate digital tools and resources to promote student learning and creativity
- Develop technology-enriched learning environments that enable all students to pursue their individual curiosities and become active participants in setting their own educational goals, managing their own learning, and assessing their own progress.
- Customize and personalize learning activities to address students' diverse learning styles, working strategies, and abilities using digital tools and resources.
- Provide students with multiple and varied formative and summative assessments aligned with content and technology standards and use resulting data to inform learning and teaching.

3. Model Digital-Age Work and Learning
Teachers exhibit knowledge, skills, and work processes representative of an innovative professional in a global and digital society. Teachers:

- Demonstrate fluency in technology systems and the transfer of current knowledge to new technologies and situations.
- Collaborate with students, peers, parents, and community members using digital tools and resources to support student success and innovation.
- Communicate relevant information and ideas effectively to students, parents, and peers using a variety of digital-age media and formats.
- Model and facilitate effective use of current and emerging digital tools to locate, analyze, evaluate, and use information resources to support research and learning.

4. Promote and Model Digital Citizenship and Responsibility
Teachers understand local and global societal issues and responsibilities in an evolving digital culture and exhibit legal and ethical behavior in their professional practices. Teachers:

- Advocate, model, and teach safe, legal and ethical use of digital information and technology, including respect for copyright, intellectual property, and the appropriate documentation of sources.
- Address the diverse needs of all learners by using learner-centered strategies and providing equitable access to appropriate digital tools and resources.
- Promote and model digital etiquette and responsible social interactions related to the use of technology and information.
- Develop and model cultural understanding and global awareness by engaging with colleagues and students of other cultures using digital-age communication and collaboration tools.

5. Engage in Professional Growth and Leadership
Teachers continuously improve their professional practice, model lifelong learning, and exhibit leadership in their school and professional community by promoting and demonstrating the effective use of digital tools and resources. Teachers:

- Participate in local and global learning communities to explore creative applications of technology to improve student learning.
- Exhibit leadership by demonstrating a vision of technology infusion, participating in shared decision making and community building, and developing the leadership and technology skills of others.
- Evaluate and reflect on current research and professional practice on a regular basis to make effective use of existing and emerging digital tools and resources in support of student learning.
- Contribute to the effectiveness, vitality, and self-renewal of the teaching profession and of their school and community.

Appendix D.

Teacher Candidate Demographic Survey

Teacher Candidate Demographic Survey

Duquesne University, School of Education

Thank you for taking the time to complete this survey.

Please indicate about how often have you done each of the following?

	A Never	B. Sometimes	C. Often	D. Very Often
1. How often do you use social networking sites (e.g., Facebook, My Space, etc.)?	○	○	○	○
2. How often do you send and receive text messages?	○	○	○	○
3. How often do you use the Internet as an academic resource?	○	○	○	○
4. In the required School of Education courses you have completed, how often did the instructors integrate technology into their teaching?	○	○	○	○
5. In the elective School of Education courses you have completed, how often did the instructors integrate technology into their teaching?	○	○	○	○
6. In the courses taken outside of the School of Education you have completed, how often did the instructors integrate technology into their teaching?	○	○	○	○
7. In the School of Education courses you have completed, how often were the classrooms equipped to integrate technology?	○	○	○	○
8. In your high school courses how often did the instructors integrate technology into their teaching?	○	○	○	○
9. In your high school courses how often were the classrooms equipped to integrate technology?	○	○	○	○

10. **Mark the box that best represents your OVERALL perception with how well the Leading Teacher Program has prepared you to integrate technology.**

A. Very little	B. Some-what	C. Average	D. Above Average	E. Very much
○	○	○	○	○

About You – please write in the following answers:

11. Year of birth — 19___

12. Gender
   - ○ Male
   - ○ Female

13. Are you an international student or foreign national?
   - ○ Yes
   - ○ No

14. What is your racial or ethnic identification? (please check one)
   - ○ American Indian or other Native American
   - ○ Asian, Asian American, or Pacific Islander
   - ○ Black or African American
   - ○ White (non-Hispanic)
   - ○ Mexican or Mexican American
   - ○ Hispanic or Latino
   - ○ Multiracial
   - ○ Other
   - ○ I prefer not to respond

