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Analysis Of Preservice Teacher And Instructor Technology Uses And Beliefs

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ANALYSIS OF PRESERVICE TEACHER AND INSTRUCTOR TECHNOLOGY USES AND BELIEFS

by

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This dissertation, submitted by Adrienne M. Salentiny in partial fulfillment of the requirements for the Degree of Doctor of Philosophy from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done, and is hereby approved.

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ABSTRACT

In our technology-immersed society in which information is central to the economy, citizens should be fluent with technology and possess 21st century skills that support responsible and effective technology use (e.g., Lin, 2000; P21, 2009). Given the role of public education in creating citizenry with the skills society needs, these qualities should be developed at the K-12 level. This is best done if teachers integrate technology into their lessons (e.g., ISTE, 2008; NCES, 2002). However, research shows that inservice teachers are not integrating technology enough because of negative attitudes, poor confidence, inadequate education, a conflicted teaching philosophy, and other barriers (e.g., Ertmer, 1999). Some suggest that this may change because the current generation of preservice teachers, presumed to be technology-savvy digital natives, will not face these barriers (e.g., Prensky, 2001, 2005). Contrasting research shows that this generation is not uniformly technical, and that what knowledge they have does not transfer to professional settings (e.g., Oblinger & Oblinger, 2005). Furthermore, preservice teachers may be even less technically-inclined than their peers, making them more likely to face the same barriers as inservice teachers (e.g., Lei, 2009; Salentiny, 2010). Preservice education instructors may also face these barriers, and thus are unable to break the cycle (e.g., Ertmer, 2005).

If we are to encourage technology integration, we must understand more about the technology characteristics of preservice teachers, their instructors, and the barriers (e.g., attitudes and beliefs) they face. To determine how to avoid preservice level barriers, research needs to explore these technology characteristics. This will help determine whether barriers are present or developing during preservice education. 198 preservice teachers and 21 instructors at a Midwestern university were surveyed about technology use and beliefs. In addition, nine preservice teachers and three instructors were interviewed as follow up to this survey. Results indicate that preservice teachers and instructors display positive attitudes about technology, but only mid-level confidence in their skills with it. Factors that could lead to barriers were found. Instructors believed it was important for preservice teachers to learn pedagogical skills with technology. Implications for preservice education are discussed.

CHAPTER I

INTRODUCTION

Introduction

Technology has become an important and practically unavoidable aspect of American life, becoming embedded in people's personal and professional lives (Eisenberg, 2008; Princeton Survey Research Associates International, 2007). The majority of Americans have computers with Internet access (Internet World Stats, 2011). Over 90% of adults have an email address that they use to communicate online, and mobile phones that they use for voice and text communication (Pew Internet Research Center, 2011b; 2011c). About a third of Americans can also access the Internet from almost anywhere using Internet-enabled mobile phone technology, and that number is rising (Deloitte, 2011). Technology is used for personal and business purposes and has become impossible to avoid for most people (e.g., Murnane & Levy, 2004). The prevalence of technology has led to a need for citizens to possess knowledge and skills that allow them to understand technology, and use it responsibly and creatively to solve problems, communicate, and be successful in the 21^{st} century.

Learning these 21^{st} century skills is thus important for young people as they transition from secondary education to college or future careers (Partnership for 21^{st} Century Skills, 2009). These 21^{st} century skills—including critical thinking, problem solving, economic, social, ethnic, cultural, technology, and multimedia-related awareness and understanding—should be developed through an educational setting in which technology has been integrated by teachers and students (e.g., Jackson, Helms, Jackson, & Gum, 2011; Margaryan, Littlejohn, & Vojt, 2011; Norton & Hathaway, 2008). It is important to note that technical skills are not the focus of the 21st century skills. Technical skills (also referred to as technology literacy) are important but not sufficient to enable a person's success in dealing with complex technology-related issues. Technology fluency (literacy plus higher order skills), which includes the informed and creative application of technical knowledge to diverse situations (Lin, 2000; NRC, 1999; U.S. Dept. of Education, 1996), is closer to what 21st century skills refer to.

So how can young people become technology-fluent and develop 21st century skills? Standards have been developed to guide efforts to improve the technology fluency of students, encouraging development of 21st century skills (ISTE, 2008; CCSSI, 2011). These standards emphasize methods of teaching that include technology. The constructivist approach of technology integration is one of these methods. Technology-integrated lessons focus on pedagogy and learning the subject matter, but interweave technology in ways that enable the development of fluency and 21st century skills (e.g., ISTE 2008; NCES, 2002). To foster this development, students must be using technology resources to gain knowledge about the subject matter; through this type of use, they also develop understanding of how to apply technology to different types of situations (e.g., Ashburn & Floden, 2006; Jonassen, Peck, & Wilson, 1999; Lowther & Morrison, 2009). In contrast, computer skills (technology literacy) lessons such as keyboarding or software training do not exemplify technology integration (Davis, 1993; Dockstader, 1999). Teachers should understand the difference between teaching technology literacy and promoting technology fluency and 21st century skills. It will be easier for them to recognize and employ methods that achieve this if they are technology fluent themselves (e.g., Graham, Culatta, Pratt, & West, 2004; Gotkas, Yildirim, & Yildirim, 2009; ISTE, 2008; NCES, 2002). It must be noted that the method of technology integration is only one method of effective technology teaching. This study focused on technology integration and the barriers that may prevent it from happening, but this is only one of the issues that can lead to insufficiency in technology fluency and 21st century skills development.

Many teachers would like to integrate technology, but barriers keep them from using it in their classrooms (e.g., Bingimlas, 2009; Ertmer, 1999; Starkey, 2010). Some of these barriers, called second order barriers, are internal to teachers and can develop through personal experiences, professional experiences, or improper or absent education about technology's role in teaching (e.g., Bingimlas, 2009; Butler & Sellbom, 2002; Maddux & Johnson, 2010). development and administrative support solutions have been suggested to help inservice teachers overcome these second order barriers, because additional education can help these teachers gain the knowledge, skills, and confidence they were missing (e.g., Butler & Sellbom, 2002; Ertmer, 2005; Harris, Mishra, & Koehler, 2009). The question is: when do barriers actually develop? Is it only in the inservice setting? Or, are preservice teachers already facing barriers before they become inservice teachers? It is possible that preservice teachers face barriers—or at least encounter some of the issues that can lead to barriers—even as they begin their preservice education program.

