FACTORS PREDICTING PRESERVICE TEACHER TECHNOLOGY COMPETENCY

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A Dissertation

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ABSTRACT

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The primary purpose of this quantitative study was to predict incoming teacher education students’ technology competency by examining factors that contribute to their background technology experience. Factors included socioeconomic status of the school district from where they graduated, district demographics related to teachers’ average number of years teaching, teachers’ average number of hours of professional development with technology, and student background experiences with technology based on uses at school and home.

Preservice teachers enter colleges of education from various educational background experiences and possess broad levels of technology competency. Research findings indicate there is a positive relationship between district affluence and technology integration (Riel & Schwarz, 2002). In addition, there is evidence that suggests socioeconomic background contributes to students’ ability to use technology (Riel & Schwarz).

As colleges of education move forward with integrating technology into teacher preparation programs, a need exists to recognize the characteristics of the students’ backgrounds that contribute to their ability to perform basic technology competencies. Identifying characteristics of student experience with technology that predict technology competency will assist colleges of education with further understanding the level of technology integration and K-12 district status of implementing data-management systems for instructional decision-making.

Pearson correlation and an exploratory multiple regression were used to examine preservice teachers’ profiles based on information obtained from multiple secondary data sources. The secondary sources utilized were the Bowling Green State University (BGSU) Assessment of Technology Competency (ATC), the ATC Retake Survey instrument that was

The BGSU ATC was administered to approximately 1100 preservice teachers during the 2004-2005 academic year. Preservice teachers who failed one or more sections of the ATC were given a retake opportunity to pass the failed section(s). The BGSU ATC Retake Survey was administered to approximately 450 BGSU Introduction to Education (EDHD 201) students during the 2004-2005 academic year. The results of this survey were utilized to identify preservice teachers by the district they graduated from and to determine the Ohio school districts being represented by this sample of students. In addition, the ATC Retake Survey results were to provide information about background technology use as indicated by responses related to access to computers at home, computer instruction at school, and estimated hours of computer time per week in high school.

The examination of factors that best predict student technology competency has significance for future teachers, university leaders, K-12 administrators, college faculty, and college faculty’s own students. Trends may be established for recognizing district characteristics regarding technology integration that contribute to preservice teacher technology competency. Challenges associated with preparing future teachers to be technology integrators will be minimized through identification of characteristics for technology competency.
This dissertation is dedicated to educators and researchers who work tirelessly to keep abreast of innovation in a constant state of change. To my husband and children who allowed me to live in two worlds throughout the duration of this lifelong learning experience. To my parents who taught me how to live and grow from change.
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CHAPTER I. INTRODUCTION

Educational reform took shape in the mid-20th century, most notably starting in the Sputnik era. During the 1980s “A Nation at Risk” was published and continued the emphasis to make educational reform a national priority. By the early 1990s, federal and state initiatives enacted investments in computer technology for the K-12 classrooms with the hopes that infusion of technology into classrooms would solve educational reform problems (Cuban, 2001; Morrison & Lowther, 2005). After decades of debate over the value of integrating technology into the classroom, nearly everyone agrees that students must have access to computers, video, and other technology in the classroom (Wise, 2001).

Initiatives such as Preparing Tomorrow’s Teachers to Use Technology (PT3), and No Child Left Behind (NCLB) have provided grant funding to help transform teacher preparation programs and teachers’ professional development to use technology for instructional purposes. However, the full potential of technology integration in the classroom is yet to be realized (U.S. Department of Education, 2004). According to Morrison and Lowther (2005), conceptions of how technology should be used versus how technology is being used is an explanation for minimal impact of technology on teaching and learning practices.

Despite the efforts of colleges of education and K-12 institutions to integrate technology into the classroom, breaking the cycle of low-level technology skills of teachers remains an issue. Colleges of education, state departments of education and professional associations have tried many approaches over time to standardize, improve, and professionalize teacher preparation as part of a solution for change (Office of Technology Assessment, 1995). For example, the National Council for the Accreditation of Teacher Education (NCATE) has developed a “Continuum of Teacher Preparation” that consists of quality-assurance measures in three phases
– preservice, extended clinical preparation and assessment, and continuing professional development (Office of Technology Assessment, 1995). However, teacher preparation does not necessarily begin when preservice teachers enter the college of education for their preservice program, nor does it end at the conclusion of their internship. The background experience students bring with them to teacher preparation programs greatly contribute to their understanding of their future roles as teachers, especially in the area of technology. As stated by Fulton, Glenn and Valdez (2004), “without a strong foundation in the knowledge and skills for using technology effectively, teacher candidates entering today’s schools will fall short of meeting the ‘highly qualified teacher’ expectations set out by the No Child Left Behind Act” (p. 1). Furthermore, Cuban (2001) claims, “students’ access to computers in American schools varies greatly by social class, race, and native language. Affluent, white, English-speaking students use computers more than their less affluent, nonwhite, nonnative-speaking peers” (p. xi).

Teacher preparation programs are being challenged to prepare future teachers to be technology integration professionals in the classroom. To meet program accreditation requirements, NCATE standards expect the use of technology to be central to teacher preparation in 2000 and beyond (NCATE, 1997). Research indicates that incoming education majors possess low levels of technology competency (Banister & Vannatta, 2006). Low technological literacy of preservice teachers entering teacher education programs creates a greater challenge for colleges of education to produce technology using teachers.

Rationale

As a result of the increasing student population and decreasing teacher population, the K-12 educational system must hire more than two million new teachers in the next decade (Milken,
1999). Nationally, colleges of education are being called upon to address the supply and demand issue of K-12 teachers and to prepare new teachers to become technology using teachers. However, numerous challenges exist for colleges of education to integrate technology into preservice education programs, such as the implementation of standards for technology, designing preservice teacher education curriculum that integrates technology, increasing faculty and preservice teacher technology skill levels, and time constraints (Glenn, 2004; Beasley & Wang, 2001; OTA, 1995; Vannatta, 2000).

New standards for teacher preparation program accreditation with NCATE include the use of technology for instruction and assessment, and have been recognized as a vital component of teacher preparation in the standards (NCATE, 1997). Initiatives such as NCATE, Preparing Tomorrow’s Teachers to Use Technology [PT3], and the International Society for Technology in Education [ISTE] seek to address the issue of preparing pre-service and in-service teachers to use technology. ISTE has defined technology standards for students (NETS-S), teachers (NETS-T), and educational administrators (TSSA) in order to further clarify conditions for using technology in the classroom. NCATE has fully adopted the NETS-T as a component of teacher education program accreditation requirements (Wise, 2001).

Incorporating technology into the teacher preparation program begins with thoughtful planning, purchase of equipment, faculty development, course modifications, and evaluation of levels of success in order to meet the accreditation standard set forth by NCATE (Vannatta, 2000). Teacher preparation institutions are focused on providing experiences for preservice teachers so they will learn to use technology and then meaningfully integrate those technologies into the learning process (Michelini, Versteeg & Schmidt, 2002). However, despite state level
initiatives to integrate technology for K-12 student learning, pre-service teachers are not well prepared for using technology in teacher preparation programs.

As stated in the report, Technology Counts, “schools have equipment, connectivity, technology standards, and licensure standards with technology. Efforts to put technology for students in place have been widespread for a number of years, but very few states test students on those standards” (Fox, 2005). Distinct from the mandate of NCLB to test the academic achievement of students prior to high school graduation (NCLB, 2002), there is no initiative or mandate that requires states to assess the level of technology skills of students prior to high school graduation. As a result, preservice teachers arrive with low technology skills that often need remediation to proceed with integration in a teacher preparation program.

The educational background of the [preservice] teacher is also a significant factor in shaping the use of computers in the classroom (Riel & Schwarz, 2002). Preservice teachers enter colleges of education from various educational background experiences and possess broad levels of technology competency. One major mid-western university has approached the challenge of broad levels of student technology competencies by implementing a mandatory technology skills assessment for all incoming teacher education majors (Banister & Vannatta, 2006).

The Assessment of Technology Competencies (ATC) is administered as a mandatory component of an introduction to education course typically accomplished in the first year of the teacher preparation program so that “students are expected to use various technologies throughout their general education courses during their first two years on campus,” according to Banister and Vannatta (2006, p. 4888). Preservice teacher education students also take an advanced technology integration course during their junior year that focuses on the use of technology to support academic content. Technologies can provide powerful tools for student
learning, but their value depends upon how effectively teachers use them to support instruction in the academic content areas (Fulton, Glenn, & Valdez, 2004). Therefore, it is imperative that students demonstrate basic computer skills upon their arrival at the university (Banister & Vannatta, 2006), in order to be successful throughout their preservice teacher education program.

With the present demands of standards-based school reform and technology integration into teacher preparation programs, college entrance requirements may need to be reconsidered. Entrance to a university baccalaureate program often depends on level of academic achievement based on assessments such as the American College Testing (ACT) exam. National college entrance examinations such as the ACT, “provide information helpful to colleges both in the process of admitting students and in ensuring their success after enrollment” (ACT, 2005). The ACT also assesses high school students' general educational development and their potential to accomplish college-level work (ACT, 2005). Unfortunately, there are no national examinations similar to ACT that provides universities with information about an incoming students’ technology skill level.

Yesterday’s students from traditional learning environments are graduating high school and now entering today’s workforce of 21st Century technological innovations. This graduating class includes people who aspire to become our future teachers. Today’s educational reform is based on a student-centered approach in an open-ended environment and is not usually supported by the more traditional uses of computer technology (Morrison & Lowther, 2005). Newer teachers in the field are generally familiar and comfortable with technology. However, their own experiences as students lack integration of technology, rather, the technology was not regularly integrated into the curriculum by their teachers (Russell, Bebell, & O’Dwyer, 2004). As reported by the U.S. Department of Education (2004), 33% of the current generation of students will
pursue careers as teachers. Since standards-based reform is relatively new, the generation of high school graduates who enter college to become teachers will be challenged to adapt to a teacher preparation environment that is quite different from their previous experience as a student. While students of the millennial generation experience challenges with adapting to the standards-based climate upon entering the teacher preparation program, not all students entering colleges of education possess similar experiences with technology.

Research suggests that the demographic profile of the school district impacts student level of technology competency. Only 60% of classrooms in low-income communities were connected to the Internet during the 2000-01 academic year, as opposed to 82% of classrooms in more affluent communities (National Education Association, 2004). Furthermore, the disadvantages of inequitable access to technology in schools and classrooms are compounded by the fact that students with limited access to technology in school are also likely to have limited access to computers and the Internet at home (National Education Association, 2004). Therefore, the possibility exists that students who come from classrooms in low-income communities will possess lower levels of technology competency than students who come from classrooms in wealthier school districts.

School district demographics may have implications for the turnover rate of newly trained teachers to replace teachers who are retiring. Research findings indicate there is a positive relationship between district affluence and technology integration (Riel & Schwarz, 2002). In addition, there is evidence that suggests socioeconomic background contributes to students’ ability to use technology (Riel & Schwarz, 2002). The number of years of teaching is one variable believed to influence technology use in the classroom (Russell, Bebell, O’Dwyer, O’Connor, 2003). For instance newer graduates of teacher preparation programs are more
comfortable with using technology than more experienced teachers. Additional factors that are linked to technology use in the classroom include: access to technology, level of technology support available, and beliefs about using technology for learning. Teacher beliefs about the importance of technology for teaching is the strongest predictor of delivery in the classroom and teacher-directed student use (Russell, Bebell, Dwyer & O’Connor, 2003).

As colleges of education move forward with integrating technology into teacher preparation programs, a need exists to recognize the characteristics of the students’ backgrounds that contribute to their ability to perform basic technology competencies. Identifying characteristics of student experience with technology that predict technology competency will assist colleges of education with further understanding the level of technology integration and K-12 district status of implementing data-management systems for instructional decision-making.

Purpose of the Study

The primary purpose of this study was to predict incoming teacher education students’ technology competency by examining factors that contribute to their background technology experience. Factors include the following: socioeconomic status of the school district from where they graduated, district demographics related to teachers’ average number of years teaching, teachers’ average number of hours of professional development with technology, and student background experiences with technology based on uses at school and home.

Pearson correlation and an exploratory multiple regression were used to examine preservice teachers’ profiles based on information obtained from multiple secondary data sources. The secondary sources utilized were the Bowling Green State University (BGSU) Assessment of Technology Competency (ATC), the ATC Retake Survey instrument that was administered to preservice teachers during the academic year 2004-2005, the Ohio Department

The BGSU ATC was administered to approximately 1,100 preservice teachers during the 2004-2005 academic year. Preservice teachers who failed one or more sections of the ATC were given a retake opportunity to pass the failed section(s). The BGSU ATC Retake Survey was administered to approximately 450 BGSU Introduction to Education (EDHD 201) students during the 2004-2005 academic year. The instrument collects information about preservice teacher background experiences with technology at home and school. The results of this survey were utilized to identify preservice teachers by the district they graduated from and to determine the Ohio school districts being represented by this sample of students. In addition, the ATC Retake Survey results were to provide information about background technology use as indicated by responses related to access to computers at home, computer instruction at school, and estimated hours of computer time per week in high school.

Another secondary data source that was utilized to gather information about preservice teacher technology background and district affluence is hosted by the Ohio Department of Education (ODE). The ODE Similar District report is based on several categories including district average daily membership (ADM), district percent poverty level, and median income. Data were collected using the population of preservice teachers who had met the following criteria: graduate of an Ohio high school during the academic year 2003-2004, enrolled at BGSU EDHD 201 Introduction to Education during Fall, 2004 or Spring, 2005 semesters, failed one or more sections of the ATC, and had consented to complete the ATC Retake Survey.
A third data source for obtaining information about preservice teacher background experience with technology was the Ohio SchoolNet (OSN) Biennial Education Technology Assessment (BETA) district level teacher survey. Once every two years OSN, the state agency legislatively charged with administering Ohio’s educational technology programs, administers a battery of surveys to gather information about technology use and access (Ohio SchoolNet Commission, 2004). The purpose of the BETA is to help guide state policy on K-12 educational technology, help identify trends across the state with regard to technology implementation and use and help align funding and human resources to address areas in need of improvement (Rogers, Borkan, & Fox, 2004). The BETA survey data from the period 2003-2005 provided information about district uses of technology resources with respect to teachers’ average number of years experience and teachers’ average number of hours of professional development opportunities with technology. The BETA 2003-2005 survey encompassed the graduating year of the preservice teacher population who had met the aforementioned study criteria and will contributed to the background profile of individual preservice teacher records.

Significance of the Study

The examination of factors that best predict student technology competency has significance for future teachers, university leaders, K-12 administrators, college faculty, and college faculty’s own students. Trends may be established for recognizing district characteristics regarding technology integration that contribute to preservice teacher technology competency. Challenges associated with preparing future teachers to be technology integrators will be minimized through identification of characteristics for technology competency.

Results of this study may also be used to foster the relationship between K-12 and higher education institutions in support of the PK-16 educational reform movement. College faculty
may utilize this information to model student-centered learning experiences that are similar to those their preservice teachers may encounter in the field with future students. Technology use in K-12 classrooms increases if preservice teachers use technology in their own learning, for example in preservice course assignments and activities (Cradler, Freeman, Cradler & McNabb, 2002; Goldberg & Sherwood, 1983; Willis & Raines, 2001).

Information from this study may further contribute to the PK-16 relationship among educational institutions by providing district administrators with a common understanding of the expectations for technology integration that preservice teachers are required to accomplish as they complete their student teaching internship. NCATE accreditation requires the higher education and K-12 faculty to collaboratively design and implement the preservice education program for teacher candidates (Wise, 2001). Results of this study may be used to determine specific areas of focus for teacher professional development with technology and allocation of funding to support technology integration.

Definitions of Terms

*Assessment of Technology Competency (ATC)* – A custom-designed performance-based instrument used by BGSU College of Education to measure student technology skills.

*Background Experience* - Learning experiences that are accomplished outside of the K-12 setting.

*Higher Education* – Higher education institutions, for the purpose of this study, are four year institutions granting bachelors, masters and doctoral degrees.

*Millennials* – The generation of people who were born between 1981-1999.

*Preservice Teacher* – A person who is enrolled at BGSU in a teacher education program (i.e Early Childhood, Middle Childhood, adolescent/youth adult, special education).
Student – A person who is receiving an education in a K-12 environment.

Teacher – An educator who is employed by a K-12 school district in the role of teacher.

Technology - Solid state circuits, miniaturization, robotics, communication, software, new ways to do things via computers, latest state-of-the-art processes, computer hardware, software skills needed to have a competitive edge, applications of computers, computer-based information (Rothwell & Kolb, 1999).

Technology Competency – Technology competency describes the fundamental skills that are essential for first-year preservice teachers. Preservice teacher technology competency, for the purpose of this study, is demonstrated through the production of three digital products that are designed based on pre-defined instructions that support teacher preparation standards for technology integration. Assessment of student technology competency is accomplished using the BGSU Assessment of Technology Competency (ATC) instrument.

Technology Integration - For the purpose of this study, technology integration means to use technology tools to synergize knowledge as part of a learning experience.

Research Questions

1. What is the relationship between preservice teacher technology competency and K-12 district socioeconomic status, K-12 teacher number of years teaching experience, K-12 teacher average number of hours of professional development in the area of technology, and preservice teacher background experiences with technology?