15. What is your current class standing? (please check one)
   - ○ Freshman
   - ○ Sophomore
   - ○ Junior
   - ○ Senior

16. What is your current status?
   - ○ Full-time
   - ○ Less than full-time

17. What is your teaching focus?
   - ○ Elementary
   - ○ Secondary
   - ○ Early Childhood
   - ○ Special Education
   - ○ Dual Certification

18. When you graduate, where would you like to teach? (please choose all that apply)
   - ☐ Urban district
   - ☐ Rural district
   - ☐ Suburban district
   - ☐ Undecided

Appendix E.

Teacher Candidate Performance Indicator Survey

(Freshmen, Sophomores, Juniors, Seniors)

ISTE/NETS*T/2008 – Teacher Candidate Performance Survey

Directions:

Based on the course work you completed at Duquesne, please rate your knowledge and skill for each of the following questions based on this scale:

Beginning	I just began to use technology to improve teaching and learning.
Developing	I became more adept and flexible in the use of technology in an educational setting.
Proficient	I became adept and flexible in the use of technology in an educational setting.
Transformative	I involve exploring, adapting, and applying technology in ways that fundamentally change teaching and learning; addresses the needs of an increasingly global and digital society.

I. Facilitate and Inspire Student Learning and Creativity

	A. Beginning	B. Developing	C. Proficient	D. Transformative
19. I am able to involve students in research using digital tools to enhance understanding of a subject.	○	○	○	○
20. I am able to engage students in the solving of real world problems through the use of digital tools & resources.	○	○	○	○
21. I am able to organize an online reflective journal for content area, so that a collaborative effect can be shown.	○	○	○	○
22. I am able to model collaborative knowledge construction by engaging in learning with students, colleagues and others in a face to face and virtual environment.	○	○	○	○
23. I am able to effectively use many kinds of digital technology resources to teach students, manage a classroom environment, conduct on line professional development, and communicate with parents and colleagues.	○	○	○	○

Directions:

Based on the course work you completed at Duquesne, please rate your knowledge and skill for each of the following questions based on this scale:

Beginning	I just began to use technology to improve teaching and learning.
Developing	I became more adept and flexible in the use of technology in an educational setting.
Proficient	I became adept and flexible in the use of technology in an educational setting.
Transformative	I involve exploring, adapting, and applying technology in ways that fundamentally change teaching and learning; addresses the needs of an increasingly global and digital society.

II. Design and Develop Digital-Age Learning Experiences and Assessments

	A. Beginning	B. Developing	C. Proficient	D. Transformative
24. I am able to design or adapt relevant learning experiences that incorporate digital tools and resources to promote student learning and creativity.	○	○	○	○
25. I am able to develop technology-enriched learning environments that enable all students to pursue their individual curiosities and become active participants in setting their own educational goals, managing their own learning, and assessing their own progress.	○	○	○	○
26. I am able to customize and personalize learning activities to address students' diverse learning styles, working strategies, an abilities using digital tools and resources.	○	○	○	○
27. I am able to provide students with multiple an varied formative and summative assessments aligned with content and technology standards and use resulting data to inform learning and teaching.	○	○	○	○
28. I am able to effectively plan for the use of many kinds of digital technology resources to meet student needs.	○	○	○	○

Directions:

Based on the course work you completed at Duquesne, please rate your knowledge and skill for each of the following questions based on this scale:

Beginning	I just began to use technology to improve teaching and learning.
Developing	I became more adept and flexible in the use of technology in an educational setting.
Proficient	I became adept and flexible in the use of technology in an educational setting.
Transformative	I involve exploring, adapting, and applying technology in ways that fundamentally change teaching and learning; addresses the needs of an increasingly global and digital society.