The issue should be addressed in preservice education: this would ideally prevent preservice teachers from developing the barriers as they become inservice teachers (e.g., Russell, O'Dwyer, Bebell, & Tao, 2007; Weibe, 1995). Complicating the issue is the fact that many do not see this as a need. Some researchers believe that the younger generation of students—sometimes referred to as digital natives (Prensky, 2001)—are already fluent with technology by virtue of their immersion in technology from an early age (Palfrey & Gasser, 2008; Tapscott, 2009). Thus, the assumption is that this generation will not require technology instruction like earlier generations of students did, and that they will be able to understand technology easily by virtue of their attitudes and skillsets with technology (Prensky, 2001; 2006). Others are less optimistic, stating that even if students do have technical skills, they are unable to transfer these skills to practical or more complex situations (Oblinger & Oblinger, 2005). Still more researchers maintain that a naturally technology-savvy generation is a myth, and that in fact students differ greatly in their abilities, attitudes, and competencies with technology (e.g., Davies, 2011; Kaminski, Seel, & Cullen, 2003). These differences among students have been found in studies of students with similar or different socioeconomic status (Sanchez, Salinas, Contreras, & Meyer, 2011), college major, and between male versus female students (Kennedy, Judd, Churchward, Gray, & Krause, 2008; Larson, Wu, Bailey, Borgen, & Gasser, 2010).

Statement of the Problem

Because of their age, current and future preservice teachers are often identified as digital natives. The instructors of these students may be familiar with the position of researchers such as Prensky, Oblinger & Oblinger, or Tapscott—and thus may make inaccurate assumptions about the technology skills of these students. These instructors may not emphasize or model technology integration in the classroom, possibly because the instructors assume that students already possess this knowledge by virtue of their generational identity. Even if preservice teachers are technology literate (and research indicates they may not be), that does not mean they are fluent or that they can integrate technology. Young people who do possess technology skills struggle to apply them to practical and professional situations (Oblinger & Oblinger, 2005). Thus, an issue arises where instructors may be assuming that preservice teachers are digital natives, and therefore are technology fluent, when they are not, and that this fluency will translate to integration, which it does not (Kaminski, Seel, & Cullen, 2003).

Furthermore, instructors at the college level may face the same barriers to technology integration that are faced by inservice teachers (Ertmer, 2005). This is important to note because preservice teachers may also develop negative attitudes (one type of second order barrier) about technology if their instructors had a negative opinion about technology use in education (e.g., Bai & Ertmer, 2008; Russell, O'Dwyer, Bebell, & Tao, 2007; Weibe, 1995). The transfer of negative attitudes or beliefs from instructors to preservice teachers could be a source of second order barriers as those preservice teachers become inservice teachers. Plus, preservice teachers may already face, or may be developing, barriers that will further hinder their use of technology integration methods. Preservice teachers may not be as technology-savvy as their peers in other majors (e.g., Lei, 2009; Salentiny, 2010), but little is known about their actual technology characteristics.

These assumptions about technology fluency among preservice teachers—and how it ought to translate to classroom teaching—leads to a situation where preservice teachers need to learn the technology integration methods, but instructors are either not aware of this need, or unable to fulfill it. As a result, many inservice teachers have not been properly trained to integrate technology in the classroom, though they are expected to use the methods (e.g., Topper, 2004; Walden, 2010). Whether or not preservice teachers will integrate technology in their lessons when they become inservice teachers is related to the methods and philosophies by which these teachers were taught in college: if technology is not modeled or used by instructors, the students cannot understand how to apply technology to their own lessons (e.g., Russell, O'Dwyer, Bebell, & Tao, 2007; Weibe, 1995). If K-12 schools are focused on professional development that helps inservice teachers overcome barriers to technology integration, it is important to know what attitudes, beliefs, and—if applicable—barriers these teachers already had when they were still preservice teachers.

Focus of Study

Focusing on barriers in the inservice setting is useful, but may be too late, if barriers are developing or already present in preservice teachers. Technology skills, attitudes, and experiences with technology are some of the factors that can lead to the development of barriers (e.g., Ertmer, 1999). And, preservice teachers may have fewer skills with technology, poorer attitudes, and fewer experiences with technology than other members of the same generation (so, studies about the generation in general may not be applicable). Thus, this study focused on the technology characteristics of preservice teachers specifically (e.g., Ertmer, 1999; Walden, 2010). The technology characteristics of college instructors who teach preservice teachers were also studied because they are related: instructors' methods, their attitudes, and their beliefs about the skills of preservice teachers can influence the teaching methods of those preservice teachers as they become inservice teachers (e.g., Teo, 2009). The knowledge gained about the technology characteristics of preservice teachers and instructors leads to implications for increasing preservice teachers' fluency and technology integration knowledge, and removing barriers from their paths as they prepare to become inservice teachers.

Terms and Definitions

Technology

Technology in this study was defined by the participants and the survey questions. (A qualitative question asked them: "what is technology?") Technology for consumer, personal, and educational use was the focus, including devices (e.g., computers, projectors, phones, *SMARTboards*), the Internet, and software (e.g., word-processing programs, smartphone apps, *Blackboard*).

Instructional Technology

The processes associated with the use of technology in teaching and learning environments. This includes technology resources developed specifically for education or those that have been adapted for that purpose.

Technology Literacy

The possession of a basic set of technical skills, not inclusive of higher-order thinking skills.

Technology Fluency

The skills required for technology literacy, with the addition of higher-order thinking skills needed to understand how and when to use technology for problem solving, critical thinking, teaching, learning, and other creative functions in the 21st century.

Technology Integration

Technology used as a constructivist teaching and learning method, as a contextual part of the curriculum. Integrated technology should be purposeful and tied to learning objectives, and the primary objective of the integrated lesson should not be to teach computer skills (literacy) to students. Carefully chosen technology tools are integrated in to a lesson (not included as a form of busy-work or used outside of the lesson context).

Technology Attitudes

Attitude refers to positive or negative feelings or inclinations preservice teachers and instructors have about technology. It is mentioned here because in this study, it relates to data collected under the quantitative subscale called Technology Knowledge, Interest, and Skills. It is also measured qualitatively.

Preservice Teacher

A college student who is majoring in education with the intention of becoming a teacher of students in grades kindergarten through 12th grade (K-12).

Inservice Teacher

An employed teacher in grades kindergarten through 12th grade (K-12).

Instructor

A professor or instructor at the college level. For the purpose of this study, ‘Instructor’ refers specifically to those instructors who are responsible for instructing preservice teachers.