2. Which factors (socioeconomic status, K-12 teacher number of years teaching experience, K-12 teacher average number of hours of professional development in the area of technology, and preservice teacher background experiences) best predict technology competency of preservice teachers?
3. Are there group differences in technology competency with respect to: Preservice teachers’ completion of a high school computer class, number of hours per week, district median household income (above or below state media), district location (rural, urban, suburban)?
CHAPTER II. REVIEW OF RELATED LITERATURE

Throughout the 1980s and 1990s, the nation reached consensus that American education must be transformed to meet the needs of an emerging information society (National Council for Accreditation of Teacher Education [NCATE], 1997). Nationally, colleges of education are transforming teacher preparation programs to meet the demands of educational reform through standards-based initiatives such as the No Child Left Behind Act (NCLB). Educators are relentlessly confronted by a call to integrate technology into teaching and learning from the media, accrediting organizations, professional associations, teachers, administrators, state and federal departments of education, and parents (Education Week, 1999; International Society for Technology in Education [ISTE], 2000a). Specifically colleges and universities are being called upon to lead the way for transformation.

Across the country, students are entering colleges of education with low levels of technology skills (Banister & Vannatta, 2006; Cunningham, 2004; Harnisch, 2002). The low level of technology skills of preservice teachers impacts the transformation process significantly. As universities have updated curriculum to infuse technology into teacher preparation programs, issues such as range of preservice teacher technology skill levels and the need to facilitate skill development have restricted faculty from modeling integration strategies (Banister & Vannatta, 2006). During the transformation process, revisions and adaptations to the plan are necessary (Kotter, 1999) and expected with respect to implementing technology into the teacher preparation program. One such adaptation is the implementation of preservice teacher technology competency assessment instruments.

Minimal research is available in the area of technology competency among preservice teachers. While the transformation process evolves, colleges of education are approaching new
horizons as they implement new methods and identify obstacles (Kotter, 1999) of preparing the future workforce of technology integrating teachers. Low level of preservice teacher technology competency is an example of an obstacle in the process of transformation. The evaluation of factors that predict preservice teacher technology competency will inform the transformation process for technology integration into teacher preparation programs.

The literature review of factors predicting preservice teacher technology competency begins with addressing advances in technology and the millennial student. Analysis of the areas of student technology experiences with entertainment, communication, and educational technology uses is explored. Student educational technology experiences are examined through research of the millennial learning environment and teachers and technology integration practices in the classroom. Issues related to socioeconomic status and accessibility further illustrate the complexity of predicting preservice teacher technology competency.

Advances in Technology

In the information age the demand for manual skills is declining. According to the U.S. Bureau of Labor Statistics, the share of manufacturing jobs versus the total number of jobs was expected to decline from 13% in 2000, to 11% in 2001 (as cited in Carew, 2004). As recently as 1970, more than one-half of employed United States adults worked in two occupational categories: blue collar jobs and clerical jobs (Levy & Murnane, 2004). Today, less than 40% of adults have blue-collar or clerical jobs and many of these jobs require at least some college education (Levy & Murnane, 2004). According to Levy and Murnane (2004), the computerization of work has played a significant role in this change. Routine tasks such as those of clerical workers are based on sets of rules that can be programmed into computers. In addition, part of the explanation for the shift in the educational requirements of clerical and blue
collar jobs is the level of expert thinking required to automate tasks that were in the past completed manually by humans. Automation has replaced repetitious tasks, but effective pattern matching based on detailed knowledge (Levy & Murnane, 2004), for example, is a task that must be completed by humans with expert thinking skills.

With the rapid change in workforce needs, educational institutions must fill the nation’s labor force with workers that can meet the demands of our information economy (Carew, 2004). Educators, government and industry leaders are working together to help reform education to assure that a basic level of digital literacy is acquired by today’s students (Carew, 2004) to support the needs of the future labor market. Learning skills that utilize 21st Century tools are described as information/communication skills and thinking/problem-solving skills (Carew, 2004), but may not be specific to computers, software, networking or media tools.

Organizations such as the North Central Regional Education Laboratory (NCREL) and International Technology Education Association (ITEA) have identified 21st century skills, learning skills, and interpersonal skills that describe digital literacy. NCREL (2001) designates 21st century technology skills which include aspects of digital literacy, inventive thinking, effective communication, teamwork, and the ability to create high quality products.

According to NCREL (2001), digital literacy skills are described as basic, scientific, and technological literacy; visual and information literacy; cultural literacy and global awareness. Inventive thinking skills include adaptability and managing complexity. Effective communication skills are described as curiosity, creativity, and risk taking as well as higher order thinking and sound reasoning abilities. Teamwork, collaboration, and interpersonal skills linked with personal and social responsibility and interactive communication comprise the teaming skills aspect of digital literacy. The ability to create high quality products, prioritize and plan,
manage for results and the effective use of real world tools make up the final aspect of digital literacy skills (North Central Regional Education Laboratory [NCREL], 2001).

The ITEA standards for technological literacy (STL) evolve around concepts such as the nature of technology, technology and society, design, abilities for a technological world, and the designed world (International Technology Education Association [ITEA], 2000). The content standards in STL articulate what needs to be taught in K–12 laboratory-classrooms to enable all students to develop technological literacy. Technological literacy is the ability to use, manage, understand, and assess technology and is not meant to be a specific area of study. Rather, it identifies content for the study of technology - what students should know, demonstrate, and understand throughout Grades K–12 (International Technology Education Association [ITEA], 2000). As consumers of technology, people tend not to be aware of the developmental aspects of how technology came to be. The ITEA agenda focuses on the education of children to comprehend the development of technologies and possess skills to promote future technologies to support the future generations of education and the labor market. Unlike past generations and because of rapid advances in technology, students are being educated for jobs that are not in existence today.

The Millennial Student

For the first time in history, four separate and distinct generations have evolved that work shoulder-to-shoulder and face-to-face in a stressful, competitive workplace (Lancaster & Stillman, 2002). The four generations are traditionalists (1900-1945), baby boomers (1946-1964), generation Xers (1965-1980), and millennials (1981-1999). The millennial generation is a focal point of this study because of the upbringing which evolves around changes with technology and educational reform, and prior generations struggle to relate to those experiences.
Millennials were born at a time of great wealth and prosperity, soccer moms, kid-centered politics and movements such as high-stakes testing, accountability, and curriculum reform (Howe & Strauss, 2000).

The first millennials were almost one year old when the need for education reform became apparent through the 1983 “Nation at Risk” report (Howe & Strauss, 2000). By the time the first millennials were in second grade, the first National Education Summit was held and “Goals 2000” was established to make the newly minted graduating class of 2000 number one in the world in math and science (Howe & Strauss, 2000). The oldest of the millennial generation are now in college and are showing signs of being “the next great generation” (Howe & Strauss, 2000). Examples of people from the millennial generation are Tara Lipinski, Prince William, and Chelsea Clinton.

Millennial students have never known life without computers and the Internet, and they regard technology as an assumed part of life (Frand, 2000). People from earlier generations see childhood from a completely different lens. Margaret Mead (1970) uses the term prefigurative to describe the phenomena of the generation gap. Mead (1970) explains, “because all the peoples of the world are part of one electronically based, intercommunicating network, young people everywhere share a kind of experience that none of the elders ever have had or will have” (p. 50).

Students’ experiences with technology include entertainment, communication, and education and greatly contribute to their knowledge of functioning in a digital world. Many students carry multiple electronic devices and use various communication protocols to remain connected to friends, events, and information (Oblinger, 2003). Prior generations such as Baby Boomers, were raised during the time in history when telephones, television and transistor radios were the cutting edge of technology (Lancaster & Stillman, 2002). The NCREL digital literacy
standards and the ITEA standards of technological literacy of today are seamlessly part of the millennial lifestyle by virtue of the environment in which they live. In comparison to earlier generations, cutting edge innovations of their time, such as telephones and television, were rarely considered for use in education until the mid-sixties when the baby boomers were young adults (Lancaster & Stillman, 2002).

A growing body of evidence reveals that today’s college and university students (young adults), also known as millennials, have developed new attitudes and aptitudes as a result of their environment (Oblinger, 2003). As cited in Ray (2002), Bill Gates believes that children are different today and advises educators to embrace change and let technology make the classroom a more habitable learning environment. The experiences of our students—their ways of learning, communicating, and engaging in the communities and world in which they live—are dramatically different from those of prior generations. The resulting challenges of preparing teachers to teach Millennial students and go beyond current educational standards assessments and practices to prepare children for the lives they lead in the 21st century are easy to state but hard to meet (Kleiman, 2004). While students are consumers of 21st century technology, there are misconceptions about technology in the classroom for learning. Technology is used primarily for entertainment and communication, not education.

Experiences with Entertainment and Communication Technologies

Millennials are regularly engaged with technology for entertainment and communication purposes. NetDay is a national survey project that was conducted via the Internet on the use of computers and Internet by students and teachers for the purpose of obtaining data related to teaching and learning with the Internet. One of the major themes revealed through the study conducted by NetDay (2003) was today’s students are very technology savvy, feel very strongly
about the positive value of technology and rely upon technology as an essential and preferred component of every aspect of their lives. As they matured, millennials were using technology for entertainment by engaging in video games such as Nintendo. Now young adults, most millennials are equipped with the latest technical devices such as cell phones, MP3 players, and home computers with high-speed Internet connections.

The typical use of the computer at home by a millennial includes activities such as communicating with friends and family (via email, instant messaging and chat rooms), entertainment (surfing the web for fun, visiting entertainment sites, playing or downloading games, and listening to music online or downloading music), learning things largely unrelated to school (hobbies, getting the news, researching a product or service before purchasing), and exploring other online interactive or transaction features such as visiting sites for trading and selling things, buying something online, or creating a web page (Levin & Arafeh, 2002). Moreover, students do a variety of activities online that mirror their daily lives including getting directions, checking on sports team schedules, visiting college websites, sending invitations, buying movie tickets, going to online museums and learning about community service projects (NetDay, 2003). Access to information is central to the life of a millennial.

Equally as important to being informed is maintaining contact with peers and parents. Among teens, instant messaging and e-mail seem to be natural communication and socialization mechanisms (Oblinger, 2003). The world of the millennial has evolved around using forms of technology for managing routine tasks in life such as reading the news and communicating with friends. Access to information has also inspired the use of the Internet for assistance in completing homework assignments and projects for school. Unfortunately, a misperception of the use of technology for teaching and learning exists (Banister & Ross, 2006).
Experiences with Educational Technology

According to the National Center for Education Statistics (NCES) (2002) one of the most common activities students perform online is schoolwork. In a study of how children ages twelve to seventeen use the Web, of the population of children surveyed, researchers found that 94% percent use the Internet for school research and that 78% believe the Internet helps them with schoolwork (Oblinger, 2003). The use of the web to support schoolwork suggests that students are pursuing additional information to support their learning.

A study conducted by NetDay (2003) found that students were surveyed on their uses of the Internet in the school learning environment. The survey indicates students find new technology devices and Internet sites outside of the formal learning environment from friends, parents and through personal online exploration, rather than from a class or a teacher recommendation (NetDay, 2003). Despite students’ claims of increased access to and use of the Internet for schoolwork, their use of technology is not typical of the way they use technology in the school learning environment.

Throughout the 1990s, the emphasis of technology in school was placed on acquisition of hardware, installation of software, and configuring networks into the classroom to support technology integrated learning experiences for students while teachers tried to incorporate various forms of digital content, such as Web sites, CD-ROMs, and videos, into instruction. The need arose for vision and description of what students should be able to do with technology throughout their K-12 careers. Therefore, the International Society for Technology in Education (ISTE) established standards and criteria that clarified how technology supports the teaching and learning process (ISTE, 2000a). Research about students’ use of computer at school, as reported by Education Week Market Data Retrieval (as cited in CEO Forum, 2001), indicates that a large
percentage of students are using computers to support schoolwork, such as research and homework assignments, rather than classroom integration practices, for example construction of multimedia presentations or collaborative problem-solving activities and student-centered learning experiences that could be facilitated during the school day (Figure 1). Computers are being utilized for activities related to schoolwork, although not necessarily during school to support teaching and learning. Typical classroom learning experiences are developed by teachers to meet specific objectives of the curriculum and often times contained within the four walls of the classroom. To provide technology-rich learning experiences for students, teachers are often faced with challenges such as obtaining professional development, technology support, and determining effective practices for teaching and learning.

![Student Use of Computers at School](image)

**Figure 1.** Student Use of Computers at School

*Note.* “MDR Interactive Poll of K-12 Students and Technology” by Education Week (2001). Adapted with permission of the author.
The Millennial Learning Environment

Similar to NCREL and ITEA efforts of defining digital literacy and technological literacy skills for students, ISTE defined the national education technology standards for students (NETs*S), teachers (NETs*T), and technology standards for school administrators (TSSA) in the uses of technology for learning (ISTE 1999, 2000a, 2000b). The NETs*S further defines six basic operations of using technology for learning for educators to use as guidelines for what students should be doing with technology in school (Appendix A). In addition, the NETs*T defines six basic operations of teachers to be able to facilitate technology integrated learning experiences for students (Appendix B). The leadership and vision component to support the use of technology for teaching and learning are defined through the Technology Standards for School Administrators (TSSA) and comprise a set of essential conditions that must be met for the successful implementation of technology into the teaching and learning environment (ISTE, 2000b).

Certain conditions must be in place before education technology transforms teaching and learning in the creative ways that improve student achievement (CEO Forum, 2001). As further indicated by ISTE (2000b), essential conditions contribute to the successful implementation of technology into the learning environment in addition to optimizing the benefits of technology in learning, teaching, and school operations. Among the essential conditions are skilled personnel in the use of technology and professional development for leaders, teachers, and support personnel (ISTE, 2000b). Also, technical assistance for maintaining technology systems and support policies must be in place for district operation purposes such as financial planning and incentive structures (ISTE, 2000b).
In order to ensure that an effective education technology system is in place, schools and districts must: provide sufficient and ongoing professional development for educators; fund education technology and ensure adequate technology infrastructure with flexibility for updates and reliable technical support; offer equitable availability of high quality courseware and digital content; and, provide local community and school leadership for the integration of technology into the curriculum (CEO Forum, 2001).

As reported by Education Week (2005), at the state level, 49 of the 51 states have adopted, adapted, aligned with, or referenced at least one set of standards in their state technology plans, certification, licensure, curriculum plans, assessment plans, or other official state documents. Superficially, the status of our nation seems favorable towards supporting technology integration through the adoption of the ISTE standards. Closer examination of the status of adoption, adaptation or alignment reveals that less than 50% of the nation has embraced all three sets of standards. Specifically, twelve states have left the teacher standards completely unrecognized. Upon further research of related facts, for example, only ten states have policies that require technology training or participation in technology related professional development for recertification of teachers (Education Week, 2005). Teacher professional development for technology integration plays a critical role in the use of technology for teaching and learning practices with students during the school day.

*Teachers and Technology Integration in the Classroom*

The Office of Technology Assessment (OTA) published a report on teachers and technology and the issues surrounding the educational uses for technology in the classroom. As of 1995, despite technologies available in schools, a substantial number of teachers report little or no use of computers for instruction (Office of Technology Assessment, 1995). According to
Cuban (2001), a technological revolution in teaching and learning has not occurred in the vast majority of American classrooms. Teachers have been infrequent and limited users of the new technologies for classroom instruction (Cuban, 2001). Cuban (2001) argues that despite the widespread use of computers by teachers outside of the classroom, instructional practices and school culture have not incorporated computer-based technologies into regular instructional practices.

Teachers’ attitudes and viewpoints on the role of technology and the Internet in education have dramatically changed in the past couple of years (NetDay, 2004). Results of the NetDay survey of 2001 indicate over nine out of ten (94%) teachers said they are comfortable using computers and 87% are comfortable using the Internet (NetDay 2001). Geographically, urban teachers are more comfortable using computers – 65% are very comfortable compared to 54% of suburban and 54% of rural teachers. The majority of teachers believe that the Internet has become important to teaching in the past two years – 48% feel that it has become very important. Despite the high comfort levels and strong positive attitudes, 67% of the teachers acknowledge that the Internet is not well integrated into their classroom (NetDay, 2001).

The National Center for Education Statistics (NCES) conducted a survey of teacher use of computers or the Internet at school (U.S. Department of Education, 2000). The population of teachers represented in this study shows that a large percentage of teachers are using computers for administrative duties and a very small percentage show the use of computers for multimedia classroom presentations (Figure 2). Further investigation of the use of computers by teachers confirms that the Internet is being used by teachers significantly more than originally believed.
The NetDay study conducted in 2001 indicates that teachers primarily use the Internet as a research tool. Over half of teachers (55%) turn to the Internet as a research or information gathering tool for lessons and 58% of teachers said that the Internet has helped them reach their research and resource goals. NetDay (2001) study revealed over two-thirds (67%) of teachers said that the Internet is a good resource and moderately helpful, but changes in the way they teach have not occurred. Integration of technology into the classroom comes with experience and professional development opportunities of the teacher to redesign instructional practices. The number of years teaching experience and amount of professional development are factors that contribute to teachers’ ability to integrate technology into the learning environment.

Figure 2. Teacher Use of Computers or the Internet at School

Number of years teaching experience.

The Use, Support, and Effect of Instructional Technology (USEIT) study was conducted for the purpose of determining teacher confidence with using technology (Russell, Bebell, O’Dwyer & O’Connor, 2003). The results of the USEIT study indicates that teachers with 5 or fewer years experience are significantly more confident using technology than are teachers who entered the profession 6 to 15 years ago or more than 15 years ago (Russell, Bebell, O’Dwyer & O’Connor, 2003). However, based on further research with the USEIT study, the belief that higher level of comfort translates to increased instructional use in the classroom is not true.