III. Model Digital-Age Work and Learning

	A. Beginning	B. Developing	C. Proficient	D. Transformative
29. I am able to demonstrate fluency in technology systems and the transfer of current knowledge to new technologies and situations.	○	○	○	○
30. I am able to collaborate with students, peers, parents, and community members using digital tools and resources to support student success and innovation.	○	○	○	○
31. I am able to communicate relevant information and ideas effectively to students, parents, and peers using a variety of digital-age media and formats.	○	○	○	○
32. I am able to model and facilitate effective use of current and emerging digital tools to locate, analyze, evaluate, and use information resources to support research and learning.	○	○	○	○
33. I am able to effectively research new technology, so to keep up to date with current technological advances for personal and professional uses.	○	○	○	○

Directions:

Based on the course work you completed at Duquesne, please rate your knowledge and skill for each of the following questions based on this scale:

Beginning	I just began to use technology to improve teaching and learning.
Developing	I became more adept and flexible in the use of technology in an educational setting.
Proficient	I became adept and flexible in the use of technology in an educational setting.
Transformative	I involve exploring, adapting, and applying technology in ways that fundamentally change teaching and learning; addresses the needs of an increasingly global and digital society.

IV. Promote and Model Digital Citizenship and Responsibility

	A. Beginning	B. Developing	C. Proficient	D. Transformative
34. I am able to advocate, model, and teach safe, legal, and ethical use of digital information and technology, including respect for copyright, intellectual property, and documentation of sources.	○	○	○	○
35. I am able to address the diverse needs of all learners by using learner-centered strategies and providing equitable access to appropriate digital tools and resources.	○	○	○	○
36. I am able to promote and model digital etiquette and responsible social interactions related to the use of technology and information.	○	○	○	○
37. I am able to develop and model cultural understanding and global awareness by engaging with colleagues and students of other cultures using digital-age communication and collaboration tools.	○	○	○	○
38. I am able to understand societal issues and responsibilities relating to the legal and ethical use of digital tools and resources.	○	○	○	○

Directions:

Based on the course work you completed at Duquesne, please rate your knowledge and skill for each of the following questions based on this scale:

Beginning	I just began to use technology to improve teaching and learning.
Developing	I became more adept and flexible in the use of technology in an educational setting.
Proficient	I became adept and flexible in the use of technology in an educational setting.
Transformative	I involve exploring, adapting, and applying technology in ways that fundamentally change teaching and learning; addresses the needs of an increasingly global and digital society.

V. Engage in Professional Growth and Leadership

	A. Beginning	B. Developing	C. Proficient	D. Transformative
39. I am able to participate in local and global learning communities to explore creative applications of technology to improve student learning.	○	○	○	○
40. I am able to model leadership by demonstrating a vision of technology infusion, participating in shared decision making and community building, and developing the leadership and technology skills of others.	○	○	○	○
41. I am able to evaluate and reflect on current research and professional practice on a regular basis to make effective use of existing and emerging digital tools and resources in support of student learning.	○	○	○	○
42. I am able to contribute to the effectiveness, vitality, and self-renewal of the teaching profession and of their school and community.	○	○	○	○
43. I am able to model leadership in my own professional community through the use of digital tools and resources.	○	○	○	○

If you are a Freshman, Sophomore or Junior: **Please Stop here**.

If you are a Senior and have done your Student Teaching assignment: **please continue**.

Teacher Candidate Demographic Survey

Duquesne University, School of Education

Additional Student Teacher Questions

Thank you for taking the time to complete this survey.

Please indicate about how often have you done each of the following?

	A. Never	B. Sometimes	C. Often	D. Very Often
44. How often did your cooperating teacher integrate technology in his/her lessons?	○	○	○	○
45. How equipped were you able to integrate technology in your lessons?	○	○	○	○
46. How often do you use the Internet as an academic resource within your classroom?	○	○	○	○
47. How often do you use a Smartboard as an academic resource within your classroom?	○	○	○	○
48. How often do you use digital cameras as an academic resource within your classroom?	○	○	○	○
49. How often do you use digital movie cameras as an academic resource within your classroom?	○	○	○	○
50. How often do you use Podcasting as an academic resource within your classroom?	○	○	○	○
51. How often did your lesson plans have technology incorporated into your lessons?	○	○	○	○
52. When Duquesne University supervisors came to your school, how often was the integration of technology discussed?	○	○	○	○