CHAPTER II

LITERATURE REVIEW

Introduction

In order to examine the context in which technology use in schools is theoretically situated, this chapter begins by framing the 21st century society of the United States as one that is technology-immersed. A framework of 21st century skills—skills young people will need to be successful in this technology-immersed society—is then presented, followed by descriptions of the commonly researched attributes we can use to understand those skills. Research on technology literacy, fluency, and integration are discussed as three different outcomes or approaches to teaching technology in schools, with particular emphasis on how they do and do not relate to 21st century skills. Technology standards and guidelines developed to aid teachers in this process are then explored within the context of these three different technology outcomes, followed by a discussion of the evidence that they are still not being taught properly or at all in many cases. Next, the reasons for this lack of progress are explored, with particular emphasis on Ertmer's concept of barriers and some of the proposed solutions to removing them. The chapter concludes by relating the context and implications of all of this to today's preservice teachers specifically the possibility that their instructors may believe preservice teachers are digital natives who are already fluent with technology. While the concept of a digitally native generation is flawed, even less is known of its relation to preservice teachers who, some research suggests, may be less enthusiastic and less skilled with technology than their peers (e.g., Lei, 2009), who themselves are not digital natives. Thus, preservice teachers may be facing barriers before they even begin their teaching careers (and not developing them later, when they are inservice teachers). Only through understanding the technology characteristics of these individuals can we understand those barriers and formulate possible solutions.

Technology Immersion in Society

Technology is prevalent in society, affecting the majority of people in the United States on a daily basis (Eisenberg, 2008). The ability to use technology is not an elite skillset that is only encountered by top executives or research scientists; computers are used in practically all sectors of the job market, meaning everybody would benefit from the possession of technical skills as well as skills to think and communicate using technology (Murnane & Levy, 2004). Technology knowledge is necessary for a person to be a well-rounded, socially active, powerful, and educated individual (Bundy, 2004). It seems that technology has become a part of the majority of American people's lives, and that it has the potential to improve productivity, efficiency, and quality of life.

Technology and Business

The technologically-immersed nature of the modern economy becomes apparent when we consider the ways technology has affected and changed professional roles. Many offices use computers for productivity, efficiency, and convenience (Atrostic & Nguyen, 2006). Employers are likely to require technical knowledge for all or most levels of employees (Murnane & Levy, 2004). Many businesses also choose to use the Internet to connect with potential customers and colleagues.

Video and audio conferencing software tools are commonly used in office environments, with half of America’s companies using some type of video conferencing tool and another quarter looking to start (BusinessWire, 2011). These tools allow employees to hold meetings without needing to be in the same room, or even on the same continent. Meeting attendees are able to attend a meeting by using their computer or smart phone to access the conference. They can then share projects and documents digitally, along with their image and voice. Advances in this type of technology have greatly cut down on the need for companies to operate from a central office environment, allowing for more flexibility in hiring and working (BusinessWire, 2011).

The use of social networking websites such as *Twitter* and *Facebook* by businesses has increased, with the average business doubling their social media-related marketing budget over the past two years (Hubspot, 2011). According to a 2011 report by Burson-Marsteller, over three-quarters of the 2011 Fortune 100 companies have a social media presence on the Twitter website, with nearly two-thirds of those companies using Facebook for the same reasons. According to that same report, these businesses use the social networking accounts for activities including news and announcements, promotions, and to deliver customer service.

Since technology use does not stop when employees leave the office, employers may provide their staff mobile devices to connect to their professional accounts while away from the computer—scheduling meetings, keeping track of tasks, receiving reminders, editing documents, and following up with clients. As smart phones gain popularity, more people are developing software applications with productivity in mind, making the tasks of businesses and individuals easier to access on the go (Ueland, 2012).

The business sector is not the only part of society that has been affected by technology. Since technology is also used in personal ways, it may become difficult for people to separate personal from professional technology use. The Internet is accessible by most people (Internet World Stats, 2011), and as such professionals must temper what they do online, taking in to consideration that anything they say, do, or have a photo of may also be visible to their employers. In some instances, people have been terminated from their positions because of what they have said or done on the Internet during their personal time (Armour, 2005; ProofPoint, 2009). According to the ProofPoint study, 8% of companies reported having fired someone because of something written on a social networking website.

Technology in the Home (and Elsewhere)

The prevalence of technology in professional settings is mirrored by the presence of technology in people's personal lives. Most people own and use some type of personal technology device (Princeton Survey Research Associates International [PSRAI], 2007), and the majority of American adults—nearly 80%—have access to the Internet (Internet World Stats, 2011). Of those who have the Internet, almost all of them have used it to find information, and about two-thirds of them do so regularly (Pew Internet Research Center, 2011c).

Email is a text-based method of communicating over the Internet. Email can be used to send text and multimedia messages, and to exchange files. Almost everyone who uses the Internet has a personal email address (Pew Internet Research Center, 2011c): accounts can be set up free of charge through many companies including Google and Microsoft. Email addresses may also be provided through an employer or an academic institution. Recall that many businesses use social networking tools to attract clients and communicate; individuals may also communicate and collaborate by using social networking tools, and the majority of Internet users use them. In a 2011 survey, 65% of adults said they use social networking (Pew Internet Research Center, 2011a). As with social networking and email, individuals may use the same or similar video chatting tools as are used by businesses for conference calls and networking. For personal use, people may use software products including *Skype, Google Talk*, and *Apple FaceTime*. These are either free, or available at a low price.

Technology can be used for more than just connecting to others. In 2010, 85% of U.S. residents reported having shopped online for merchandise including clothing, shoes, books, electronics, toys, tickets to events, and many other items (Nielsen, 2010). There are countless websites and tools available to people who wish to complete a task: one must only think of the task, and a website can likely be found. People use the Internet for information, networking, entertainment, navigation, financial services, travel, and more (Accenture, 2012). The services, sites, and tools available are always changing and expanding, so it would be impossible to list every technology resource available. Computers, websites, and applications used on a smart phone are as unique as the user, customizable for their activities and their lifestyle.