According to NCES (U.S. Department of Education, 2000), teachers with fewer years of teaching experience and those with more hours of professional development felt better prepared to use computers and the Internet for classroom instruction. Teachers without recent professional development were more likely to report feeling not at all prepared to use computers and the Internet in classrooms than teachers who had received one or more hours of professional development (U.S. Department of Education, 2000).

Technology training and professional development.

Well-trained teachers are essential for creating sophisticated digital learning environments. Of teachers who received eleven or more hours of training on the topic of integrating technology into the curriculum in the previous year, 48% say that they rely on software, digital content, and the Internet to a “very great” or “moderate” extent (CEO Forum, 2001). According to NCES (U.S. Department of Education, 2000), teachers with more professional development in the use of computers and the Internet over the last three years were more likely to assign students various types of work involving computers or the Internet. For example, teachers with more than 32 hours of professional development were more likely to
conduct problem solving learning experiences (41%) than were teachers with zero hours (14%) or those with one to eight hours (24%) (Table 3).

A surprising discovery was made by Bell South (2001) when a program was conducted to focus on teacher professional development and how teachers’ experiences could best be applied in the technology use of students for engaged learning. Despite the strong efforts of the project and the significantly improved technology skills of the teachers, students reported that barriers to technology integration in the classroom still exist. Upon further examination of the results of the study, Bell South (2000) realized vast differences between student and teacher perceptions of instructional technology practices.

As reported in a study conducted by the National Education Association (NEA), *Survey of Educational Technologies in U.S. Schools* (2004), training on using technology was not adequate to prepare most instructional staff to use technology for instruction. In addition, educators increased their use of technology for sharing information with colleagues, but few educators found opportunities to integrate technology into other instructional activities (National Education Association, 2004). Of the few teachers who attempted to integrate technology into instruction, some used it to vary instructional delivery; these educators were more likely to be working in secondary or low-poverty schools (National Education Association, 2004). Others used technology to reinforce student skills through drill and practice. These educators were more likely to be working in elementary or high-poverty schools (National Education Association, 2004). Moreover, the NEA study found that gains took place in training staff on using technology although few opportunities to learn about instructional technology uses occurred (National Education Association, 2004).
Table 1

*Teacher Use of Technology by Type of Training Received*

<table>
<thead>
<tr>
<th>Teacher Use of Technology by Type of Training Received</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No training</strong></td>
</tr>
<tr>
<td>Use to a moderate extent</td>
</tr>
<tr>
<td>Use to a very great extent</td>
</tr>
<tr>
<td><strong>Basic technology skills</strong></td>
</tr>
<tr>
<td>Use to a moderate extent</td>
</tr>
<tr>
<td>Use to a very great extent</td>
</tr>
<tr>
<td><strong>Curriculum integration</strong></td>
</tr>
<tr>
<td>Use to a moderate extent</td>
</tr>
<tr>
<td>Use to a very great extent</td>
</tr>
<tr>
<td><strong>Both basic skills and Curriculum Integration</strong></td>
</tr>
<tr>
<td>Use to a moderate extent</td>
</tr>
<tr>
<td>Use to a very great extent</td>
</tr>
</tbody>
</table>


The NEA study (2004) indicates the impact of technology on direct instruction is varied by school poverty level. Instructional staff in high-poverty schools used technology to reinforce student skills through drill and practice (73.8%) compared with those in low poverty schools (67.5%). Educators in high-poverty schools were more likely to use technology to improve variation in instructional delivery (72%) compared with staff in low-poverty schools (64%). In each case, low levels of technology integration is connected to lack of teacher professional development related to technology (NEA, 2004).
According to the NCES report *Teachers' Tools for the 21st Century: A Report on Teachers’ Use of Technology*, teachers in schools with high poverty enrollments were generally less likely to use computers or the Internet for instruction during class time than teachers in schools with low poverty enrollment in 1999 (U.S. Department of Education, 2000). This gap existed despite the fact that nearly all public schools had access to the Internet, regardless of poverty level (Williams, 2000). Moreover, classroom-level access to the Internet and support in the form of training and assistance are important factors in instructional use of the Internet during class time (U.S. Department of Education, 2000).

*Classroom Accessibility and Socioeconomic Status*

While students report the use of the Internet as a support mechanism for schoolwork, accessibility during the school day remains an issue. A great deal of technology lies unused in schools. The computers and wires may be there, but the plans to put them to good educational use, the preparation necessary for the teachers to use them well, and the support needed to ensure that they will work when needed are lacking (Kleiman, 2004). Socioeconomic status of school districts contributes to the issue of inequitable access to the Internet for learning in the classroom.

According to NCES (U.S. Department of Education, 2000), teachers in schools with high enrollment of poor students were less likely to report classroom Internet access and the availability of training and assistance in the use of the Internet. Prior to the year 1996, technologically speaking, obtaining access to the Internet in school was a problem due to lack of infrastructure and expense. The Telecommunications Act that passed in 1996 created the E-rate program and provided discounts of 20%-90% to schools (depending on the number of low wealth children in the district) to purchase Internet access for the school or library (Levin &
Arafeh, 2002). According to the U.S. Department of Education (2000), as of the beginning of academic year 2000-01, 98% of public schools had access to the Internet, as did 77% of individual classrooms. Though, the number of individual classrooms drops to 60% for schools with the highest concentrations of poverty (Levin & Arafeh, 2002). Research concludes that a substantial disconnect exists between how students use technology for school and how they use the technology during the school day and under teacher direction (Levin & Arafeh, 2002). Therefore, inequitable access to the Internet and computers remains an issue.

The disadvantages of inequitable access to technology in schools and classrooms are compounded by the fact that students with limited access to technology in school are less likely to have access to computers and the Internet at home (National Education Association, 2004). As stated by Levin and Arafeh (2002), surveys suggest that school is often the place where children of single-parents and those from low-income families have their primary access to the Internet. The term “digital divide” has traditionally described inequalities in access to computers and the Internet between groups of people based on one or more social or cultural identifiers (Gorski, 2002).

Researchers often equate the digital divide to comparing rates of physical access to technology across individuals or schools based on race, gender, socioeconomic status, education level, disability status, and first or primary language (Gorski, 2005). Furthermore, studies indicate that even when access to technology and connectivity exists, students may have unequal learning experiences (CEO Forum, 2001), associated with instructional design. Studies show that teachers in low-income schools are less likely than their peers at high-income schools to have computers and Internet in their classrooms, and thus less likely to develop comfort, competence, and confidence with technology (Clark & Gorski, 2002). In addition, many teachers in poorer
schools rely on technology to reinforce basic skills, rather than to support higher-order thinking and the full range of 21st century skills (CEO Forum, 2001). Therefore, students of low-income schools do not have access to the same quality of learning experiences with technology during the school day as their higher-income counterparts.

Additional reasons for disparity between school uses and home uses of computers are tied to the ways that schools and teachers are oriented towards the Internet, their inability in many instances to integrate online tools into schooling, and the real and perceived barriers students face as they seek Internet access (Levin & Arafeh, 2002). For example, the decision to make an assignment involving use of the Internet is influenced by many factors including the ease of in-school access, the school’s orientation toward the use of the Internet, a teacher’s Internet skills and knowledge, and a teacher’s sense of whether students have home access to the Internet or not (Levin & Arafeh, 2002). The teacher is the center of instructional decisions in the classroom and must be comfortable with facilitating uses of technology for learning. The classroom is a place where teachers are in control of the learning experiences for students. Computers continue to be used in ways that are peripheral, rather than central, to the curriculum and important learning goals. Despite the progress that has been made in equity of access to technology in schools, serious inequities remain in terms of ways those computers are used in classrooms and the preparation of teachers to use them effectively (Kleiman, 2004). What is now known about learning provides important guidelines for uses of technology that can help students and teachers develop the competencies needed for the twenty-first century (Bransford, Brown, & Cocking, 1999). Students are independently finding ways to use 21st century technology to engage in the process of learning.
Regardless of what technology is being used or where students are using technology, engagement through digital mediums is occurring and students are learning. The challenge for educators is to channel student engagement efforts into the structured learning environment where learning through technology and skills for managing information are modeled. The implications of students’ background learning experiences utilizing technology could potentially have long term effects on their ability to succeed in their future workplace or pursuits of earning a college degree.

The Future for Millennials

Graduating high school seniors of today are faced with deciding the best options for preparing for their future. Options for career development beyond high school include four year colleges, two-year colleges, trade schools, or the choice of no post-graduate education. The types of jobs that require a minimum four year college education include teachers, ministers, doctors, engineers, and other white-collar jobs and are referred to as professional occupations (Tapscott, 1998). Occupations that are categorized as blue collar include skilled craftsmen, assembly line workers, day laborers, and similar workers, most of whom are employed in industrial settings and have not completed college (Tapscott, 1998). Service workers are also in the category of occupations that do not require a college degree, such as janitors, cafeteria servers and waiters, firemen, childcare workers, and others who deal with people face to face (Tapscott, 1998).

As cited in Riel and Schwarz (2002), computer skills and Internet access are increasingly required for participation in learning opportunities (Dede, 1998), and are baseline requirements for employment (Rifkin, 2000). A study conducted by Levy and Murnane (2004), examines occupational trends that occurred between 1969 and 1999 when computers entered the economy. The main purpose of the study was to discover the ways in which computers have changed
occupations and to determine if computers have replaced the occupational structure as predicted. The results of this study indicate an increase in the number of service workers from 11.6% in 1969 to 13.9% in 1999, a decline in blue collar workers and administrative support workers collectively making up 56% of adult workers in 1969 falling to 39% of adult workers in 1999 (Levy & Murnane, 2004). In addition, the study found that technical positions and professional occupations such as engineers, teachers, scientists, and lawyers increased (Levy & Murnane, 2004). An explanation for the increase in number of service workers and decrease in blue collar workers is the out-sourcing of work to other countries where labor is cheaper (Friedman, 2005). Also, the study findings are consistent with predictions that computers would replace humans in the workforce with the exception of the service worker occupation. With the increase of technical positions and professional occupations, and the increased level of technological skills to support these positions, schools must prepare millennial students to support this demand.

The Horatio Alger Association (Achieve, 2004) conducted a study for the United States Department of Education researching characteristics of the millennial population. In response to inquiry about their future careers, 49% of millennials say they may be interested in pursuing a career in technology, 47% in business, 41% in medicine, 35% in law, 34% in entertainment and 33% in teaching. The population of millennials who aspire to become teachers is of concern when considering they have not been well prepared to use technology in the learning environment and how they will use technology in their future role as teachers.

Employers report that a majority of high school graduates are inadequately prepared to succeed in an increasingly competitive economy (Achieve, 2004) regardless of their future aspirations. According to research conducted by Achieve (2004), 30% of college freshmen are immediately placed into remedial courses that cover material they should have learned in high
school. In addition, only 32% of students who enter 9th grade and graduate four years later have mastered basic literacy skills and have completed the coursework necessary to succeed in a four-year college (Achieve, 2004).

Technology and the Preparation of New Teachers

The need to prepare new teachers to use technology effectively has received attention in state certification standards for teachers, in accreditation standards for colleges of education (COEs), and in various efforts to reform and upgrade teacher education (Office of Technology Assessment, 1995). Several groups, such as the American Council on Education (American Council on Education, 1999), the CEO Forum of Educational Technology (1999), the International Society for Technology in Education (ISTE, 1999), and the National Council for Accreditation of Teacher Education (NCATE, 1997), have reported that schools of education are not adequately preparing preservice teachers to effectively integrate technology in their future classrooms.

As cited by Gibson and Halverson (2004), preservice teachers need to seek ways to connect student learning with their teaching and make the changes necessary to aid student achievement (Girod & Schalock, 2002; Milman, 1997). At the same time, teachers need to develop more effective ways to employ technology for higher order thinking and equitable achievement by all students. Thus, teacher education programs need to prepare future teachers for the increasing diversity of learners as well as the sophistication of technology so that they will be technologically as well as conceptually equipped to help all students learn (Gibson & Halverson, 2004). However, several challenges exist with preparing students to become technology using teachers.
Challenges Facing Colleges of Education

Numerous conditions impact the successful integration of technology into preservice teacher education programs. Faculty professional development, continuous evolution of digital technologies, equipment, and systemic change are conditions that play an important role in the process of preparing technology using teachers to support 21st century learning environments. Research indicates that most faculty lack the skills and knowledge to model technology uses and/or teach their students how to effectively infuse technology into the learning environment. (Fabry & Higgs, 1997; Office of Technology Assessment, 1995). Much of the faculty professional development takes place while utilizing technology for research as well as applications associated with presenting course material and/or conferences. An important part of a higher education faculty member’s role is to explore the edge of current thinking and to seek answers to fundamental questions about teaching and learning (Glenn, 2004). However, research and professional development are supplemental to the primary focus of the teacher education faculty member.

Numerous studies have documented improvement in the amount and quality of course work in educational computing but have recognized that one required class is inadequate to prepare teachers to use technology effectively in the teaching/learning process (Hunt, 1994; Strudler, 1991; Wetzel, 1993). In addition to computing courses, it is recommended that preservice teachers need to observe appropriate modeling throughout their university course work (Franklin & Beach, 2002; Hunt, 1994; Novak & Berger, 1991; O’Bannon, Matthew, & Thomas 1998; Strudler, 1991; Wetzel, 1993).

Teacher education faculty need to serve as role models for demonstrating uses of and their attitudes towards technology in the classroom which will strongly influence the
implementation of technology by preservice teachers (Franklin & Beach, 2002). Current faculty will need continued professional development as they develop expertise and seek to explore innovative uses of technology as part of the students’ learning experiences (Glenn, 2004).

The International Society for Technology in Education (ISTE) has had some influence on the process of technology integration in teacher education by revising the teacher standards for technology integration. The current document, the National Education Technology Standards for Teachers (NETS-T) outlines key technology skills preservice teachers should possess by the end of predictable phases in the teacher preparation process (ISTE, 2000a). Teacher preparation and technology integration phases include the following: a) skills that prospective teachers should have prior to entering a teacher preparation program, b) skills that prospective teachers should develop during the terms prior to student teaching, c) skills that prospective teachers should develop during student teaching, and d) skills that a teacher should develop by the end of the first year of full-time teaching (ISTE, 2000a). Further outlined within the teacher preparation and technology integration phases are levels of technology for teacher use that include six basic operations and concepts (Appendix C). As pre-service teachers progress through the program, stages of technology integration should be advancing.

The continuing evolution of digital technologies poses challenges for teacher educators (Glenn, 2004) with regard to updating, acquiring, and utilizing new technologies to advance preservice teachers through stages of technology integration as defined by ISTE (ISTE, 2000a). Inadequate resources to purchase hardware and software for university classrooms and surrounding K-12 schools have impeded progress for colleges of education to integrate technology (Vannatta & O’Bannon, 2000). Moreover, inservice teachers and school districts are
struggling to keep abreast of rapidly changing technology and innovative best practices for uses in the classroom, therefore students learning experiences with technology are compromised.

*Preservice teacher technology competency.*

Recent studies indicate that students are entering colleges of education without practical experience using technology for teaching and learning (Banister & Vannatta, 2006). Furthermore, as technological advances are occurring, classroom practices will continue to change. Despite the implementation of ISTE standards for student use of technology in the teaching and learning process, a very small percentage of K-12 schools nationally are evaluating levels of student technology skills as a graduation requirement (Education Week, 2005). The lack of technology experiences that many teacher education students bring to college is a barrier to successful implementation of technology into preservice teacher education programs (Vannatta & O'Bannon, 2000).

Because of the critical nature of preparing the future teacher workforce to be technology using teachers, colleges of education are implementing procedures to measure the level of incoming teacher education students’ technology skills. Initiatives such as Preparing Tomorrow’s Teachers to Use Technology (PT3) have provided grant funding to help transform teacher preparation programs to become models for technology integration. Recognizing that most students do not enter the university setting with fundamental computer skills necessary for developing technology integration practices as a teacher, baseline instruments for measuring skills have been developed (Banister & Vannatta, 2006). Also, one of the best ways for teacher educators to better prepare teacher candidates to integrate technology is to determine what they already know about using technology before they begin a program, as well as examine what they have learned throughout a program (Milman, 2003). The K-12 background experiences students
bring to teacher preparation programs comprise the foundational knowledge of using technology for learning.

An example of a custom-built performance-based instrument that was developed and implemented into one mid-western college of education is the Assessment of Technology Competency (ATC). The ATC contains a set of instructions for preservice teachers to construct three digital products during a proctored, ninety-minute lab session. The products utilize word-processing, spreadsheet, and presentation, and integrate graphics, Internet, and file management expertise (Vannatta & Banister, 2003). The philosophy behind the use of this instrument to measure fundamental technology skills is grounded in the belief that if students can demonstrate the skills included in the ATC, they are also able to navigate the menus and applications well enough to produce quality word-processed, spreadsheet, and presentation digital documents (Vannatta & Banister, 2003). Specific components of each section of the ATC are identified as critical fail points that students must demonstrate in order to pass word processing, spreadsheet, and presentation sections (Appendix D) and are based on technology skills that were identified by ISTE as essential for preservice teachers (ISTE, 2000). A pilot of the ATC was conducted in the Spring, 2003, and fully implemented during the 2003-2004 school year. Results from the implementation of the ATC during the 2003-2004 school year indicated that preservice teachers possess low levels of technology skills, with only 28.6% of the students passing all sections of the ATC during the first attempt (Vannatta & Banister, 2003).