53. Did your school receive any awards or grants that you are aware of for the implementation of student teaching?
   - ○ Yes
   - ○ No
   - ○ Unsure

54. What type of setting did you complete your student teaching?
   - ○ Urban district
   - ○ Rural district
   - ○ Suburban district
   - ○ PDS School

55. Were inservice lessons or workshops ever provided by the district, for the teachers, on how to integrate technology?
   - ○ Yes
   - ○ No
   - ○ Unsure

ISTE/NETS*T/2008 – Teacher Candidate Performance Survey

Directions:

Based on your student teaching experience, please rate your knowledge and skill for each of the following questions based on this scale:

Beginning	I just began to use technology to improve teaching and learning.
Developing	I became more adept and flexible in the use of technology in an educational setting.
Proficient	I became adept and flexible in the use of technology in an educational setting.
Transformative	I involve exploring, adapting, and applying technology in ways that fundamentally change teaching and learning; addresses the needs of an increasingly global and digital society.

I. Facilitate and Inspire Student Learning and Creativity

	A. Beginning	B. Developing	C. Proficient	D. Transformative
56. I am able to involve students in research using digital tools to enhance understanding of a subject.	○	○	○	○
57. I am able to engage students in the solving of real world problems through the use of digital tools & resources.	○	○	○	○
58. I am able to organize an online reflective journal for content area, so that a collaborative effect can be shown.	○	○	○	○
59. I am able to model collaborative knowledge construction by engaging in learning with students, colleagues and others in a face to face and virtual environment.	○	○	○	○
60. I am able to effectively use many kinds of digital technology resources to teach students, manage a classroom environment, conduct on line professional development, and communicate with parents and colleagues.	○	○	○	○

Directions:

Based on your student teaching experience, please rate your knowledge and skill for each of the following questions based on this scale:

Beginning	I just began to use technology to improve teaching and learning.
Developing	I became more adept and flexible in the use of technology in an educational setting.
Proficient	I became adept and flexible in the use of technology in an educational setting.
Transformative	I involve exploring, adapting, and applying technology in ways that fundamentally change teaching and learning; addresses the needs of an increasingly global and digital society.

II. Design and Develop Digital-Age Learning Experiences and Assessments

	A. Beginning	B. Developing	C. Proficient	D. Transformative
61. I am able to design or adapt relevant learning experiences that incorporate digital tools and resources to promote student learning and creativity.	○	○	○	○
62. I am able to develop technology-enriched learning environments that enable all students to pursue their individual curiosities and become active participants in setting their own educational goals, managing their own learning, and assessing their own progress.	○	○	○	○
63. I am able to customize and personalize learning activities to address students' diverse learning styles, working strategies, an abilities using digital tools and resources.	○	○	○	○
64. I am able to provide students with multiple an varied formative and summative assessments aligned with content and technology standards and use resulting data to inform learning and teaching.	○	○	○	○
65. I am able to effectively plan for the use of many kinds of digital technology resources to meet student needs.	○	○	○	○

Directions:

Based on your student teaching experience, please rate your knowledge and skill for each of the following questions based on this scale:

Beginning	I just began to use technology to improve teaching and learning.
Developing	I became more adept and flexible in the use of technology in an educational setting.
Proficient	I became adept and flexible in the use of technology in an educational setting.
Transformative	I involve exploring, adapting, and applying technology in ways that fundamentally change teaching and learning; addresses the needs of an increasingly global and digital society.

III. Model Digital-Age Work and Learning

	A. Beginning	B. Developing	C. Proficient	D. Transformative
66. I am able to demonstrate fluency in technology systems and the transfer of current knowledge to new technologies and situations.	○	○	○	○
67. I am able to collaborate with students, peers, parents, and community members using digital tools and resources to support student success and innovation.	○	○	○	○
68. I am able to communicate relevant information and ideas effectively to students, parents, and peers using a variety of digital-age media and formats.	○	○	○	○
69. I am able to model and facilitate effective use of current and emerging digital tools to locate, analyze, evaluate, and use information resources to support research and learning.	○	○	○	○
70. I am able to effectively research new technology, so to keep up to date with current technological advances for personal and professional uses.	○	○	○	○

Directions:

Based on your student teaching experience, please rate your knowledge and skill for each of the following questions based on this scale:

Beginning	I just began to use technology to improve teaching and learning.
Developing	I became more adept and flexible in the use of technology in an educational setting.
Proficient	I became adept and flexible in the use of technology in an educational setting.
Transformative	I involve exploring, adapting, and applying technology in ways that fundamentally change teaching and learning; addresses the needs of an increasingly global and digital society.