While computers are a common form of technology used for the purposes described above, many people also use mobile technology tools such as smart phones and tablets to communicate (via text and voice) and to access the internet. Mobile telephone technology has been around for decades as a voice-only technology, but these devices have become multi-functional in recent years. In 1992, mobile phones gained the ability to send a text (or SMS) message (Ahmed, 2002). Text messaging—or texting—has become a popular alternative to making a voice phone call. In 2011, the Pew Internet Research Center reported that of the 83% of Americans who own mobile phones, 73% of them use text messaging and about a third of those people prefer texting to voice calls (2011b). About a third of Americans have a smart phone: a phone that can be used to access the Internet (Deloitte, 2011). This technology has grown in popularity in recent years: among people who do not own a smart phone, 40% reported that they planned to buy one soon (Consumer Electronics Association, 2011; Deloitte, 2011). Other devices similar to the smart phone are also popular: the *Apple iPad* tablet—bought by 15 million people in its first year on the market—is larger than a smart phone, but smaller than a laptop computer (Apple, 2011). A 2010 market survey found that 1 in 10 United States households owned a tablet computer such as the *iPad* (CEA, 2011), and 22% of people under age 35 had intention to buy one within a year (Accenture, 2012). With advances in mobile technology, people are not required to sit at a computer to use Internet communication and productivity technologies; they are able to use their phones or tablets to do many of the things they can do on their computers, including email, social networking, video calls, shopping, and a variety of the other tasks that were discussed earlier.

Just as this type of connectivity has become invaluable in the business world, the ability to be connected to the Internet—to friends, to work, home, and everything else—from anywhere has also become a convenience for many Americans. In 2010, the average United States household spent over $1100 on the technology tools (including televisions) (CEA, 2011); this figure was an average of about 2% of those households' annual incomes (Accenture, 2012). Not included in that figure was the combined two trillion dollars spent by Americans on the service subscriptions, software, and applications to connect their devices, including high-speed internet, cable and satellite connectivity, and mobile access to those services (Gartner, 2011).

As members of new generations grow up, many have been exposed to various forms of technology for as long as they can remember. According to a 2011 study, half of children ages eight and younger in the U.S. have access to a mobile device such as a smart phone or tablet, with 29% of parents saying they have downloaded applications on to their devices for their children to use (Common Sense Media, 2011). In addition to playing games on their parents' mobile devices, half of children under eight have access to a video game system in their home and over a third of them use the game system at least once a week (Common Sense Media, 2011). The same survey reported that 90% of children under eight have used a computer in their home. As we will see later, this prevalence has given rise to the unsupported belief that today's generation are natural experts (digital natives) when it comes to technology. Nevertheless, the ubiquitous nature of technology in personal and professional lives gives rise to the question of whether our schools are preparing students for this world, and to what extent the inner world of classrooms resembles this ever-changing landscape. It turns out, students may be exposed to technology in their classrooms as little as 2% of the time they are learning (Pianti, Belsky, Houts, Morrison, NICHID Early Child Care Network, 2007). If this is the case, how can they develop the skills they will need to function as they grow up? One action has been the development of a framework of 21st Century Skills.

21st Century Skills

The term "21st century skills" is used to describe the work and life skills we have just discussed. A framework for identifying these 21st century skills was developed in 2009 by the Partnership for 21st Century Skills [P21] (Gewertz, 2009; Trilling & Fadel, 2009). The goal of P21 was to create a "unified, collective vision for learning," which would equip students with the skills—including technology-use skills—to function and be successful in a technology-immersed society (P21, 2009a, p. 1; Walden University, 2010). According to P21, these 21st century skills must include subject masteries as well as "interdisciplinary themes," that are referred to as "21st Century Themes," (2009a, p. 2). The 21st Century Themes include different types of societal awareness: global, financial, civic, health, and environmental. In other words, students should gain knowledge of core subjects (e.g., math, social studies), their learning should reflect the interdisciplinary 21st Century Themes (e.g., health awareness, global awareness), and they should be fostered to develop the skills of each of the three focus areas of 21st Century Skills (e.g., problem solving skills, media literacy skills). See Figure 1.

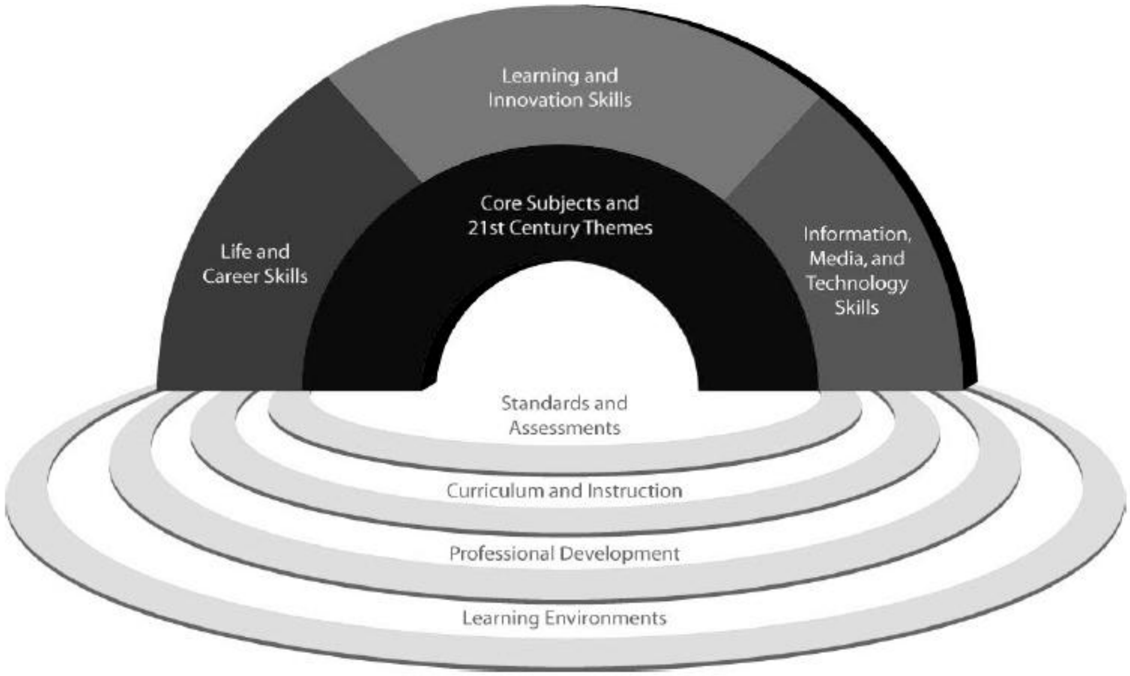


Figure 1. 21st Century Outcomes and Support Systems (P21, 2009a, pp. 2).