Predictors of Technology Competency

Predicting student technology competency is vital information for colleges of education in preparation of the future teacher workforce. Students’ experiences, and those of their states, districts, schools, teachers, and parents, strongly affect how [technology] is adopted in schools
Factors such as socioeconomic status (Gorski, 2005; Kleiman, 2004; U.S. Department of Education, 2002; National Education Association, 2004; Williams, 2000), preservice teacher background experience with technology (Levin & Arafeh, 2002), district average number of years teaching experience (U.S. Department of Education, 2002) and district average number of hours of teacher professional development related to technology (U.S. Department of Education, 2002) have implications on preservice teacher technology competency.

**District Socioeconomic Status**

Research indicates that in the United States there is a direct relationship between family income and access to computers and the Internet (Tapscott, 1998). This correlation also exists between the higher- and lower-income schools (Tapscott, 1998). *A Digital Disconnect: The Widening Gap between Internet-Savvy Students and Their Schools* (Levin & Arafeh, 2002), reports on the differences in technology skills of students who come from technology-rich home environments and those who do not have the advantage of a computer and Internet connection at home. The findings of their report indicate a widening gap between how students use the Internet for school and how they use Internet during the school day and under teacher direction (Levin & Arafeh, 2002).

Furthermore, as reported by the NEA (2004), substantial gaps in technology access remained for particular demographic and geographic groups. The numbers of computers available in high-poverty and low-poverty classrooms were nearly equal, but computers in high-poverty schools were older and more obsolete and had less adequate software. Educators were less likely to have Internet access if they worked in high-poverty schools or in elementary
schools, if they were newer in the profession, or if they resided in the eastern part of the country (National Education Association, 2004).

*Preservice Teacher Background Experience with Computers*

An issue that impedes the use of technology for instruction in the classroom during the first few years of teachers’ careers evolves around the lack of exposure to applications of technology in the classroom. The findings of the USEIT study conducted by Russell, Bebell, and O’Dwyer (2004), indicate that in most cases, of the schools surveyed, the new teachers are teaching at the schools they attended as K-12 students when classrooms were not yet equipped with technology or the technology was not regularly integrated into the curriculum by their teachers. Thus, the students’ models of teaching based on their own experiences as students do not include the integration of technology into instruction (Russell, Bebell, & O’Dwyer, 2004).

The vast majority of students surveyed in the Pew Internet and American Life Project report their primary access to the Internet is at home and that is the place they most frequently go online (Levin & Araféh, 2002). The access point for technology use, particularly for the older students is home-focused, not school-focused (NetDay, 2003). As a result of the gap in home ownership and Internet access between various cultural [and socioeconomic level] groups, teachers in upper income neighborhoods do not have to invest valuable classroom time in teaching students how to use computers; moreover, they can even rely on students for their own technical support (Riel & Schwarz, 2002).

*Technology Integration and the K-12 Teacher*

The transformation of classroom technology from hardware, software, and connections into tools for teaching and learning depends on knowledgeable and enthusiastic teachers who are motivated and prepared to put technology to work on behalf of their students (CEO Forum,
Professional development is how teachers can learn new skills, improve practice, and keep current with changes in knowledge, technology, and the community they serve (Renyi, 1996). When considering the professional development of teachers in the area of educational technology, numerous resources are available to provide educators with ideas and guidelines to effectively, meaningfully, and innovatively use technology in the learning environment (Jonassen, 2003). However, simply having these resources does not necessarily result in changes to the learning environment (King, 2002). Teachers’ professional development has been more prominently recognized as an essential component to ensure pedagogically sound use of technology in the classroom (Darling-Hammond, 1999; Jelfs & Colbourn, 2000; King, 2002; O’Brien-Vojtek & Vojtek, 1999).

Statistics from NCES indicate since 1999, 99% of all public school teachers reported having computers available in their schools and 84% of those teachers had access in their classroom (U.S. Department of Education, 2000). However, only one third of these teachers reported being “well prepared” or “very well prepared” to use computers for classroom instruction (U.S. Department of Education, 2000). To help prepare and educate themselves about using technology, more than 90% of the respondents cited “independent learning”, more than 80% of the respondents listed professional development and colleagues as resources for preparation (U. S. Department of Education, 2000). In 2002, almost all of the teachers participated in technology professional development session during the previous twelve months and more than 80% of public schools with Internet access offered professional development on how to integrate the use of the Internet into the curriculum (U.S. Department of Education, 2003). Professional development with educational technology is an essential condition of successful technology integration in the classroom (ISTE, 2000b).
The state of Ohio conducted a study to focus on the patterns in teacher use of technology in Ohio’s regular public schools (Ohio SchoolNet Commission, 2004). The survey battery, Ohio’s Biennial Educational Technology Assessment (BETA), includes a district level survey, a building level survey, and a teacher survey. Over 80% of Ohio teachers responded to the BETA Teacher Survey. The data analysis includes an examination of relationships between teacher technology use and other teacher and school characteristics (Ohio SchoolNet Commission, 2004). The results of the survey indicate a relationship between professional development and teacher technology use (Ohio SchoolNet Commission, 2004). In addition, professional development with educational technology is imperative for teachers at all stages in their teaching career.

Optimally, comfort and skills of new teachers develop while growing up with computers and will help transform their instructional practices as teachers (U.S. Department of Education, 2000). Instances of research show teachers with 5 or less years of experience are significantly more confident using technology than are teachers who entered the profession 6 to 15 years ago or more than 15 years ago (Russell, Bebell, O’Dwyer, & O’Connor, 2003). Demographic characteristics of the NEA study focused on number of years of full-time work experience as an educator, school poverty level, school grade level, and geographic region. A major finding of the NEA study was that computer skill levels vary based on number of years in the teaching profession (National Education Association, 2004). Teachers self-rated their computer skills and the results (26.3%) indicate early career teachers self-rated as excellent, while the mid career and senior career teachers had lower percentages of self-rating as excellent, 15.0 and 18.7 respectively (NEA, 2004). The majority of teachers at each career level self-rated computer skills
as good, 63.5% early career teachers, 67.0% mid career teachers, and 58.0% senior career teachers (National Education Association, 2004).

Summary

The literature reflects various studies about the barriers of integrating technology across the PK-16 educational continuum. Research indicates that the learning environments of past generations no longer serve the needs of the 21st century learner (Lancaster & Stillman, 2005; Levin & Arafeh, 2002; NetDay, 2003; Oblinger, 2003). As technology continues to evolve from as recent as a decade ago, educators have struggled to support technology-rich learning experiences for students (CEO Forum, 2001; Cuban, 2001; Education Week, 2005; Office of Technology Assessment, 1995). The lack of student experience with technology integration in the learning environment has implications for colleges of education in preparing the future teacher workforce to integrate technology into the classroom (Vannatta & O’Bannon, 2000).

Studies show that inservice teachers at various stages in their career benefit from more hours of professional development for using computers and the Internet for instruction (U.S. Department of Education, 2002). However, sophisticated uses of technology for teaching and learning remain few as teachers’ instructional delivery practices with technology demonstrate low level uses such as reinforcing student skills through drill and practice (Bell South, 2002; National Education Association, 2004). Millennial students are using technology as part of managing daily living tasks such as reading the newspaper, communicating with friends, researching hobbies, and schoolwork (NetDay, 2004). However, research indicates differences in the way students use technology for home and how technology is used in school which explains why students lack understanding in the use of technology for teaching and learning practices (Carew, 2004; Frand, 2002; International Technology Education Association, 2000; Levin &
Arafeh, 2002; North Central Regional Education Laboratory, 2001) and may have implications for their future regardless of career choice.

Colleges of education are being challenged to produce future teachers to be technology integrators and have discovered that preservice teachers’ technology skills are low level upon arrival to teacher preparation programs (Banister & Vannatta, 2006; Gibson & Halverson, 2004; Vannatta & O’Bannon, 2000). Without the support of K-12 districts and teachers for modeling technology integration practices in the classroom, preservice teachers cannot connect student learning with teaching strategies that employ sophisticated uses of technology (Millman, 1997).

Studies indicate that district socioeconomic status plays an important role on the impact of technology on direct instruction and accessibility of the Internet in the classroom remains an issue (Gorski, 2005; Kleiman, 2004; Levin & Arafeh, 2002; National Education Association, 2004; U.S. Department of Education, 2002; Williams, 2000). The challenge of producing technology using teachers is further complicated for colleges of education by the diminishing resources and demands of standards-based education, while simultaneously updating technology infrastructures and researching best practices for technology integration to support P-16 school reform efforts (Glenn, 2004).

The research attempts to inform progression through the phases of transformation (Kotter, 1999) taking place as colleges of education continue efforts of integrating technology into teacher preparation programs. The results of the proposed study sought to provide a mechanism for examining preservice teacher technology background for the purpose of analyzing trends associated with the market environment (Kotter, 1999) of preparing the future workforce of teachers who integrate technology into the classroom.
The study suggests an avenue for researching the background of preservice teachers’ technology to move the teacher preparation towards a deeper understanding about the learning experiences and demographics of preservice teachers. Current research indicates that factors of socioeconomic status, teacher number of years experience, teacher professional development, and student background experience with technology have implications on preservice teacher preparation and technology competency however; the factor that best predicts technology competency is unknown. The examination of factors that best predicts technology competency has implications for colleges of education in designing preservice teacher preparation programs that best meet the needs of the nation’s future teacher workforce.
CHAPTER III. METHODOLOGY

This chapter highlights the research methodology and procedures used in the study which consists of the following sections: participants of the study, instrumentation, research design, procedures, proposed data analysis, and assumptions and limitations.

Participants of the Study

Over the Fall, 2004 and Spring, 2005 semesters approximately 1,100 preservice teachers were enrolled in BGSU’s College of Education and Human Development Introduction to Education (EDHD 201) course. The course is typically the first in a sequence of preservice teacher preparation curriculum for BGSU College of Education programs. Teacher candidates are derived from programs offered in the following areas: Early childhood (EC); middle childhood (MC); adolescent/youth adult (AYA); special education (SE); or other specialty program areas including foreign language, music, art, physical education, business, and technology education. The EDHD 201 preservice teachers were required to complete the Assessment of Technology Competency (ATC), a performance-based skills test that measured preservice teachers’ technology skills. The participants of the study were comprised of 278 preservice teachers from the EDHD 201 course who had completed round one of the ATC during Fall, 2004 and Spring, 2005, had failed one or more sections of the ATC, completed the ATC retake opportunity, originated from a school district located in the state of Ohio, and consented to complete the ATC retake survey.

The ATC retake opportunity was a part of the ATC process that was required for preservice teachers who failed one or more sections of the ATC during the Fall, 2004 or Spring, 2005 semesters. The typical preservice teacher of EDHD 201 is Caucasian, female and in the first semester of the preservice teacher preparation program.
Instrumentation

Multiple secondary data sources were utilized for the purpose of the study. The sources were as follows: results of the evaluation of Bowling Green State University (BGSU) Assessment of Technology Competency (ATC); the ATC Retake Survey results; the Ohio Department of Education (ODE) Similar District computation report from fiscal year 2003-2004; and the Ohio SchoolNet (OSN) Biennial Education Technology Assessment (BETA) district level teacher survey from the biennial academic year 2003-2005.

The Assessment of Technology Competency

Preservice teachers enrolled in BGSU Introduction to Education course (EDHD 201) for Fall, 2004 and Spring, 2005 were provided information during a lecture presentation given in the second class meeting about the requirement of completing the Assessment of Technology Competency (ATC) process. The lecture presentation included specific details about the process for completing the ATC requirement, the ATC test instrument, the ATC support website, as well as a brief demonstration of how to access the ATC practice test and grading rubric. A hard copy notes page accompanied the presentation and included the ATC support website address.

Each preservice teacher who was enrolled for EDHD 201 was required to complete the ATC process that was divided into three phases. Phase one of the ATC process was registration and completion of the ATC test; phase two of the ATC process was the upload and evaluation of the ATC test; phase three of the ATC process was the results reporting and, if necessary, retaking of failed sections of the ATC.

The first phase of the ATC process was the registration and completion of the ATC test. During the lecture presentation, and as indicated on the hard copy materials, students were informed of how to reserve a seat for an ATC lab session that was provided in addition to regular
class meeting time. The ATC lab session schedule was distributed through the secured
BlackBoard course portal and small group instructors further reinforced the availability of ATC
session times. For the Fall, 2004 semester ATC registration procedure, preservice teachers were
instructed to send reservation requests via email to the ATC administrator who then returned a
confirmation of requested date and time availability. An online registration procedure was
developed for ATC registration for the Spring 2005 semester.

As part of the Fall, 2004, administration duties, the ATC administrator downloaded the
Introduction to Education preservice teacher enrollment data from the secured BGSU
Blackboard course portal. The names, section number, and email contact information for each of
approximately 680 preservice teachers were imported into spreadsheet format and cross-
referenced with their requests to reserve an ATC lab session. Confirmed reservations were then
manually recorded into the spreadsheet for the purpose of further developing an electronic
system to manage preservice teachers’ status through the ATC process. This spreadsheet was
later utilized to record preservice teachers’ ATC evaluation results for Fall, 2004 EDHD 201
results.

The ATC registration procedures for Spring 2005, were modified to utilize a web-based
registration system for preservice teachers to reserve their chosen ATC lab session date and time.
Through the online registration process, the ATC registration data was downloaded from a SQL
database file using phpMyAdmin. PhpMyAdmin is a tool written in PHP (hypertext pre-
processing) intended to handle the administration of MySQL over the web which can create and
drop databases, create/drop/alter tables, delete/edit/add fields, execute any SQL statement, and
manage keys on fields. The use of phpMyAdmin simplified the transfer of preservice teacher
reservation requests to an automated process.
Once a reservation was confirmed, preservice teachers were required to attend their scheduled lab session to complete the ATC test. The ATC test is a performance-based instrument in which preservice teachers demonstrate technology competency by following a prescribed set of instructions to create three separate products using software programs such as word processing, spreadsheet, and presentation. The ATC lab session was a ninety-minute period arranged specifically for creating the three products of the ATC.

The second phase of the ATC process is the evaluation phase. Upon completion of the ATC test, preservice teachers uploaded products from the local workstation in the lab to a secure server for the purpose of evaluation by small group instructors. Specific components of each section of the ATC were identified as critical fail points that must be successfully demonstrated in order to pass word processing, spreadsheet, and presentation sections. If a preservice teacher missed a critical fail component of a section, evaluation results were recorded as fail for that section. Preservice teachers were then given an opportunity to schedule a second ATC lab session to retake the failed section(s). The small group instructors used evaluation checklists (Appendix D) for evaluating the products based on the criteria prescribed by the ATC test.

In order to support preservice teachers through the ATC test process, a demonstration was given during the lecture presentation on how to download the portable document format (pdf) of the ATC practice test and rubric which could be used in preparation for taking the ATC test. The ATC support website also contains video-based tutorials that match the ATC practice test for those who needed assistance with performing skills of the ATC.

The third phase of the ATC process was the results reporting and, if necessary, the retaking of the failed section(s). Evaluation results of preservice teachers’ first ATC attempt were reported through the secure Blackboard portal gradebook. The small group instructors
manually entered results into the ATC registration spreadsheet for the purpose of uploading them into the secure BlackBoard portal gradebook. Results were reported per section, one point per item within each section; word processing (15 points), spreadsheet (12 points), and presentation (13 points). A total of 40 points was possible for preservice teachers who successfully completed the ATC test without error. If a preservice teacher failed a section, the score of zero was entered for that section. Preservice teachers who failed one or more sections of the ATC were required to retake the failed section(s). The ATC first attempt evaluation results determined whether the preservice teacher was required to retake the ATC. The preservice teachers’ total score of the ATC first attempt was used as a technology competency measure for this study.

During the pilot phase conducted in Spring 2002, the ATC was reviewed for content validity by a panel of experts in the field of educational technology and then further reviewed by teacher education faculty in the college to determine appropriateness of content and skill level (Banister & Vannatta, 2006). Prior to full implementation, the ATC was administered as a pilot with approximately 125 students from the EDHD 201 course (Banister & Vannatta, 2006). The instrument and scoring methodology were revised to increase content validity and inter-rater reliability.

ATC administration records were available from Fall, 2004 and Spring, 2005 to determine which small group instructor completed the ATC evaluation of their respective small group section students’ ATC products. Small group instructors were responsible for scoring and recording student evaluation results. Another aspect of the evaluation process that increased instrument reliability was the training for small group instructors on the evaluation of the ATC was provided during the Fall, 2004 and Spring, 2005 semesters.
The ATC Retake Survey

Over the course of the academic year 2004-2005, the ATC retake survey was administered to approximately 450 BGSU Introduction to Education (EDHD 201) participants. The purpose of the ATC retake survey instrument was to collect information about preservice teacher background experiences with technology and to identify the school district demographics from where they graduated high school. Results of the ATC retake survey revealed a cross-section of preservice teacher backgrounds with technology at home and at school.

The ATC Retake Survey was administered to EDHD 201 participants upon arrival to the ATC retake sessions and contained eleven items to collect information about preservice teacher ATC preparation experience and background experience with using technology (Appendix E). Particularly, data collected from items seven, eight, and nine were utilized to describe preservice teacher background experiences at home and school related to their access to and use of technology. Responses were made in checkbox format.