IV. Promote and Model Digital Citizenship and Responsibility

	A. Beginning	B. Developing	C. Proficient	D. Transformative
71. I am able to advocate, model, and teach safe, legal, and ethical use of digital information and technology, including respect for copyright, intellectual property, and documentation of sources.	○	○	○	○
72. I am able to address the diverse needs of all learners by using learner-centered strategies and providing equitable access to appropriate digital tools and resources.	○	○	○	○
73. I am able to promote and model digital etiquette and responsible social interactions related to the use of technology and information.	○	○	○	○
74. I am able to develop and model cultural understanding and global awareness by engaging with colleagues and students of other cultures using digital-age communication and collaboration tools.	○	○	○	○
75. I am able to understand societal issues and responsibilities relating to the legal and ethical use of digital tools and resources.	○	○	○	○

Directions:

Based on your student teaching experience, please rate your knowledge and skill for each of the following questions based on this scale:

Beginning	I just began to use technology to improve teaching and learning.
Developing	I became more adept and flexible in the use of technology in an educational setting.
Proficient	I became adept and flexible in the use of technology in an educational setting.
Transformative	I involve exploring, adapting, and applying technology in ways that fundamentally change teaching and learning; addresses the needs of an increasingly global and digital society.

V. Engage in Professional Growth and Leadership

	A. Beginning	B. Developing	C. Proficient	D. Transformative
76. I am able to participate in local and global learning communities to explore creative applications of technology to improve student learning.	○	○	○	○
77. I am able to model leadership by demonstrating a vision of technology infusion, participating in shared decision making and community building, and developing the leadership and technology skills of others.	○	○	○	○
78. I am able to evaluate and reflect on current research and professional practice on a regular basis to make effective use of existing and emerging digital tools and resources in support of student learning.	○	○	○	○
79. I am able to contribute to the effectiveness, vitality, and self-renewal of the teaching profession and of their school and community.	○	○	○	○
80. I am able to model leadership in my own professional community through the use of digital tools and resources.	○	○	○	○

Appendix F.

Letter of Permission From ISTE

From: Lanier Brandau <lbrandau@iste.org>
To: <koch957@duq.edu>
Date: Friday - September 19, 2008 10:43 AM
Subject: Re: Permissions and Requests Deadline!

Thank you for your request for permission to use the ISTE¹s National Education Technology Standards for Teachers.

As long as your usage is noncommercial, not for profit and for educational purposes only, you have our permission to use the NETS€T.

Please use the following credit lines in all uses of the material:

NETS for Teachers:
National Educational Technology Standards for Teachers,
Second Edition © 2008 ISTE ® (International Society for Technology in Education),
www.iste.org. All rights reserved.

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http://www.iste.org/Content/NavigationMenu/NETS/ForTeachers/2008Standards/NETS_for_Teachers_2008.htm

If linking does not meet your needs you have permission to post but please use the credit lines listed above.

Also, please do share your results with us when your project is complete. We like to see samplings of our our NETS are used.

Please let me know if I can be of additional assistance. We wish you success with your project.

Best Regards,

Lanier Brandau

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Appendix G.

Letter of Invitation to Participate in a Survey

Dear Student:

You are being asked to volunteer as a research participant by taking part in a survey. The research is being done within the Duquesne University School of Education and will examine both coursework and student teaching experience in relation to preservice teachers' perceptions on how to infuse technology into a learning environment.

Your participation in this survey is strictly voluntary and will take approximately 20 minutes of your time to complete. As a participant your views about the subject would be greatly appreciated.

Sincerely,

Anne S. Koch