Even while the P21 framework was still being developed, several states began to use its guidelines (Gewertz, 2008). Many of those skills (e.g., critical thinking, problem solving, and social consciousness) have been important for many years—not just for the 21st century (Silva, 2009). So why are proponents of technology so focused on this framework of 21st century skills? Technology use affects nearly every part of the economy, so these skills must now be applied in new and different ways (Silva, 2009, p. 631; Murnane & Levy, 2004). According to Galarneau & Zibit, technology skills are "necessary to succeed in an ever-changing, global society where communication is ubiquitous and instantaneous, and where software tools allow for a range of creative and collaborative options that yield new patterns and results that we are only beginning to see," (2011, p. 1875). Trilling and Fadel, two chairs of the board for P21, wrote an explanatory book about the P21 framework in which each skill was discussed in detail.

The skills interwoven with a goal of creating knowledgeable and responsible young people who will be able to function in present and future society, where technology is one of many tools they will use to explore, analyze and work to solve complex issues in their personal, professional or academic lives. “Whether at work, in school, at home, or in the community, there will be increasing demands on our ability to access information efficiently and effectively, evaluate information critically and competently, and use information accurately and creatively,” (Trilling & Fadel, 2009, p. 65). It follows that schools should be training students for this type of future: a future based on the importance of information and ideas, rather than the production of tangible items.

Supporters of P21 are enthusiastic because of the technology immersed nature of the framework (Gewertz, 2008; Walden University, 2010). The following sections explore each of the skillsets in detail. While technology specifically has its own section within the framework, there also is an expectation that each of the skills should be interwoven with each of the others (and this includes the technology).

Societal Awareness Skills

The first of the 21st century skills sections is devoted to societal awareness. We have seen that technology touches the professional and personal lives of citizens, and that sometimes the line between personal and professional technology is blurred. In a society that is technology immersed, people are informed and involved in global, financial, business, entrepreneurial, civic, health, and environmental issues of which—pre-Internet—they may never have been aware. (P21, 2009a). A societally aware individual would be able to understand, learn from, and respect differences in an informed manner (Trilling & Fadel, 2009).

Learning and Innovation Skills

These skills are broken in to three subsections within the framework: creativity and innovation, critical thinking and problem solving, and communication and collaboration. Creativity and innovation skills include the ability to be creative and to work in groups with others. With such convenient and available access to avenues of information, the ability to learn from and work with the knowledge and individuals a person may encounter becomes very important. Students must learn to work with others toward solutions, even if their colleagues have different perspectives or frames of reference than they do (Trilling & Fadel, 2009). Constantly evolving, often interlinked technology tools are available, so students need to be prepared to handle the complex issues or projects that may arise in their futures. This is where creativity comes in: a solution is not always straightforward.

Critical thinking and problem solving skills go hand-in-hand with creativity and innovation skills. Students need to be able to think critically about the complexity of issues and form solutions where none were readily apparent (Trilling & Fadel, 2009). These abilities describe critical thinking and problem solving, while also tying in creativity and requiring that students practice the societal awareness skills from the first section. We saw that a large percentage of American adults communicate through their computers and mobile devices, using avenues including text messaging, email, video conferencing, and social networks. Mobile, Internet-enabled devices especially allow people to stay connected to others more than was possible prior to the existence of these tools. We saw also that in the work place, collaboration with clients, consumers, and far-away colleagues has become easier through networking and social tools. Thus, the skills to effectively communicate and collaborate are important because these activities are easier and more frequent than they have been in the past (Trilling & Fadel, 2009). However, increases in connectivity and communication avenues can be problematic in some cases. We saw a different type of example in an earlier section: people may write personal thoughts on a social network or online avenue, which are then seen by an employer and can lead to consequences (ProofPoint, 2009). Making thoughtful decisions about what should or should not be written online—and the right time to write it (i.e., from a home computer, rather than an office computer)—is a part of communication skills (Trilling & Fadel, 2009). Additionally, people can expect more diversity among the people with whom they communicate over the Internet, as they are not limited to just those who are in a local community or office environment. Thus, people need to be aware of different cultures and willing to work with a variety of different individuals respectfully and productively. This again ties back to skills including innovation, societal awareness, and creativity.

Information, Media, and Technology Skills

With so much emphasis on technology in society, information, media, and technology skills have to be addressed. There are three subsections to describe these skills: information literacy, media literacy, and Information Communication Technology [ICT] literacy**.**

The Internet and the devices used to access it allow a wealth of information to be available to nearly anyone, nearly any time. The availability of information is a concern: not all information is created equal, and not all information is free to use. Thus, information literacy includes the ability to judge whether information is true and reliable, how that information can be used, and to whom credit should go to for the use of the information (P21, 2009a).

Media literacy is similar to information literacy, except it refers to news resources. Persons who are media literate should be able to apply their critical thinking skills to the media they encounter, considering the purpose of the media, the intended audience, and the intended consequence of the media dissemination (P21, 2009a). As with information literacy, this skillset also includes the ability to make ethical decisions about the appropriate use of media resources.

ICT literacy relates directly to information and media skills, while also tying in to traits included as communication and collaboration skills. This is because the skills described above are technological experiences, and technology in the 21st century means access to information and communication avenues. Being able to use technology proficiently, understand the implications of use, and troubleshoot or solve problems that may arise with that use, are valuable skills (Trilling & Fadel, 2009). Since technology is so widely used in 21st century society—some researchers have said it is unavoidable (Eisenberg, 2008; Prensky, 2001)—a 21st century environment should be synonymous with a technology-rich environment.

Life and Career Skills

The life and career skills section of the framework suggests that students need to master "the ability to navigate the complex life and work environments in the globally competitive information age," (P21, 2009a, p. 6). This skill set essentially ties together the aspects of the other skill sets to describe the intended outcomes of having gained those skills. It asserts that those with 21st century skills should be flexible, adaptable, self-directing, able to take initiative, be able to work with others or independently, manage their time and learning effectively, be tolerant of diversity, manage products and find solutions, and be responsible leaders to others (P21, 2009a).

To summarize, we have seen that all of these 21st century skills support each other. Learning and innovation skills must be interlinked with information, media, and technology skills, and all of these skills need to be encompassed by societal awareness, life, and career skills. When all of these skills are woven together, they give students the ability to become well-rounded and successful members of their technology-immersed society (Trilling & Fadel, 2009).

We can understand these new ideas of 21st century skills within the context of research on technology over the last quarter century. Specifically, researchers have discussed the ideas of technology literacy and technology fluency, both of which will help us to operationalize what is meant by "21st century skills" from a theoretical and empirical perspective.