All ATC Retake Survey responses were aggregated and analyzed using descriptive statistics. In particular, ATC Retake Survey item number seven asked preservice teachers to respond by checking “yes” or “no” to the following question, “Prior to entering BGSU did you have a computer with Internet connectivity at home?” The preservice teacher response was given a score of 1 for yes and 0 for no. ATC Retake Survey item number eight asked preservice teachers to respond to the following question, “Did you have a computer class in high school prior to attending BGSU?” The response was given a score of 1 for yes and 0 for no. The third item being used from the ATC Retake Survey was question nine which requested an estimation of the number of hours of computer time per week acquired in high school. Responses were
made by choosing one of the following options: a) 0-5 hours, b) 6-10 hours, c) 11-15 hours, d) 16-20 hours, or e) more than 20 hours.

The ATC Retake Survey results were manually entered into spreadsheet format for the purpose of examining support mechanisms that preservice teachers utilized to prepare for the ATC. In addition, the ATC Retake Survey results were used to examine preservice teachers’ previous technology experience and high school demographics. Item eleven of the ATC Retake Survey asked preservice teachers to complete the following information in written form: Name of high school; name of district (if public); city (if private), and state. The ATC Retake Survey results provided the researcher with the preservice teachers’ high school demographics and subsequently were manually entered into the ATC Retake Survey results spreadsheet for reference to school district demographics. For the purpose of this study, the ATC Retake Survey results spreadsheet was utilized to further examine preservice teachers’ background experiences with technology at school, based on district demographic factors relating to socioeconomic status.

Content validity of the ATC Retake Survey was accomplished through expert review of format, language and construction of questions to determine appropriateness for the sample. Modifications were not required for use in Spring, 2005.

*The Ohio Department of Education Similar District Report*

Another secondary data source that was utilized to gather information about preservice teacher background experience is the Ohio Department of Education (ODE) Similar District Report. The ODE Similar District Report was used to obtain district socioeconomic status based on student average daily membership (ADM), household median income, and poverty as percent of student enrollment data.
Raw data were downloaded from the ODE Similar District website for use based on data from the year 2004, aligned with the year of high school graduation of the sample. After the ODE Similar District Report was downloaded from the ODE website, corresponding participant district data were identified and manually entered into student ATC Retake Survey spreadsheet.

*The Ohio SchoolNet Biennial Educational Technology Assessment*

A third data source for information about preservice teacher background experience with technology was the state level Ohio SchoolNet (OSN) Biennial Education Technology Assessment (BETA) district level teacher survey. Once every two years OSN, the state agency legislatively charged with administering Ohio’s educational technology programs, administers a battery of surveys to gather information about technology use and access (Rogers, Borkan, & Fox, 2004). The primary purpose of the BETA was to help guide state policy on K-12 educational technology, help identify trends across the state with regard to technology implementation and use and help align funding and human resources to address areas in need of improvement (Rogers, Borkan, & Fox, 2004). The BETA survey data from the biennial period 2003-2005 was used for this study to provide information about district teachers average number of years teaching experience and district teachers average number of hours educational technology professional development opportunities as factors contributing to preservice teacher background experiences with technology. The BETA 2003-2005 survey results encompassed the graduating year of the preservice teacher sample of those BGSU EDHD 201 who were enrolled in either the Fall, 2004 or Spring, 2005 semester. The OSN BETA data were received from OSN in electronic raw data format for the purpose of importing into a spreadsheet using a comma separated variable (csv) format. Corresponding participant district information was identified and manually entered into preservice teacher ATC Retake Survey results spreadsheet.
Content experts were utilized for the development of each state level data source, ODE Similar District Report and OSN BETA to ensure content validity, however reliability was not conducted as these instruments were primarily used for data-driven decisions regarding policies related to educational technology at the state and local levels (Fox, J., personal communication, October 8, 2005). As educators, policy-makers and researchers continue to engage in critical dialogue about the achievement of all students, this annual report will help inform the conversation about educational policies and practices in Ohio for years to come (Ohio Department of Education, 2004). BETA served as a primary source of technology information for state policymakers as they considered the current and future educational technology needs of Ohio's school districts (Fox, J., personal communication, October 8, 2005). The data were collected in a controlled, electronic environment and supported the purpose of providing information used for statistical analysis.

Research Design

Correlational research was used to investigate the degree of relationships between preservice teacher technology competency and district socioeconomic status, district average teacher number of years experience, district average number of teacher professional development hours and preservice teacher background experience with technology at home and school. Correlational research design provided the researcher with information regarding the relationship of dependent and multiple independent variables for the purpose of identifying factors that predict preservice teacher technology competency.

Procedures

This study utilized secondary data sources, therefore the following procedures described address the process of merging these data sources for analysis.
The ATC Retake Survey results spreadsheet was used as the basis for assembling the secondary sources of data for the study. A copy of the ATC Retake Survey results spreadsheet data was created to preserve the original ATC Retake Survey results and was saved as ATC Retake Research in spreadsheet format. The study used preservice teacher records and ATC Retake Survey results from questions 7, 8, and 9, and contained the following fields: Preservice teacher name; home access; high school technology class; hours of computer time; high school name, district name, city, and state. Additional fields were created to accommodate the information that was being imported from the secondary sources: ATC registration Fall, 2004 and Spring, 2005; ODE Similar District Report 2004; and OSN BETA survey 2003-2005.

The ATC retake participants’ first attempt ATC total score were imported manually from the ATC registration spreadsheets from Fall, 2004 and Spring, 2005 to the ATC Retake Research spreadsheet. The ATC registration spreadsheets for Fall, 2004 and Spring 2005, contained a field by which the preservice teachers’ first attempt ATC total scores were entered and results were sorted by pass or retake. The records with the status of retake were copied from the ATC registration spreadsheets for Fall, 2004 and Spring 2005, and imported into the ATC Retake Research spreadsheet. Using the ATC Retake Research spreadsheet, a field was created to import the preservice teachers’ first attempt ATC total score. The field was named ATC Score.

The Similar District Report raw data file from the year 2004 was downloaded from the ODE website and manually incorporated into the existing ATC Retake Research spreadsheet to match existing participant records. Additional fields were created in the ATC Retake Research spreadsheet for importing the district information from the ODE Similar District report. The fields were named the following: District ADM; district median income; and district poverty.
The OSN BETA survey raw data file was received electronically from OSN and manually incorporated into the ATC Retake Research spreadsheet to match existing participants’ records. Two fields were created in the ATC Retake Research spreadsheet for importing the district information from the OSN BETA survey data. The fields were named district average number of years experience and district average number of hours of professional development.

The ATC Retake Research spreadsheet data were imported into the Statistical Package for Social Sciences (SPSS) version 11.5 for Windows for data analysis.

Research Questions

1. What is the relationship between preservice technology competency and K-12 district socioeconomic status, K-12 teacher number of years teaching experience, K-12 teacher average number of hours of professional development in the area of technology, and preservice teacher background experiences with technology?

2. Which factors (socioeconomic status, K-12 teacher number of years teaching experience, K-12 teacher average number of hours of professional development in the area of technology, and preservice teacher background experiences) best predict technology competency of preservice teachers?

3. Are there group differences in technology competency with respect to: preservice teachers’ completion of a high school computer class, number of hours per week, district median household income (above or below state media), district location (rural, urban, suburban)?

Data Analysis

Descriptive statistics were used to analyze responses to the ATC Retake Survey questions related to preservice teacher technology preparation and experience with the ATC. Measures of central tendency and variability were calculated for all quantitative variables examined.
Frequencies and percents were calculated for all categorical variables. Quantitative variables addressed in the posed research questions were evaluated for normality using the Kolmogorov-Smirnoff test. The variable of overall ATC score and district poverty were transformed to normalize the distributions. A Pearson correlation matrix was generated to examine Research Question 1 - the relationships among preservice teacher technology competency based on ATC first attempt total score, socioeconomic status (SES) factors such as district median household income and % poverty level based on ADM, K-12 teachers’ average number of years teaching experience, K-12 teachers’ average educational technology professional development hours, and preservice teacher background experience with technology. A scatterplot matrix was constructed to evaluate linearity among variables.

Exploratory multiple regression method was used to address Research Question 2 to determine factors that best predict preservice teacher technology competency. Multiple regression is an extension of simple linear regression involving more than one independent variable (IV), or predictor variable and was based on an exploratory approach (Mertler & Vannatta, 2005) for this study.

The criterion variable was the student ATC score, and the predictor variables being used were the mean score of district teacher number of years experience, mean score of district teacher number of hours of professional development, the median of income level of the district, the percent district poverty level, the district student enrollment average, preservice teacher computer access from home, preservice teacher computer class in high school, estimated number of hours of preservice teacher computer time in high school (see Table 2).
Table 2

*Summary of Dependent and Independent Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Source</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATC score</td>
<td>Dependent variable ATC first attempt total score across 3 ATC sections (word processing, spreadsheet, presentation); x(atc)</td>
<td>ATC results</td>
<td>0-40</td>
</tr>
<tr>
<td>District Median Income</td>
<td>Quantitative; Median district income based on data from 2002 Department of Taxation; y(minc)</td>
<td>ODE Similar District Report</td>
<td></td>
</tr>
<tr>
<td>District Poverty</td>
<td>Quantitative; Mean; Children living in families receiving social service benefits as a percent of ADM; y(pov)</td>
<td>ODE Similar District Report</td>
<td>%</td>
</tr>
<tr>
<td>District Student Enrollment</td>
<td>Quantitative; Mean; Student average daily membership (ADM), the number of students served by a district and describes the size of the education enterprise; y(adm)</td>
<td>ODE Similar District Report</td>
<td>%</td>
</tr>
<tr>
<td>District Average Number of Years Teachers’ Experience</td>
<td>Quantitative; represents the K-12 teachers’ average number of years teaching experience per district 0 = 1 year or less; 1 = 2-5 years; 2 = 6-12 years; 4 = 13-20 years; 5 = 20 + years; y(taxp)</td>
<td>Ohio SchoolNet BETA 2004 K-12 Teacher Survey, Item 1</td>
<td>0-5</td>
</tr>
<tr>
<td>District Average Number of Hours Teachers’ Professional Development</td>
<td>Quantitative; represents the teachers’ average number of hours of educational technology professional development per district 0 = none; 1 = less than 5 hours; 2 = 5-10 hours; 3 = 11-15 hours; 4 = more than 15; y(tapd)</td>
<td>Ohio SchoolNet BETA 2004 K-12 Teacher Survey, Item 3</td>
<td>0-5</td>
</tr>
<tr>
<td>Preservice Teacher Home Computer Access</td>
<td>Access to computer and internet at home Quantitative; yes = 1, no = 0; y(home)</td>
<td>ATC Retake Survey, Item 7</td>
<td>1,0</td>
</tr>
<tr>
<td>Preservice Teacher Computer Class in High School</td>
<td>Computer class in high school Quantitative; yes = 1, no = 0; y(clahs)</td>
<td>ATC Retake Survey, Item 8</td>
<td>1,0</td>
</tr>
<tr>
<td>Preservice Teacher Hours of Computer Time in High School</td>
<td>Quantitative; Estimated number of hours computer time per week in high school 1 = 0-5; 2 = 6-10; 3 = 11-15; 4 = 16-20; 5 = more than 20; y(hrshs)</td>
<td>ATC Retake Survey, Item 9</td>
<td>1-5</td>
</tr>
</tbody>
</table>
The data were analyzed using the Statistical Package for Social Science (SPSS), version 11.5. SPSS was used for determining correlation, regression, and group differences of the ATC survey responses with the ODE Similar District Report data and the OSN BETA data.

Assumptions and Limitations

Limitations of this study included the sample being measured representing only the K-12 educational institutions of the state of Ohio and only those preservice teachers who failed one or more sections of the ATC. In addition, over the 2004-2005 academic year policies related to the administration of the ATC test were modified. This study did not take into account the impact of test administration modifications.

The ODE Similar District Report data and the OSN BETA data were sources of information available only for statistical analysis for the purpose of data-driven decision making. The lack of test validity and reliability restricts the use of the data for rigorous research purposes.

Based on the use of the state level instruments for this study, assumptions of validity and reliability of the state level data were made. In addition, the researcher assumed that the ATC instrument measures preservice teacher technology competency based on performance of essential skills for developing fundamental word processing, spreadsheet, and presentation products.
CHAPTER IV. THE FINDINGS

This chapter presents the descriptive results of the ATC Retake Survey responses related to the preservice teacher responses to the ATC experience and preservice teacher background. In addition, descriptive results of ODE similar district report data related to district variables of socioeconomic status and teacher average years teaching and professional development are presented. Finally, inferential results related to the research questions are presented.

The ATC Experience

Of the total number of preservice teachers who completed the ATC Retake Survey and who qualified for this study (n=278), preservice teachers’ responses indicated that 56.4% (n=157) did not read the ATC information materials provided in the orientation packet. Preservice teachers who read the ATC materials and used them to prepare for the ATC comprise 7.5% (n=21) of those who completed the survey (see Table 3).

Table 3

<table>
<thead>
<tr>
<th>Preservice Teacher Responses to ATC Experience – Use of ATC Information (n=278)</th>
<th>%</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did not read ATC information</td>
<td>56.4</td>
<td>157</td>
</tr>
<tr>
<td>Read information and found informative</td>
<td>18.3</td>
<td>51</td>
</tr>
<tr>
<td>Did not attend orientation</td>
<td>17.6</td>
<td>49</td>
</tr>
<tr>
<td>Read and used information to prepare for ATC</td>
<td>7.5</td>
<td>21</td>
</tr>
</tbody>
</table>

Preservice teacher preparation for the ATC was accomplished through the use of various resources. Survey responses were made by checking all resources that applied. A total of 241 responses were given for question 2. As indicated in Table 4, the largest percentage of preservice teachers, 66% (n=188) used the ATC practice test to prepare for the ATC. Interestingly, 14.3% (n=64) of the preservice teachers did not prepare for the first ATC round. The lowest percentage of preservice teachers (2.0%, n=9) used the BGSU StudentTech resources.
Preservice Teacher Responses to ATC Experience – Use of ATC Resources for Round 1

Preparation (n=241).

<table>
<thead>
<tr>
<th>Resource</th>
<th>%</th>
<th>(f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATC practice test</td>
<td>78.0</td>
<td>188</td>
</tr>
<tr>
<td>Online tutorial</td>
<td>44.4</td>
<td>107</td>
</tr>
<tr>
<td>Consulted with family/friend</td>
<td>34.4</td>
<td>83</td>
</tr>
<tr>
<td>No preparation</td>
<td>26.5</td>
<td>64</td>
</tr>
<tr>
<td>Used StudentTech resources</td>
<td>3.7</td>
<td>9</td>
</tr>
</tbody>
</table>

Preservice teachers were asked to identify the sections of the ATC that had to be retaken. The largest percentage of preservice teachers were retaking the presentation section of the ATC (73%, \(n=206\)). Preservice teachers retaking the spreadsheet section of the ATC comprised 55.4% (\(n=158\)), and 35.4% (\(n=101\)) of the preservice teachers were retaking the word processing section of the ATC. Obviously, several students were retaking multiple sections of the ATC, not necessarily all three sections.

Preservice teacher survey responses related to the preparation for ATC retakes revealed 60% (\(n=171\)) utilized the ATC practice test materials. Interestingly 34.7% (\(n=99\)) of the preservice teachers consulted with a family member or friend for ATC preparation, and the smallest percentage of the preservice teachers (1.4%, \(n=4\)) attended ATC support sessions in preparation for the ATC retake opportunity (see Table 5).

Table 5

Preservice Teacher Responses to ATC Experience – Use of ATC Resources (n=285).

<table>
<thead>
<tr>
<th>Resource</th>
<th>%</th>
<th>(f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice test</td>
<td>60.0</td>
<td>171</td>
</tr>
<tr>
<td>Online tutorials</td>
<td>38.6</td>
<td>110</td>
</tr>
<tr>
<td>Consulted with family/friend</td>
<td>34.7</td>
<td>99</td>
</tr>
<tr>
<td>Did not prepare</td>
<td>8.8</td>
<td>25</td>
</tr>
<tr>
<td>Other</td>
<td>8.1</td>
<td>23</td>
</tr>
<tr>
<td>Used StudentTech resources</td>
<td>1.8</td>
<td>5</td>
</tr>
<tr>
<td>Attended support sessions</td>
<td>1.4</td>
<td>4</td>
</tr>
</tbody>
</table>
In response to query on the use of the ATC website for information, preservice teacher responses indicated that a majority of the preservice teachers (76.8% n=202) downloaded the ATC practice test, while 52.9% (n=139) of the preservice teachers downloaded the ATC practice rubric, and 48.7% (n=128) of the preservice teachers downloaded the ATC video-based tutorials. Preservice teachers were asked to check all options that apply (see Table 6).

**Table 6**

*Preservice Teacher Responses to ATC Experience – Use of ATC Website (n=263).*

<table>
<thead>
<tr>
<th>Downloaded ATC practice test</th>
<th>%</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downloaded ATC practice rubric</td>
<td>52.9</td>
<td>139</td>
</tr>
<tr>
<td>Downloaded ATC video tutorial</td>
<td>48.7</td>
<td>128</td>
</tr>
</tbody>
</table>

The survey indicated that the most popular registration method that preservice teachers used for the ATC was email/electronic procedures (80.1%, n=226). A small percentage of preservice teachers registered for the ATC in person with the ATC office (15.2%, n=43), and less than 5% (4.6%, n=13) of the preservice teachers used both email and walk-in options to register for the ATC.

**ATC Retake Survey Preservice Teacher Background**

Information regarding the participants’ technology uses prior to entering the preservice education program was collected from responses to ATC Retake Survey items 7 – 10 (see Table 8). The results indicated a large percentage (95.5%, n=283) of the preservice teachers responded that they had a computer with Internet access at home. Conversely, only 2.7% (n=8) did not have a computer with Internet access at home. Survey results also showed 77.6% (n=229) completed a computer class in high school, while 20.7% (n=61) indicated they did not complete a computer class in high school.
Participants also reported the number of hours of computer time per week. The results revealed 36.5% (n=106) of preservice teachers surveyed estimated 0-5 hours of computer time per week, and almost as many (32.7%, n=95) of the preservice teachers estimated 6-10 hours of computer time per week. Small percentages of preservice teachers estimated more than 11 hours of computer time per week (see Table 7).

Table 7

Estimated Hours of Computer Time Per Week (n=290)

<table>
<thead>
<tr>
<th>Hours of Computer Time</th>
<th>%</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 hours</td>
<td>36.5</td>
<td>106</td>
</tr>
<tr>
<td>6-10 hours</td>
<td>32.7</td>
<td>95</td>
</tr>
<tr>
<td>11-15 hours</td>
<td>21.4</td>
<td>62</td>
</tr>
<tr>
<td>16-20 hours</td>
<td>5.5</td>
<td>16</td>
</tr>
<tr>
<td>More than 20 hours</td>
<td>3.7</td>
<td>11</td>
</tr>
</tbody>
</table>

The high school demographics such as class size and the type of school (rural, urban, suburban) were reported. Graduating class sizes were categorized and reported as follows: 1-49 (.4%), 50-99 (12%), 100-199 (25%), 200-299 (23%), 300-399 (17%), 400-499 (11%), and 500+ (12%). The focus of this research was the public schools of Ohio, therefore the qualifying surveys were sorted by responses that indicated the location of the school as public. The private/charter/parochial and home school respondents were excluded. Of those preservice teachers from public school type, 49.5% (n=142) were from a suburban school district, 42.9% (n=123) were from a rural school district, and 7.6% (n=22) were from an urban school district.

The preservice teachers’ response related to the class size category indicated the largest percentage of preservice teachers (23.7%, n= 70) come from a graduating class size of 100-199. The fewest percentage of preservice teachers (0.3%, n=1) come from a graduating class size of 1-49 (see Table 8).
Table 8

*Graduating Class Size Survey Responses (n=295)*

<table>
<thead>
<tr>
<th>Class Size</th>
<th>%</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-199</td>
<td>23.7</td>
<td>70</td>
</tr>
<tr>
<td>200-299</td>
<td>22.0</td>
<td>65</td>
</tr>
<tr>
<td>300-399</td>
<td>16.3</td>
<td>48</td>
</tr>
<tr>
<td>50-99</td>
<td>11.5</td>
<td>34</td>
</tr>
<tr>
<td>500 or more</td>
<td>11.2</td>
<td>33</td>
</tr>
<tr>
<td>400-499</td>
<td>10.8</td>
<td>32</td>
</tr>
<tr>
<td>1-49</td>
<td>0.3</td>
<td>1</td>
</tr>
</tbody>
</table>

*Technology Competency Process*

The technology competency score was calculated by combining the total points earned across the three sections of the ATC, word processing (15 points), spreadsheet (12 points), and presentation (13 points), for a total possible score of 40 points. The points were awarded based on successful completion of each instructional element for each section of the ATC, one point was earned for successful completion of each element. In addition, each ATC section contains a minimum of four critical fail elements. A preservice teacher can fail a section by incorrectly completing a critical element. The ATC total was compiled by summing the points awarded for each section.

Preservice teachers who failed a section of the ATC due to failing a critical element were awarded half the points earned for that section. Section scores were then totaled to create an overall ATC score (M=25.25, SD=7.80). A histogram of the overall ATC score revealed a substantially negatively skewed distribution. An appropriate strategy to apply in this case was to “reflect” and take the logarithm of the overall ATC score. First a constant was created by finding the largest score in the distribution and adding one to it to form a constant that was larger than any score in the distribution (Mertler & Vannatta, 2005). A new variable was created by
subtracting each score from the constant so that the distribution was converted from negative skewness to positive skewness (Mertler & Vannatta, 2005), and subsequently the log transformation (\( \text{LG10}(K-X) \)) was obtained. The normality of the distribution was then re-evaluated using the transformed variable (\( \text{M}=.78, \text{SD}=.4133 \)).

**District Variables**

The Ohio Department of Education (ODE) similar district report and the Ohio SchoolNet BETA survey were existing data sources used to collect K-12 district information related to socioeconomic status and teacher characteristics based on the population of EDHD 201 preservice teachers who met the research criteria (graduated from an Ohio public school, completed round 1 of the ATC, failed one or more sections of the ATC during round 1, and completed the ATC Retake survey).

Existing data collected by the Ohio SchoolNet BETA survey provided district average years of teaching experience and the average number of professional development hours with technology. The data collected corresponds with the preservice teachers of EDHD 201 Fall 2004 and Spring 2005 semesters who completed the ATC Retake survey and who meet the qualifications of the study. The total number of Ohio Public school districts represented by this qualifying population was 159.

**District Socioeconomic Status**

Variables that were used to describe district socioeconomic status include the district median income and poverty (% of students qualifying for free/reduced lunches). Normality was examined by conducting a Kolmogorov-Smirnov test of normality and creating a histogram. Both indicated that median income was normally distributed. However, district poverty percentage was substantially positively skewed (\( \text{M}=.11, \text{SD}=.11 \)). Therefore, district poverty
percentage was transformed using a logarithm (LG10) which resulted in a normal distribution (Mertler & Vannatta, 2005).

Descriptive statistics were generated for the median income, poverty transformed, teacher experience, and teacher professional development hours. The median household income mean was $33,782.14 (SD = 7,262.00), and the transformed poverty mean was M = -1.202 (SD = .477).

District Teacher Average Years Teaching and Professional Development

The district average teacher years experience was categorical: 1 = 1 year or less, 2 = 2-5 years, 3 = 6-12 years, 4 = 13-20 years, and 5 = 21+ years. The mean teacher years experience was 3.64 (SD = .225), or approximately 10-15 years. The district average number of hours of technology professional development (between July 1, 2002 and June 30, 2003) was categorical: 1 = none; 2 = less than 5 hours; 3 = 5-10 hours; 4 = 11-15 hours; and 5 = more than 15 hours. The mean district average teacher number of hours of professional development was 1.251 (SD = .329), or less than 5 hours (see Table 9).

Table 9

<table>
<thead>
<tr>
<th>Variables Representing District Socioeconomic Status and Teacher Characteristics (n=273)</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median household income</td>
<td>33,782.14</td>
<td>7,262.00</td>
</tr>
<tr>
<td>Transformed Poverty (% free/reduced lunch)</td>
<td>.11</td>
<td>.11</td>
</tr>
<tr>
<td>Teacher Experience (Avg District years)</td>
<td>3.64</td>
<td>.23</td>
</tr>
<tr>
<td>Teacher Professional Development Hours</td>
<td>1.25</td>
<td>.33</td>
</tr>
</tbody>
</table>

Inferential Results

Inferential statistics were used to address the three research questions that guided this study of predicting preservice teacher technology competency: 1) What is the relationship between preservice teachers' technology competency and K-12 district socioeconomic status, K-
12 teacher number of years teaching experience, K-12 teacher average number of hours of professional development in the area of technology, and preservice teachers’ background experiences with technology?, 2) Which factors (socioeconomic status, K-12 teacher number of years teaching experience, K-12 teacher average number of hours of professional development in the area of technology, and preservice teacher background experiences) best predict technology competency of preservice teachers?, and 3) Are there group differences in technology competency with respect to: preservice teachers’ completion of a high school computer class, number of hours per week, district median household income (above or below state media), district location (rural, urban, suburban)?

Research Question 1

A scatterplot matrix was constructed to evaluate linearity among the study variables: new total technology competency, transformed total technology competency, preservice teacher estimated hours of technology use per week, preservice teacher graduating class size, district median income, district average teacher years experience, district average teacher number of hours professional development with technology, and new poverty district percentage. No curvilinear relationships were detected.

Additionally, a correlation coefficients matrix was created to measure and describe the relationships between the quantitative variables (see Table 10). The results of the study showed a significant correlation between Overall ATC scores (trans) and preservice teacher estimated number of hours of computer time per week in high school \( r(274) = -.122, p < .05, \) two-tailed). The reader should keep in mind that this negative correlation is due to transformation of overall ATC scores that applied a reflection. Significant correlation was also found between the independent variables of district average teacher years experience and district household median
income ($r(249) = -.330, p < .01, two-tailed$). In addition, a significant correlation was detected between the independent variables of district average teacher hours of technology related professional development and district household median income ($r(272) = .299, p < .01, two-tailed$). The low correlation coefficient may be due to the limited variability in the district variables of teacher experience and professional development as well as the variable transformations that were conducted.

Table 10

Correlation Coefficients

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Overall ATC</td>
<td>1.00</td>
<td>-.919**</td>
<td>.131*</td>
<td>-.011</td>
<td>.010</td>
<td>.010</td>
<td>.006</td>
<td>-.011</td>
</tr>
<tr>
<td>2. Overall ATC (trans)</td>
<td>-.919**</td>
<td>1.00</td>
<td>-.122*</td>
<td>.025</td>
<td>-.010</td>
<td>-.008</td>
<td>-.017</td>
<td>.059</td>
</tr>
<tr>
<td>3. Preservice teacher</td>
<td>.131*</td>
<td>-.122*</td>
<td>1.00</td>
<td>.036</td>
<td>.090</td>
<td>-.024</td>
<td>-.019</td>
<td>-.052</td>
</tr>
<tr>
<td>est. hrs tech/week</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Graduating class</td>
<td>-.011</td>
<td>.025</td>
<td>.036</td>
<td>1.00</td>
<td>.497*</td>
<td>-.089</td>
<td>.103</td>
<td>.015</td>
</tr>
<tr>
<td>size</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. District median</td>
<td>.010</td>
<td>-.010</td>
<td>.090</td>
<td>.497*</td>
<td>1.00</td>
<td>-.330*</td>
<td>.299**</td>
<td>-.579**</td>
</tr>
<tr>
<td>income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. District avg. teacher yrs experience</td>
<td>.010</td>
<td>-.008</td>
<td>-.024</td>
<td>-.089</td>
<td>-.330**</td>
<td>1.00</td>
<td>-.050</td>
<td>.185**</td>
</tr>
<tr>
<td>7. District avg. teacher hrs tech professional development</td>
<td>.006</td>
<td>-.017</td>
<td>-.019</td>
<td>.103</td>
<td>.299**</td>
<td>-.050</td>
<td>1.00</td>
<td>-.118</td>
</tr>
<tr>
<td>8. District poverty</td>
<td>-.011</td>
<td>.059</td>
<td>-.052</td>
<td>.015</td>
<td>-.579**</td>
<td>.185**</td>
<td>-.118</td>
<td>1.00</td>
</tr>
<tr>
<td>percentage (transformed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Research Question 2

The purpose of this correlation study was to examine the degree to which district variables and preservice teacher background experience variables predict preservice teacher technology competency. According to Fraenkel and Wallen (2003), if a relationship of sufficient
magnitude exists between two variables, it becomes possible to predict a score on either variable if a score on the other variable was known. Unfortunately, multiple regression generated an insignificant model for predicting technology competency, most likely due to the lack of significant correlations between the dependent variable and the independent variables. Therefore, predictions of preservice teacher technology competency cannot be made.

**Research Question 3**

Additional data analyses were performed to explore group differences in preservice teacher technology competency. The t-test of independent samples and analysis of variance (ANOVA) were used to determine significant differences between the group means of the variables of the study.

The t-test of independent samples was conducted to determine technology competency differences by median income of preservice teachers (below the state median income level and above the state median income level). The state of Ohio median income is $30,461. SPSS was used to categorize the district median income variable into two groups; 1=below state median income, 2=above state median income. Results indicated no significant difference in the overall ATC total or the transformed ATC total based on district median household income (see Table 11).

Table 11.

*Median Income Group Differences (n = 293)*

<table>
<thead>
<tr>
<th></th>
<th>Below</th>
<th>Above</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall ATC</td>
<td>26.186</td>
<td>25.345</td>
<td>.805</td>
<td>.421</td>
</tr>
<tr>
<td>Overall ATC (trans)</td>
<td>.7351</td>
<td>.7909</td>
<td>-1.017</td>
<td>.310</td>
</tr>
</tbody>
</table>
The t-test of independent samples was conducted to determine the differences in technology competency between preservice teachers who did not complete a high school technology class and those who completed a high school technology class. Results indicated a significant difference between overall ATC scores for preservice teachers who did not complete a high school technology class and those who completed a high school technology class (see Table 12). Specifically, students who had completed a high school computer course scored significantly higher on the ATC than those who had not completed such a course. Effect size (partial eta squared) was also calculated.

Table 12

*Completion of High School Technology Class Group Statistics (n = 293)*

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes</th>
<th>t</th>
<th>p</th>
<th>Partial eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>Overall ATC</td>
<td>23.03</td>
<td>8.069</td>
<td>26.21</td>
<td>7.505</td>
<td>.029</td>
</tr>
<tr>
<td>Overall ATC (trans)</td>
<td>.917</td>
<td>.400</td>
<td>.7436</td>
<td>.407</td>
<td>.030</td>
</tr>
</tbody>
</table>

The t-test of independent samples was conducted to determine differences in technology competency between preservice teachers who had an Internet connection at home and those who did not have an Internet connection at home. Results indicated no significant difference in overall ATC score for preservice teachers who did not have an Internet connection at home and the preservice teachers who had an Internet connection at home.

The one-way analysis of variance (ANOVA) was conducted to investigate the differences in overall ATC score based on type of school (rural, urban, suburban). Results showed that type of school was not significant in overall ATC score ($F(2, 271) = .699$, $p = .498$).
A univariate ANOVA test was conducted to detect differences in technology competency based on the number of hours per week that preservice teachers spent on the computer during high school. The technology hours per week were categorized: 0 = 0-5 hours, 1 = 6-10 hours, 2 = 11=15 hours, and 3 = 16 or more hours. A significant difference in overall ATC score and overall ATC score was found between the preservice teachers who had 0-5 hours per week and those who had 6-10 hours. The Bonferroni post hoc test was used. Effect size indicates that minimal (3.7%) variance in technology competency (overall ATC) was accounted for by change in hours of technology per week (see Table 13).

Table 13

Technology Hours Per Week

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>F</th>
<th>Sig</th>
<th>Partial eta squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall ATC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-5 Hours</td>
<td>101</td>
<td>23.59</td>
<td>8.58</td>
<td>3.509</td>
<td>.016</td>
<td>.037</td>
</tr>
<tr>
<td>6-10 Hours</td>
<td>88</td>
<td>27.01</td>
<td>6.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-15 Hours</td>
<td>59</td>
<td>25.55</td>
<td>8.67</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16+ Hours</td>
<td>27</td>
<td>26.96</td>
<td>6.21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall ATC (trans)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>0-5 Hours</td>
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<td>.874</td>
<td>.409</td>
<td>2.601</td>
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<td>6-10 Hours</td>
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<td>.724</td>
<td>.394</td>
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<tr>
<td>11-15 Hours</td>
<td>59</td>
<td>.734</td>
<td>.461</td>
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<tr>
<td>16+ Hours</td>
<td>27</td>
<td>.743</td>
<td>.344</td>
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</table>
CHAPTER V. DISCUSSION

This chapter restates the problem, purpose of the study and addresses research questions associated with predicting preservice teacher technology competency. Quantitative methods of correlation and group variance are reviewed. A discussion of the results of the study, the implications of the results, contributions to the related literature, and suggestions for improvements to the study of predicting student technology competency and recommendations for future research are included.

Restatement of the Problem

Colleges of education, state departments of education and professional associations have tried many approaches over time to standardize, improve, and professionalize teacher preparation as part of a solution for change (Office of Technology Assessment, 1995) and impact on educational reform. Teacher preparation programs play a major role in reform efforts and are being challenged to prepare future teachers to be professionals who integrate technology in the classroom. To meet program accreditation requirements, NCATE standards expect the use of technology to be central to teacher preparation in 2000 and beyond (NCATE, 1997).

Breaking the cycle of low-level technology skills of teachers remains an issue. Teacher preparation does not begin when a preservice teacher enters a college of education; the background experience preservice teachers bring with them from K-12 grade to teacher preparation programs greatly contributes to an understanding of their future roles as teachers, especially in the area of technology. Without a strong foundation in the knowledge and skills for using technology effectively, preservice teachers will be unable to meet expectations set out by the No Child Left Behind Act (Fulton, Glenn & Valdez, 2004).
Research indicates that entering teacher preparation students possess low levels of technology competency (Banister & Vannatta, 2006). Low technological literacy of preservice teachers entering teacher education programs creates a challenge for colleges of education to produce technology using teachers. Teacher preparation programs need to further understand why preservice teachers are entering colleges of education with low level technology skills. The purpose of this study was to identify variables that predict preservice teachers’ technology competency by examining high school variables and the quantity and quality of students’ early technology experiences.

Factors that were studied include preservice teachers’ previous encounters with technology use at school and home, socioeconomic status of the school district from where preservice teachers graduated, school district dynamics such as inservice teachers’ average number of years teaching experience and average number of hours of professional development with technology. An additional purpose of the study was to examine the degree to which district and in-service teacher variables, in combination with preservice teacher background experiences predict initial preservice teacher technology competency.