Technology Literacy

Defined as Acquisition of Technical Skills

People may think of literacy as the ability to read and write (Merriam-Webster, 2011a). Applying literacy to technology then, we could say that a technology literate person has the ability to use technology. Technology literacy is the simplest form of technology understanding (Kaminski, Seel, & Cullen, 2003). Technology literacy is presented to teachers as a list of technology skills they should acquire (ISTE, 2008). A technology-literate person is expected to understand how to use some software programs on a computer and use the Internet or other technologies (Lin, 2000). These descriptions of literacy are built around the idea that technology is a static skill that must be learned as a subject, in the same way that a person learns the alphabet or multiplication tables. Teachers and school administrators who think of literacy in this way will likely offer technology lessons or computer skills classes that are separated from other subjects that students learn (Gotkas, Yildirim, & Yildirim, 2009; Russell, O'Dwyer, Bebell, & Tao, 2007). We will later see that this approach is not recommended or effective.

Technology literacy lessons focus on the acquisition of technical skills including computer software use, hardware, and parts (Hoffman & Blake, 2003). In one study, 80% of frequent computer use by students was reported to take place in a computer class, (Barron, Kemker, Harmes, & Kalaydjian, 2003). The skills learned by students in classes such as these have been described as vocational skills, which are taught in a manner that offers "insufficient opportunities to apply the ICT skills, learnt in separate ICT classes, to work in other subjects," (Watson, 2001). In other words, students acquire technical skills in these computer classes (which are modeled on the notion that the students will grow up to produce things) but do not learn how to apply the skills in ways that would benefit them in the now information-based society.

While the traditional definition has been used by many over the years, a new definition emerged sixteen years ago, when the U.S. Department of Education defined technology literacy as "the ability to use computers and other technology to improve learning, productivity, and performance," (1996, p. 5). Many papers published since the turn of the 21st century have adopted this modern definition of literacy that includes more that the acquisition of technical skills (see: Davies, 2011; Eisenberg, 2008; Shapka & Ferrari, 2003).

Defined with Higher Order Knowledge

The broader definition of literacy indicates that technology literacy should be inclusive of the development of technical skills, but also of the ability to use those skills in a problem solving manner (Eisenberg, 2008). Problem solving and critical thinking skills are included in other literacy definitions as well, including "the abilities to use [technological] tools to solve unique problems, analyze information, and model complex ideas," (Judson, 2010, p. 272). Being able to handle complex tasks on a computer, and being confident in computer use have been suggested as additional aspects of literacy (Shapka & Ferrari, 2003). Therefore, in addition to using the tools to be productive and solve problems, technology literate persons should be confident in their use of these tools.

Others have similarly defined technology literacy to include higher order skills. The Educational Training Service [ETS], for example, defines literacy as "using digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society," (2007, p. 2). Likewise, another definition of literacy includes "the ability to effectively use technology…to accomplish required learning tasks," (Davies, 2011, p. 47). Thus, a literate person is confident and proficient in their abilities to achieve goals via the use of technology; this person's literacy should lead him or her to be a productive member of society. Selfe (1999) also relates technology literacy to traditional literacy (e.g., reading, writing), stating that to be technologically literate is to acquire technical skills, but also many other components. Selfe's components are similar to those described as 21st century skills, including the ability to understand and think critically about the responsible and efficient use of technology tools and resources.

What all these definitions have in common is that literacy includes tech skills and the ability to use those skills for functionality, learning, critical thinking, and problem solving. Researchers who use this definition believe that a person is not technology literate simply by having the skills to use technology (ETS, 2007). Since technology can be quite variable in terms of features, reliability, and design; the concept here is that a technology literate person would be able to understand the technologies in which they are proficient, and be able to conceptualize how technology could be used to solve a problem.

Contrasting Literacy Definitions: An Issue of Semantics

There is significant agreement among researchers that defining literacy as the acquisition of a technical skill set is not sufficient, and that it must include understanding of how to use technology for critical thinking and problem solving. Technology changes frequently as new discoveries lead to upgrades, so it is unlikely that skills specific to one version or type of technology would be useful to a person for more than a year or two after learning them (Kaminski, Switzer, & Gloeckner, 2009). If a person is instead exposed to technology in a way that teaches them to think critically about its use, that person will probably be able to adapt to changing technologies and technology needs in the future (Lin, 2000). The problem with using the term "technology literacy" to describe technology skills that include goal-driven problem solving and critical thinking is that the higher-order definition of literacy overlaps with the definitions of technology fluency (Lin, 2000; National Research Council, 1999).

Technology Fluency

Definition

We have defined technology literacy as the skills to use technology; adding a higher-order thinking component to those skills then makes it technology fluency rather than literacy (Lin, 2000). Fluency has to encompass literacy (along with critical thinking) because fluent persons do need to have some technology skills (McEuen, 2001). Without technology literacy, a person might only be able to hypothesize what technology can accomplish. A fluent person uses technology for critical thinking including finding, analyzing, evaluating, and presenting knowledge or information—so technology tools are exactly that: tools, and not the center of the tasks at hand (Overholtzer & Tombarge, 2003). Fluent persons see technology as part of a possible solution to a problem, confronting a situation with the ability to choose the most efficient solution, given the resources available (Kaminski, Seel, & Cullen, 2003).

In 1999, the National Research Council of Computer Science and Telecommunications Board [NRC] developed a nationally accepted working definition for fluency with information technology. The NRC further defined fluency by defining 10 areas across which fluent people should be proficient. Table 1 presents these abilities.

Table 1.

Ten Proficiencies Expected of Fluent Persons

Engage in sustained reasoning	Collaborate
Manage complexity	Communicate to other audiences
Test a solution	Expect the unexpected
Manage problems in faulty situations	Anticipate changing technologies
Organize and navigate information structures and evaluate information	Think about information technology abstractly

Note. Adapted from “Information Technology Fluency in Practice,” by Dougherty, Clear, Cooper, Dececchi, Richards, & Wilusz, 2002, *ITiCSE Conference Working Group Report*, p. 169.

The ability to manage complexity implies that situations will not always be simple or transparent. A fluent person would test solutions, rather than operating on the assumption that a proposed solution will absolutely work. Managing problems in faulty situations is fairly straightforward: it postulates that problems will arise and circumstances will not be perfect (Kaminski, Switzer, & Gloeckner, 2009). Fluent persons must also expect the unexpected, which ties directly to the anticipation of changing technologies (which often change in unexpected ways). Thinking abstractly about technology—another quality of the fluent individual—can enable him or her to prepare for the unexpected and the introduction of new or revamped technologies. Other areas of fluency (e.g., sustained reasoning, communication with other audiences, collaboration, organization, navigation, and evaluation) act to prepare the fluent individual for any of the other possible issues: faulty situations, unexpected changes, problems, and complexities (Kaminski, Switzer, & Gloeckner, 2009).