Methods

The study sample was comprised of preservice teachers enrolled in the BGSU EDHD Introduction to Education course during the Fall 2004-Spring 2005 semesters. The ATC was the instrument used to determine the technology competency of entering preservice teachers enrolled in the initial education course. Approximately 450 of these preservice teachers failed one or more of the sections of the ATC and since have retaken the test. A total of 278 of these individuals originated from a school district located in the state of Ohio and consented to complete the ATC retake survey, therefore qualified for this study.
Two additional existing sources of data were used for gathering information about preservice teacher background experiences. The Ohio Department of Education (ODE) Similar District report was used to obtain district socioeconomic status based on student average daily membership (ADM), household median income, and poverty as percent of student enrollment data. The Ohio SchoolNet BETA survey data from the biennial period 2003-2005 were used to provide information about district teachers’ average number of years teaching experience and district teachers’ average number of hours of professional development in the area of technology. Data acquired from the ODE Similar District report and the Ohio SchoolNet BETA survey results were aligned with preservice teacher ATC scores and ATC Retake Survey results to compile a record which contained a quantitative profile of individual preservice teacher background experiences.

Various descriptive and inferential methods were utilized to determine the correlation of background factors with preservice teacher technology competency. Scatterplots were constructed to evaluate linearity among all of the study variables and a correlation coefficient matrix was created to measure and describe the relationships between the quantitative variables: ATC score, socioeconomic status of district from where preservice teacher graduated, district inservice teacher variables: number of years experience and hours of technology related professional development. In addition, the means and standard deviations of grouped variables were calculated. A t-test of independent samples was conducted to determine the technology competency differences as affected by group variables: household median income (low-high), completion of high school technology class (yes-no), and number of hours of technology use (0-5, 6-10, 11-16, 16-20, more than 20). A one-way ANOVA test was conducted to investigate the differences in overall ATC scores based on type of school (rural, urban, or suburban). In
addition, a univariate ANOVA test was conducted to detect differences in technology competency of groups of preservice teachers responses based on categorical data which indicated the number of hours per week (0-5, 6-10, 11-16, 16-20, more than 20) spent on the computer during high school.

Discussion of the Findings

The discussion of the findings present the descriptive results of the ATC Retake Survey and inferential results that address the three research questions of the study of predicting preservice teacher technology competency.

Descriptive Results

Overall, the descriptive results of the ATC Retake Survey show a majority of preservice teachers were able to use Internet technology to obtain the resources that were made available for preparation for taking the ATC. The results of the ATC Retake Survey indicated that a large majority (97%) of the preservice teachers had a computer with Internet access at home during their high school years. In addition, preservice teachers were able to use electronic mediums such as email communication and web-based registration, for scheduling a lab session to take the ATC.

Despite their accessibility to a computer and the Internet at home during high school years and ability to use telecommunications for preparation and scheduling, participating preservice teachers fell into a category of “lacking the ability to create a novice level product” in one or more areas of the ATC test: word processing, spreadsheet, or presentation software (Banister & Vannatta, 2006). Optimally, inservice teachers utilize word processing, spreadsheets, and presentation software for various tasks related to student learning such as managing individual student learning needs, reporting student assessment outcomes, and communicating
with parents and associates (Darling-Hammond, 1999; Franklin & Beach, 2002; King, 2002; Ohio SchoolNet Commission, 2004; Russell, Bebell, O’Dwyer, & O’Connor, 2003). More importantly, mastery of word processing, spreadsheet, and presentation software programs is critical to building a foundation for other classroom technology integration practices that extend beyond the development of electronic worksheets and grade reporting.

The practice of using the appropriate technology tools to manage the learning environment, model information management and solve learning problems comes with a strong foundation of the basics as assessed in the ATC process. These skills are critical to the development of technology integration practices of teachers. The traditional four-year teacher preparation programs are struggling to advance preservice teachers’ technology integration practices to meet the teacher technology standards set forth by ISTE (NETs*T) because of the need to provide instruction for preservice teachers at the NETs*S 9th-12th grade profile level (Banister & Vannatta, 2006).

The professional development of teachers who integrate technology into the classroom actually begins prior to entrance into a preservice teacher preparation program. Technology skills development comes from experience with inquiry, problem-solving and learning through the use of technology to construct knowledge. Society in general has embraced 21st century technology innovations for daily living, however, a gap remains in the understanding of appropriate uses for technology in the learning environment (Banister & Ross, 2006). Therefore, development of technology integrating teachers will remain a challenge and instructional practices for teacher preparation in colleges of education will need to continue to focus on technology skills development rather than integration of technology into the classroom.
Research Question 1

Previous studies have shown a positive relationship between district affluence and technology integration and evidence that proves socioeconomic background contributes to students’ ability to use technology (Reil & Schwarz, 2002; Sandholtz, Ringstaff & Dwyer, 1997). However, results from the present study were unable to establish a relationship between preservice teachers’ socioeconomic status and levels of technology competency given the factors of student background experience and district related variables aggregated from the ATC Retake Survey, ODE Similar District Report and OSN BETA results.

Originally, the researcher was suspicious of school type as a factor of technology competency based on research which concludes rural and urban school districts demonstrate lower levels of technology access (Bell South, 2001; Clark & Gorski, 2002; Gorksi, 2005; Levin & Arafeh, 2002; NEA, 2004). With regard to additional socioeconomic factors of the preservice teachers’ home school district, the respondents of the present study were somewhat evenly split between rural and suburban schools with very few originating from urban schools. Perhaps this is a reason why evidence of a relationship between school type and technology competency was not found in this study.

Research indicates the importance of in-service teacher professional development to the successful integration of technology into the classroom (CEO Forum on Educational Technology, 1999; Cradler, Freeman, Cradler, & McNabb, 2002; Darling-Hammond, 1999; Franklin & Beach, 2002; King, 2002; Ohio SchoolNet Commission, 2004; Russell, Bebell, O’Dwyer, & O’Connor, 2003). Research concludes that teachers with fewer years of teaching experience (i.e., more recent graduates) and those with more hours of professional development felt better prepared to integrate technology into the classroom (U.S. Department of Education,
A finding of the present study shows a very slight negative relationship existed between district average teacher years experience and district household median income. Since there is no significant correlation between preservice teacher technology competency and either variable, conclusions cannot determine that those from lower median income districts and districts with more experienced (older) teachers exhibited lower levels of technology competency on the ATC.

A very slight positive relationship exists between district average number of teacher hours of professional development related to technology and median household income. This relationship is interesting and supports earlier research that identifies a positive relationship between increased household median income and technology related professional development opportunities for teachers. Despite the relationship of these independent variables with each other, conclusions about the relationships that affect preservice teacher technology competency cannot be made.

While practically significant relationships were not detected among the dependent and independent variables of this study, a slight positive relationship between class size and median income was discovered through the analysis of the inferential results. However, the relationship is not relevant to the purpose of the research since neither variable shows a correlation with the dependent variable. It is interesting to note that this relationship exists. Based on research of socioeconomic status (National Education Association, 2004; Riel & Schwarz, 2002), the researcher expected to find a negative relationship between the two variables (i.e., an increase in district median income and decrease in class size or vice versa, an increase in class size and decrease in median income). Rather, this study showed the contrary.

The present research did not detect a relationship between overall ATC scores and independent variables of either district average inservice teacher number of years experience or
average inservice teacher number of hours of professional development. That is not to say that such relationship does not exist, rather that the variables as defined in this study were not sufficiently discriminating so as to detect differences that might have been present. In addition, the district variables of teacher professional development and experience were ordinal which limited the variability.

Research Question 2

Which factor (socioeconomic status, K-12 teacher number of years teaching experience, K-12 teacher average number of hours of professional development in the area of technology, and student background experiences) best predicts technology competency of preservice teachers?

Multiple regression was used to determine the factor that best predicts preservice teacher technology competency; however, no correlations were detected among the dependent and independent variables. As a result, a significant regression model was not generated.

Research Question 3

Are there group differences in technology competency with respect to: Preservice teachers’ completion of a high school computer class, number of hours per week, district median household income (above or below state media), district location (rural, urban, suburban)?

An interesting finding of this study was that preservice teachers who had more time per week on any computer during high school showed higher overall ATC scores. This finding indicates that these preservice teachers possess more of the foundational technology skills that are critical in learning how to integrate technology into teaching and learning. Specific details related to what preservice teachers accomplished during the estimated number of hours of computer time was not available in this study, however might be considered as an area for
further investigation. There is benefit to purely and simply increasing the amount of time
students spend on the computer per week to provide opportunity for students to experience
computer application programs in general.

This study also found that those preservice teachers who completed a computer class in
high school showed higher overall ATC scores. The content of the “computer class” that
preservice teachers completed when in high school is unknown, only that at least one class was
completed. Regardless of the content of the computer class, preservice teachers generally
benefited from the experience of using a computer interface to navigate and communicate using
a mouse and keyboard. The possibility exists for preservice teachers to have completed more
than one computer class, yet the ATC Retake Survey only provided for a response of “yes” or
“no” for having completed a computer class during high school.

Recommendations for Practice

Determining the level of technology competency of preservice teachers through the use
of an evaluation such as the ATC is important to the overall success of the teacher preparation
program in the planning process to prepare future teachers to integrate technology into teaching
and learning. If teacher preparation programs need to continue developing technology skills for
preservice teachers, then accommodations within the teacher preparation curriculum need to be
made to increase the technology skill levels of preservice teachers. Advancing integration
practices of preservice teachers to meet the NETs *T standards by the end of the teacher
preparation program depends on competency in basic technology skills of word processing,
spreadsheet, and presentation.

At the preservice teacher preparation level, ISTE recommends key technology skills of
prospective teachers (NETs *T) as they pass through phases of technology integration, General
Preparation, Professional Preparation, Student Teaching/Internship, First Year Teaching. In alignment with the use of the ISTE NETs for students in K-12 classrooms, the ATC actually measures technology skills from NETs at the ninth through twelfth grade levels. When preservice teachers begin to demonstrate an increase in technology skills through improved results of the ATC scores, program development and adaptations will advance to address the ISTE NETs*T at the general and professional preparation levels. Continued monitoring of preservice teacher technology skills upon entrance to the teacher preparation program is essential and acts as a barometer for advancing technology integration skills as well as facilitates a process for data-driven decision making related to more advanced technology curriculum, faculty professional development and technology infrastructure needs for teacher preparation programs.

The outcome of the present study has implications for K-12 school districts of Ohio who are not situated to provide resources for teachers or students to integrate technology into the classroom. Regardless of the content of the learning experience, an increase in number of hours of computer time for students may be a positive step towards increasing technology competency of students who enter preservice teacher preparation professional development programs. The present study shows that preservice teachers’ background experience utilizing technology has a positive effect on their ability to demonstrate technology competencies related to teacher preparation. If high school students are provided more opportunities for computer use on a weekly basis and complete one or more computer classes, then an increased level of technology competency upon entrance to colleges of education may be demonstrated. This overall increase in technology skills would most likely reduce the variability of technology skills among entering teacher candidates. Presently, a very small percentage of K-12 schools in the United States are evaluating levels of student technology skills as a graduation requirement (Education Week,
Rather than addressing the issue of low level of technology competency upon entrance to teacher preparation programs, student technology skill levels should be evaluated nationally as a graduation requirement. Then, specifically, teacher preparation programs can focus on technology integration practices for the classroom and meet the goals set forth by the No Child Left Behind Act of preparing new teachers with expertise of classroom technology integration.

An additional implication for K-12 school districts of Ohio is the potential of obtaining data from BGSU that is gathered through the ATC process which provides performance levels of technology competency of high school students who have entered the college of education teacher preparation program. The findings of this study strengthen the importance of technology integration in the K-12 classroom. Teacher professional development at the preservice level should focus on the pedagogy of integration in the classroom rather than the acquisition of technology skills (Banister & Vannatta, 2006). Thus, incoming preservice teachers are expected to enter with a foundation of skills that can be used in general education and applied in the classroom. At a time when accountability and data-driven decision making are the focal point of school reform efforts, access to student performance data is valuable for tracking district success of students post-graduation. K-12 school districts can benefit from this information to guide practices for improving technology skills of K-12 students.

Recommendations for Future Research

The participants of this study were selected based on their inability on the first attempt to successfully pass all sections of the ATC and subsequently were provided the opportunity to retake the ATC test and complete the ATC Retake Survey. The overall ATC scores of this sample were already indicative of their low level technology skills. To improve the outcome of predicting technology competency, the sample of preservice teachers should include all
participants of the Introduction to Education course and the ATC. By studying all preservice teachers who have taken the ATC and discriminating the first round ATC scores from the ATC retake scores, there will be a wider representation of skill levels. Furthermore, an issue related to the present study was the low number of preservice teachers representing the large number of Ohio districts in this study. There were 278 students representing 156 Ohio districts, roughly 2 former students from each district being studied. This may be an explanation for why no correlations existed.

While the present study may not have successfully correlated variables in attempt to predict preservice teacher technology competency, an approach for examining the variables of background experiences preservice teachers have with technology was provided. The focus for researching additional, or more specific district, teacher, and preservice teacher related factors is narrowed. Several limitations have inhibited the outcome of the present study. For example, the K-12 school district variables were based on socioeconomic status categories established by data gathered from combined resources at the state level. The district variables were too broad to be specifically aligned to technology and the outcome of an individual preservice teacher performance assessment such as the ATC. Future studies of predicting preservice teacher technology competency could focus less on the district variables and more on factors directly associated with individual preservice teachers, such as college entrance exam scores (SAT/ACT), background experiences with specific computer uses at home and school, as well as specific types of computer courses completed in high school.

Another limitation of the study to predict student technology competency was the categorical nature of the student background variables for example. The response options were too broad to identify specific behaviors that lead to technology competency (for instance “yes” or
“no” responses for completion of computer class in high school). Survey questions regarding student background should be written more specifically to the completion of technology competencies in high school (wp, ss, ppt) that are being evaluated at the preservice teacher program. A revised education and technology background survey should be administered prior to completion of the ATC scores and then should be compared with aggregated results of the education and technology background survey. The goal of the revised education and technology background survey would be to collect specific information about preservice teachers’ access to computers at home and school, number of hours of computer time per week, and quantity and quality of computer courses completed during high school. With better alignment of individual technology background experiences and technology competencies, there may be different results in predicting technology competencies of preservice teachers.

Additional research agendas should include continued efforts in predicting preservice teacher technology competency to establish and document levels of technology skills upon entrance to the teacher preparation program. With a report of technology skill levels upon entrance to the program, preservice teachers’ increase in skills can be measured in phases through completion of the program, at which time assessment and evaluation of program success in preparing teachers to integrate technology into the classroom may be conducted.

Coursework throughout the BGSU teacher preparation program is aligned with technology standards set forth by ISTE NETs*T. Presently, BGSU does not conduct an assessment of technology competency at the conclusion of the teacher preparation program; however, administration of such assessment would provide a record of preservice teachers’ level of technology competency upon program completion and provide an additional measure of accountability. An increase or decrease in variation of technology competencies of entering
freshmen can also be assessed and used as a variable in the research of preservice teacher technology integration skills at the conclusion of the teacher preparation program.

Transformation of PK-16 education continues based on evaluation of institutional data to measure success and failure of instructional practices. The ATC represents a benchmark at the early stage of a complex evaluation process in BGSU College of Education and Human Development. Additional key assessment records are used to measure success as preservice teachers progress through teacher preparation phases. The ATC is the only benchmark specific to technology integration. To measure the success of technology integration practices in the teacher preparation program at BGSU, a longitudinal study should be conducted including assessment points at the beginning, middle, and end of the program. With the use of the college database, program directors have the ability to continually monitor presevice teacher progress via ongoing evaluation of data specific to critical program benchmarks.

Conclusion

In conclusion, the study of predicting technology competency of preservice teachers is part of an assessment process of learning how to break the cycle of low technology skills of preservice teachers. Researchers have been studying teacher professional development with technology for decades and have discovered many ways to improve practices, yet have not been able to conquer the issue of low levels of technology use in the classroom. Continued research in this area will evolve in the effort to increase practices of technology integration in the classroom throughout the cycle of PK-16 education. Studies such as predicting preservice teacher technology competency provide more clues that assist in the process of identifying the strengths and weaknesses within the cycle of low levels of technology competency. The results of the present study have provided this researcher with enough insight to provide subtle approaches to
remedying the problem of preservice teachers entering colleges of education with low levels of technology competency.
REFERENCES


International Society for Technology in Education [ISTE]. (1999). *Will new teachers be prepared to teach in a Digital Age? A national survey on information technology in teacher education*. Santa Monica, CA:


APPENDIX A. ISTE NATIONAL EDUCATION TECHNOLOGY STANDARDS FOR STUDENTS

Technology Foundation Standards for All Students

The technology foundation standards for students are divided into six broad categories. Standards within each category are to be introduced, reinforced, and mastered by students. These categories provide a framework for linking performance indicators within the Profiles for Technology Literate Students to the standards. Teachers can use these standards and profiles as guidelines for planning technology-based activities in which students achieve success in learning, communication, and life skills.

Technology Foundation Standards for Students

1 Basic operations and concepts
   • Students demonstrate a sound understanding of the nature and operation of technology systems.
   • Students are proficient in the use of technology.

2 Social, ethical, and human issues
   • Students understand the ethical, cultural, and societal issues related to technology.
   • Students practice responsible use of technology systems, information, and software.
   • Students develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.

3 Technology productivity tools
   • Students use technology tools to enhance learning, increase productivity, and promote creativity.
   • Students use productivity tools to collaborate in constructing technology-enhanced models, prepare publications, and produce other creative works.

4 Technology communications tools
   • Students use telecommunications to collaborate, publish, and interact with peers, experts, and other audiences.
   • Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.

5 Technology research tools
   • Students use technology to locate, evaluate, and collect information from a variety of sources.
   • Students use technology tools to process data and report results.
   • Students evaluate and select new information resources and technological innovations based on the appropriateness for specific tasks.

6 Technology problem-solving and decision-making tools
   • Students use technology resources for solving problems and making informed decisions.
   • Students employ technology in the development of strategies for solving problems in the real world.
Educational Technology Standards and Performance Indicators for All Teachers

Building on the NETS for Students, the ISTE NETS for Teachers (NETS•T), which focus on preservice teacher education, define the fundamental concepts, knowledge, skills, and attitudes for applying technology in educational settings. All candidates seeking certification or endorsements in teacher preparation should meet these educational technology standards. It is the responsibility of faculty across the university and at cooperating schools to provide opportunities for teacher candidates to meet these standards.

The six standards areas with performance indicators listed below are designed to be general enough to be customized to fit state, university, or district guidelines and yet specific enough to define the scope of the topic. Performance indicators for each standard provide specific outcomes to be measured when developing a set of assessment tools. The standards and the performance indicators also provide guidelines for teachers currently in the classroom.

1 TECHNOLOGY OPERATIONS AND CONCEPTS.
Teachers demonstrate a sound understanding of technology operations and concepts. Teachers:
- demonstrate introductory knowledge, skills, and understanding of concepts related to technology (as described in the ISTE National Education Technology Standards for Students)
- demonstrate continual growth in technology knowledge and skills to stay abreast of current and emerging technologies.

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

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

4 ASSESSMENT AND EVALUATION.
Teachers apply technology to facilitate a variety of effective assessment and evaluation strategies. Teachers:

- apply technology in assessing student learning of subject matter using a variety of assessment techniques.
- use technology resources to collect and analyze data, interpret results, and communicate findings to improve instructional practice and maximize student learning.
- apply multiple methods of evaluation to determine students’ appropriate use of technology resources for learning, communication, and productivity.

5 PRODUCTIVITY AND PROFESSIONAL PRACTICE.

Teachers use technology to enhance their productivity and professional practice. Teachers:

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

6 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 those principles in practice. Teachers:

- model and teach legal and ethical practice related to technology use.
- apply technology resources to enable and empower learners with diverse backgrounds, characteristics, and abilities.
- identify and use technology resources that affirm diversity
- promote safe and healthy use of technology resources.
- facilitate equitable access to technology resources for all students.
Essential Conditions for Teacher Preparation

A combination of essential conditions is required for teachers to create learning environments conducive to powerful uses of technology. The most effective learning environments meld traditional approaches and new approaches to facilitate learning of relevant content while addressing individual needs. For these new learning environments to develop, certain prerequisite factors or essential conditions must be present in every phase of an aspiring teacher's education-in the university's general education programs, in the chosen major, in teacher preparation programs, and at the school sites hosting student teachers and interns. First-year teachers cannot be expected to put into practice what they have learned about how to use technology without the presence of these essential conditions in their new job environment. Policy decisions supporting technology use greatly affect a new teacher's ability to use technology effectively.

Because there are many avenues to becoming a teacher, this document addresses a wide variety of teacher preparation program designs. In the context of university-based programs, teacher education must be viewed as a university-wide responsibility. Prospective teachers must experience and observe effective uses of technology in their general education and major coursework. School and college of education coursework must consistently model exemplary pedagogy that integrates the use of technology for learning content with methods for working with PK-12 students.

In school-based programs, candidates must continually observe and participate in the effective modeling of technology use for both their own learning and the teaching of their students. Technology must become an integral part of the teaching and learning process in every setting supporting the preparation of teachers. The following elements are necessary to be in place at the university, the college or school of education, and the school site:

- **Shared Vision** – There is proactive leadership and administrative support from the entire system.
- **Access** – Educators have access to current technologies, software, and telecommunications networks.
- **Skilled Educators** – Educators are skilled in the use of technology for learning.
- **Professional Development** – Educators have consistent access to professional development in support of technology use in teaching and learning.
- **Technical Assistance** – Educators have technical assistance for maintaining and using the technology.
- **Content Standards and Curriculum Resources** – Educators are knowledgeable in their subject matter and current in the content standards and teaching methodologies in their discipline.
- **Student-Centered Teaching** – Teaching in all settings encompasses student-centered approaches to learning.
- **Assessment** – There is continuous assessment of the effectiveness of technology for learning.
- **Community Support** – The community and school partners provide expertise, support, and resources.
- **Support Policies** – School and university policies, financing, and rewards structures are in place to support technology in learning.
The following chart provides guidelines for the essential conditions that should be in place for each phase in the teacher preparation process in order to support effective use of technology to improve learning, communications, and productivity.

<table>
<thead>
<tr>
<th>General Preparation</th>
<th>Professional Preparation</th>
<th>Student Teaching/Internship</th>
<th>First-Year Teaching</th>
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<tbody>
<tr>
<td><strong>SHARED VISION</strong>—There is proactive leadership and administrative support from the entire system.</td>
<td>The professional education administration and faculty share a vision for technology use to support new modes of teaching and learning.</td>
<td>University personnel and teachers and school administrators at the cooperating school site share a vision for technology use in the classroom.</td>
<td>Schools, districts, and universities share a vision for supporting new teachers in their use of technology in the classroom.</td>
</tr>
<tr>
<td>University leaders share a vision for technology use in all appropriate courses and content areas.</td>
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</tr>
<tr>
<td><strong>ACCESS</strong>—Educators have access to current technologies, software, and telecommunications networks.</td>
<td>Access to current technologies, software, and telecommunications networks is provided for all students and faculty both inside and outside the classroom.</td>
<td>Access to current technologies, software, and telecommunications networks is provided for teacher education faculty, classes, and field sites, including technology-enhanced classrooms that model environments for facilitating a variety of collaborative learning strategies.</td>
<td>Access to current technologies, software, and telecommunications networks is provided for new teachers for classroom and professional use, including access beyond the school day.</td>
</tr>
<tr>
<td>Access to current technologies, software, and telecommunications networks is provided for all students and faculty both inside and outside the classroom.</td>
<td></td>
<td>Access to current technologies, software, and telecommunications networks is provided for student teachers/interns and their master teachers/mentors/supervisors in the classroom and professional work areas.</td>
<td></td>
</tr>
<tr>
<td><strong>SKILLED EDUCATORS</strong>—Educators are skilled in the use of technology for learning.</td>
<td>Teacher education faculty are skilled in using technology systems and software appropriate to their subject area specialty and model effective use as part of the coursework.</td>
<td>Master (cooperating/supervising) teachers and university supervisors model technology use that facilitates students' meeting the ISTE National Educational Technology Standards for Students.</td>
<td>Peers and administrators are skilled users of technology for teaching and school management.</td>
</tr>
<tr>
<td>Faculty teaching general education and major courses are knowledgeable about and model appropriate use of technology in their disciplines.</td>
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### PROFESSIONAL DEVELOPMENT
—Educators have consistent access to professional development in support of technology use in teaching and learning.

- University faculty and students are provided with opportunities for technology skill development and reward structures that recognize the application of technology in teaching, learning, and faculty collaboration.

- Personnel in teacher education and field experience sites are provided with ongoing professional development.

- Cooperating/master teachers and supervisors of student teachers/interns are readily provided with professional development in applications of technology in teaching.

- Faculty has continuous access to a variety of professional development opportunities in several delivery modes, with time to take advantage of the offerings.

### TECHNICAL ASSISTANCE
—Educators have technical assistance for maintaining and using the technology.

- Timely technical assistance is available for all faculty to ensure consistent, reliable functioning of technology resources.

- Technical assistance for teacher education faculty and students is readily accessible and includes expertise in the use of technology resources for teaching and learning in PK-12 settings.

- In field-experience settings, technical assistance is onsite to ensure reliability of technology resources.

- Technical assistance for faculty and staff is timely, onsite, and includes mentoring to enhance skills in managing classroom software and hardware resources.

### CONTENT STANDARDS AND CURRICULUM RESOURCES
—Educators are knowledgeable in their subject matter and current in the content standards and teaching methodologies in their discipline.

- Prospective teachers have knowledge in the subject area(s) they intend to teach.

- Technology-based curriculum resources that address subject matter content standards and support teaching, learning, and productivity are available to teacher candidates.

- Technology-based curriculum resources that are appropriate in meeting the content standards in teaching areas and grade ranges are available to teacher candidates at the student/intern site.

- The school district provides professional development opportunities related to local policies and content standards and the technology-based resources to support the new teacher’s efforts to address those standards.
**STUDENT-CENTERED TEACHING**—Teaching in all settings encompasses student-centered approaches to learning.

| University faculty incorporate student-centered approaches to learning (e.g., active, cooperative, and project-based learning). | Teacher education faculty and professional teaching staff model student-centered approaches to instruction in education coursework and field experiences. | Opportunities to implement a variety of technology-enhanced, student-centered learning activities are provided for teacher candidates/interns. | Faculty routinely use student-centered approaches to learning to facilitate student use of technology. |

**ASSESSMENT**—There is continuous assessment of the effectiveness of technology for learning.

| University faculty and support staff assess the effectiveness of technology for learning to examine educational outcomes and inform procurement, policy, and curriculum decisions. | Teacher education faculty and professional teaching staff model the integration of teaching and assessment to measure the effectiveness of technology-supported teaching strategies. | Cooperating/staff master teachers work with student teachers/interns to assess the effectiveness of technology-supported learning and of technology in supporting that learning. | The district and school site support the classroom teacher in the assessment of learning outcomes for technology-supported activities to inform planning, teaching, and further assessment. |

**COMMUNITY SUPPORT**—The community and school partners provide expertise, support, and resources.

| Prospective teachers experience technology use in real-world settings related to their general education and courses in their majors. | Teacher preparation programs provide teacher candidates with opportunities to participate in field experiences at partner schools where technology integration is modeled. | Student teachers/interns teach in partner schools where technology integration is modeled and supported. | Schools provide beginning teachers with connections to the community and models of effective use of local and other resources. |

**SUPPORT POLICIES**—School and university policies, financing, and reward structures are in place to support technology in learning.

| University faculty are provided with resources for meeting subject area needs and with reward structures that recognize the application of technology in teaching, learning, and faculty collaboration. | Policies associated with accreditation, standards, budget allocations, and personnel decisions in teacher education programs and field experience sites support technology integration. Retention, tenure, promotion, and merit policies reward innovative uses of technology by faculty with their students. | Student teaching/internships are located at sites where administrative policies support and reward the use of technology. | School induction-year policies, budget allocations, and mentoring assignments support the first-year teacher’s use of technology. Hiring practices include policies regarding technology skills of prospective hires. |
APPENDIX D. BGSU ASSESSMENT OF TECHNOLOGY COMPETENCY EVALUATION RUBRIC

EDHD Assessment of Technology Competencies
Scoring Checklists

Student Name______________________ Section #________

Part 1: Word Processing

<table>
<thead>
<tr>
<th>Criterion</th>
<th>LH Column</th>
<th>RH Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>Header in Word Art across both columns</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>Two columns in document</td>
<td>pass fail</td>
<td></td>
</tr>
<tr>
<td>Horizontal blue line across both columns</td>
<td>pass fail</td>
<td></td>
</tr>
<tr>
<td>Horizontal line is 3 point thickness</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>• Title of article and name placed before text</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>• Two font types used</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>• Justified text</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>• Two font styles used</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>• Two font sizes used</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>• Spell check used (no spelling errors)</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>• Graphic inserted below article</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>• Web site address of graphic noted</td>
<td>pass fail</td>
<td></td>
</tr>
<tr>
<td>File saved correctly</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>File transmitted successfully</td>
<td>pass fail</td>
<td></td>
</tr>
</tbody>
</table>

Note: “Fail” on any item is failure for Part 1 only.

Part 2: Spreadsheet

<table>
<thead>
<tr>
<th>Criterion</th>
<th>LH Column</th>
<th>RH Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numerical data in columns displayed according to instructions</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>Bold font is used for column headers</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>First column size is adjusted</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>Formulas entered correctly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Class average (#####)</td>
<td>pass fail</td>
<td></td>
</tr>
<tr>
<td>• Total (###)</td>
<td>pass fail</td>
<td></td>
</tr>
<tr>
<td>Numbers formatted per instructions (2 decimal places)</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>Columnar chart shown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Columnar chart created per instructions</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>• Appropriate data shown in chart</td>
<td>pass fail</td>
<td></td>
</tr>
<tr>
<td>• Title for chart included</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>• Categories labeled properly on x-axis</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>Spreadsheet saved correctly</td>
<td>pass 0</td>
<td></td>
</tr>
<tr>
<td>Spreadsheet transmitted electronically</td>
<td>pass fail</td>
<td></td>
</tr>
</tbody>
</table>

Note: “Fail” on any item is failure for Part 2 only.
### Part 3: Presentation Software

<table>
<thead>
<tr>
<th>Project consists of 2 slides</th>
<th>pass</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title Slide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Used slide design</td>
<td>pass</td>
<td>fail</td>
</tr>
<tr>
<td>• Information on slide accurate</td>
<td>pass</td>
<td>0</td>
</tr>
<tr>
<td>• Text centered</td>
<td>pass</td>
<td>0</td>
</tr>
<tr>
<td>• Clip Art inserted correctly and sized</td>
<td>pass</td>
<td>0</td>
</tr>
<tr>
<td>• Text box in lower left corner that reads “Call for more info.”</td>
<td>pass</td>
<td>0</td>
</tr>
<tr>
<td>Content slide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Title on slide per instructions</td>
<td>pass</td>
<td>0</td>
</tr>
<tr>
<td>• Bullet points use “wipe” animation</td>
<td>pass</td>
<td>0</td>
</tr>
<tr>
<td>• Uses “lightening bolt” autoshape</td>
<td>pass</td>
<td>fail</td>
</tr>
<tr>
<td>• Default fill color is changed</td>
<td>pass</td>
<td>0</td>
</tr>
<tr>
<td>Slide Show features</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transition added to all slides</td>
<td>pass</td>
<td>fail</td>
</tr>
<tr>
<td>Presentation saved per instructions</td>
<td>pass</td>
<td>0</td>
</tr>
<tr>
<td>Presentation transmitted electronically</td>
<td>pass</td>
<td>fail</td>
</tr>
</tbody>
</table>

**Note:** "Fail" on any item is failure for Part 3 only.
APPENDIX E. ATC RETAKE SURVEY

ATC Retake Survey Spring 2005

Directions: There are two parts to this survey. Part 1 inquires about your experiences with the ATC. Part 2 inquires about your background experience from high school. Please answer each question by placing a checkmark next to the appropriate response.

PART 1 – ATC Experience
1. This summer you likely received information regarding the Assessment of Technology Competencies (ATC) in your orientation packet. How did you use this information?
   a. I did not attend orientation
   b. I read it and it was informative
   c. I read it and used it to prepare for the assessment
   d. I did not read it

2. What resources did you use to prepare for the ATC for the FIRST time you took it? Check all that apply.
   a. Practice Test
   b. Support Sessions
   c. Knowledgeable friend/family member
   d. Did not prepare for first ATC
   e. Online Tutorials
   f. Student Tech Center
   g. Other (describe): ____________________________

3. What part(s) of the ATC are you RETAKING? Check all that apply.
   a. Word Processing
   b. Spreadsheet
   c. PowerPoint

4. What resources did you use to prepare to RETAKE portions of the ATC? Check all that apply.
   a. Practice Test
   b. Online Tutorials
   c. Support Sessions
   d. Did not prepare for first ATC
   e. Student Tech Center
   f. Knowledgeable friend/family member
   g. Other (describe): ____________________________

5. How did you use the ATC web site? Check all that apply.
   a. I reviewed the ATC video-based tutorial
   b. I downloaded the ATC practice test
   c. I downloaded the ATC test rubric

6. What method did you use to register for taking the ATC?
   a. Email to ATC administrator
   b. Walk-in to ATC office and signed up
   c. Phone the ATC office

PART 2 – Background Experience
7. Prior to entering BGSU did you have a computer with internet connectivity at home?  Yes  No

8. Did you have a computer class in high school prior to attending BGSU? Yes  No

9. How many hours of computer time per week would you estimate you had in high school prior to attending BGSU?
   a. 0-5
   b. 6-10
   c. 11-15
   d. 16-20
   e. more than 20

10. For each of the following categories, place a check mark next to the option that best describes your high school.

<table>
<thead>
<tr>
<th>TYPE of School</th>
<th>Location</th>
<th>Graduating Class Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>Public School</td>
<td>1-49</td>
</tr>
<tr>
<td>Suburban</td>
<td>Private (parochial, charter)</td>
<td>50 - 99</td>
</tr>
<tr>
<td>Urban</td>
<td>Home School</td>
<td>100-199</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200-299</td>
</tr>
<tr>
<td></td>
<td></td>
<td>300-399</td>
</tr>
<tr>
<td></td>
<td></td>
<td>400-499</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500 +</td>
</tr>
</tbody>
</table>

11. Please provide the following information:
    Name of High School: ____________________________
    City (if private): ____________________________
    District Name (if public): _____________________
    State: ____________________________