When discussing fluency, an acronym may be used. The acronym used by the NRC was for fluency: FITness, derived from Fluency with Information Technology)

(1999). Thus, we could say that a person who is fluent is FIT (Kaminski, Switzer, & Gloeckner, 2009; Lin, 2000; NRC, 1999).

Herbert Lin—a senior scientist at the National Academy of Sciences in Washington D.C.—was a member of the aforementioned NRC. When detailing the fluency definition developed by the NRC, Lin described an end goal of FIT students as an ability to "express themselves creatively, reformulate knowledge, and synthesize new information," (2000, p. 73). Assuming some technology literacy has been achieved, FITness then also requires the ability to apply technology to things like problem solving, personal, and professional situations (Lin, 2000).

Technology fluency, for our purposes, will follow the NRC's (1999) description. This definition includes technology literacy as well as the higher-order thinking skills needed to use technology for problem solving, critical thinking, teaching, and learning. References to technology *literacy* in this study refer to the simpler definition: the acquisition of a basic set of technical skills, without the additional application and conceptual traits many researchers attach to the term (Kaminski, Seel, & Cullen, 2003). This was done to avoid confusion in discussions of literacy and fluency, since—aside from literacy—another popular term does not exist in the literature to describe the acquisition of basic technology skills.

Because fluency encompasses the valuable critical thinking and deeper knowledge outcomes that enable students to thrive in our information-based society, fluency is a focus of many researchers, administrators, and teachers (Kaminski, Switzer, & Gloeckner, 2009). Thus, the following sections will briefly describe some of the popular standards and guidelines that are available for states, districts, and schools in the United States. These can be thought of as rules of thumb for instructors who are developing their class lessons. In other words, these standards and guidelines should help a teacher develop lessons—with any part of their subject matter—that foster fluency development in their students.

Standards and Guidelines that Promote Fluency

As teachers and school administrators look for ways to establish technology instruction that promotes fluency in their schools, several guidelines are available. This section will describe some of the guiding standards and initiatives that have been designed to help schools and teachers. The United States government has developed some technology initiatives that are discussed first, followed by resources developed by other (non-federal) organizations and groups. We will once again encounter the 21st century skills discussed earlier in the chapter, but this time, as they relate to school district standards and other guidelines that have been developed by the federal government and other organizations.

Government initiatives. For years, the United States government has asserted that technology is important in the education of young people. In 1996, a government report proclaimed: “our children’s future, the future economic health of the nation, and the competence of America’s future workforce depend on [children understanding technology]” (U.S. Department of Education, 1996). Prior to this time, personal computers and the Internet had not become widely used, so while technology in education was discussed, it was not relevant to society in the way it has become now. The United States Department of Education has supported technology in education in various ways, revising and building on new research as technology and education needs have changed; what follows are some of their key reports and initiatives in chronological order.

Being Fluent with Information Technology (1999). Recall that the NRC's research and development of the concept of FITness—fluency with information technology—defined ten ways in which students should be able to use technology (Table 1, above). While the NRC produced an informational book of guidelines rather than a set of standards, they did make an important clarification about any FITness standards that would be implemented by schools:

> Educational standards that focus on the acquisition of specific skills or recitation of specific concepts promote learning in isolation without any realizable connection to anything of interest to most individuals. Standards related to information technology revised to better reflect the integration of intellectual capabilities, fundamental concepts, and contemporary skills described in this report suggest a more holistic consideration based on the use of portfolios and other similar techniques. (NRC, 1999, p. 52)

In contrast with the government's initial report about technology in 1996, this distinguishes between literacy (learning technology skills) and fluency (higher order knowledge with technology).

Enhancing Education through Technology Act (2001). The United States government introduced an act called the Enhancing Education through Technology Act in 2001. This is a subsection of its No Child Left Behind Act [NCLB]. NCLB is an act of the United

States government that sought to alleviate educational inequities between schools in different regions or districts in the United States (U.S. Department of Education, 2001b). Like the NRC's report regarding FITness, the Technology Act does not provide any actual standards for technology use in schools, relying instead on purposes of encouraging, assisting, promoting, enhancing and supporting schools as they include more technology. The act did provide federal money to schools based on their need for assistance in including more technology in education.

Technology in Schools Task Force (2002). The Technology in the Schools Task Force included several representatives from school districts around the country, and a few members of the United States Department of Education. The purpose of the report was to help assess the kinds of technology use taking place in schools, and to help prepare schools to integrate technology. Topics discussed within it are "technology planning and policies; finance; equipment and infrastructure; technology applications (software and systems); maintenance and support; professional development and training; and technology integration," (NCES, 2002, p. xxi).

In addition to policies regarding such topics as acceptable use, student records, and security, the task force report provides conceptual suggestions for planning for technology use, goals, equity, and the ways teachers should be teaching with technology. These components set the stage for an environment where students can become fluent with technology, learning those higher order skills. The report also places importance on evidence of the plan being used, and ways to evaluate whether it is being followed appropriately. The report also gives some examples and counter-examples of how fluency should be promoted. It also defines technology integration, a central concept to developing fluency. Integration is defined and discussed later in this chapter.

Although the information included in the task force report is important, the report is now a decade old. The government has developed more recent plans, such as the National Educational Technology Plan.

National Education Technology Plan (2010). The 2010 National Education Technology plan calls for "applying the advanced technologies used in our daily personal and professional lives to our entire education system to improve student learning, accelerate and scale up the adoption of effective practices, and use data and information to continuous empowerment." It proposes five components identified as essential to this process: "learning, assessment, teaching, infrastructure, and productivity," (U.S. Department of Education, 2010, p. v.). Consider the following passage from the introduction to the plan:

> We want to develop inquisitive, creative, resourceful thinkers; informed citizens; effective problem-solvers; groundbreaking pioneers; and visionary leaders. We want to foster the excellence that flows from the ability to use today's information, tools, and technologies effectively and a commitment to lifelong learning. All these are necessary for Americans to be active, creative, knowledgeable, and ethical participants in our globally networked society. (U.S. Department of Education, 2010, p. 1)

Compare these to the goals of P21:

> All students must gain the cognitive and social skills that enable them to deal with the complex problems of our age. The Partnership for 21st Century Skills Framework emphasizes learning and innovation skills, information, media and technology skills and life and career skills, as well as core subjects and 21st century themes. (P21, 2009b, p. 2)

The goals of the National Education Technology Plan are similar to those developed by P21: to ensure that children become technology fluent through their work in school, before they enter a world where technology is used by almost everyone in almost every aspect of life.

While no standards were proposed in the government plan, it does include several goals to set the plan in motion, one of which is the development or revision of technology standards. Like the Technology in Schools Task Force report, this report also provides examples and scenario descriptions that may be useful to educators as they envision how the plan might work in their curricula (U.S. Department of Education, 2010).

Digital Promise (2011). The Digital Promise is an educational initiative announced by the U.S. government in September 2011. Secretary of Education Arne Duncan described the Digital Promise:

> Digital Promise will [bring] together people from business, education, and the research community to advance the education technology field… Digital Promise will be a truly collaborative effort across all sectors. Working together, the

> collaboration can help America in providing a world-class education for millions of students through learning technologies. (U.S. Dept. of Education, 2011)

Though made possible through the government, Digital Promise is actually a not-for-profit corporation: its full name is the National Center for Research in Advanced Information and Digital Technologies. The corporation conducts research regarding education and technology, drawing talent from experts of the private, government, academic, and business sectors (Digital Promise, 2011). As with other government initiatives, Digital Promise does not list any specific standards, but promotes goals of better teaching and learning through education with technology. The intended purpose of increased technology use is more ambiguous in the Digital Promise than stated in other guidelines and standards, but seems to suggest alignment with 21^{st} century skills acquisition and the development of fluency. At the time of this writing, Digital Promise has been officially active for about six months; its future is yet unknown.

Other initiatives. This section lists a selection of national-level standards. The National Educational Technology Standards—educational technology standards first released in 1998 and continually revised—is discussed in this section along with a selection of others. Many of the standards are related to the work done by P21 (which we have just seen has similar goals to the National Education Technology Plan of 2010). Some of the standards were developed using P21 as a guide (P21, 2009b); others preceded P21 in developing standards that work to achieve similar outcomes to those described by P21. P21 maintains online documentation of sets of 21^{st} century skills-related standards that have been developed to help educators as they move toward using curricula that develop these types of skills. As of 2009, all 50 states in the U.S. had some type of technology standards in place for students, and 44 of those states had standards for teachers as well (EdWeek, 2012).

National Education Technology Standards (1998-present). The standards developed by the International Society of Technology in Education [ISTE] were first released in 1998, preceding other standards in their initial development. The ISTE standards are unique in that they include separate standards sets for teachers, students, and administrators. These standards attempt to define what kind of technology education should be occurring in the schools (ISTE, 2008). Each of the standards sets has been titled National Educational Technology Standards [NETS], and the final portion of the title describes to whom the standard applies. NETS for Teachers is NETS-T; NETS for administrators is NETS-A, and NETS for Students is NETS-S. The most recent NETS-T was revised in 2008; NETS-A was revised in 2009; and the NETS-S was most recently revised in 2007. We have seen that the government initiatives of the past shifted from technology skills to technology fluency, with a focus on technology as an integral part of society. The ISTE standards also reflect this shift: while the original NETS-S standards focused on students' technology literacy—with some fluency characteristics—they are now more closely aligned with fluency and the development of 21st century skills (ISTE, 2008).

The NETS-T encourages teachers to use instructional methods that include creativity, context-based or experiential learning, and digital responsibilities (ISTE, 2008). One of the teacher standards asks teachers to "model digital-age work and learning," and a description of this includes "model and facilitate effective use of current and emerging digital tools to locate, analyze, evaluate, and use information resources to support research and learning.” In the U.S. as of 2008, the majority of states with technology standards for teachers were using the NETS-T (Reed, 2008).

The NETS-S state that students need to be able to communicate and collaborate, research, think critically, solve problems, be technology fluent and have understanding of how technology operates, and be digital citizens. A description of digital citizenry includes: “exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity,” (ISTE, 2007).

Administrators’ roles in the standards are more leadership- and example-based. The NETS-A standards say administrators should advocate for technology use, be technology use leaders, practice excellent technology use themselves, and improve their schools’ systems. One NETS-A standard states that administrators need to strive for “excellence in professional practice,” and a model administrator would: “allocate time, resources, and access to ensure ongoing professional growth in technology fluency and integration,” (ISTE, 2009).

Standards for the 21st Century Learner (2007). These standards—developed by the American Association of School Librarians [AASL]—precede the official completion of the skills by P21, but were developed in collaboration with P21 (P21, 2009b). They also align with the qualities of fluency. They include four standards, each with several specific outcomes to be achieved. The first standard, “inquire, think critically, and gain knowledge,” includes skills such as “demonstrate creativity by using multiple resources and formats,” and responsibilities like “follow ethical and legal guidelines in gathering and using information.” The other standards are: “draw conclusions, make informed decisions, apply knowledge to new situations, and create new knowledge," "share knowledge and participate ethically and productively as members of our democratic society," and "pursue personal and aesthetic growth," (AASL, 2007). Expected skills and responsibilities of these standards are inclusive of technology as one of many resources, along with textual, auditory, and other sources of information and creativity.

Twenty-first Century Skills State Leadership Initiative (2009). Individual states can join P21, and by doing so they become P21 Leadership States. According to P21, these states "design new standards, assessments, and professional development programs that ensure 21st century readiness for every student," (2009). Sixteen states have become a part of the Partnership. To become a P21 Leadership State, the state must develop standards that incorporate the P21 framework. The states and their standards are then listed on the P21 web site.

Common Core State Standards Initiative (2011). These standards were developed with the input of educators and citizens around the country, and led by the National Governors' Association Center for Best Practices. The standards are age-based, with different standards defined for kindergarten through fifth grade students versus sixth through twelfth grade students. The standards define what students should know and be able to do by the time they reach the end of each grade. They include standards for specific subjects such as mathematics, language learning, history and social sciences, science, and technical subjects. They also define provisions and applications for students who have disabilities or other special needs (Common Core State Standards Initiative [CCSSI], 2011).

Within each subject area, technology can be found woven into context-based activities. As an example, the writing standards of CCSSI include the ability to "gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism," (CCSSI, 2011). And, the history/social studies standard says that students should "integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts," (CCSSI, 2011). This type of context-appropriate activity teaches students to use technology tools to achieve their learning goals, which as we will see in the next section is the appropriate way to nurture the development fluency.

Standards and guidelines including those above are available to any teacher or administrator who wishes to access them. As with the core curricular standards of which we saw examples when exploring literacy, it is likely that different teachers will interpret these standards and guidelines in different ways and mold them to fit their lessons. Still, most of the standards and guidelines offer descriptions or even examples to help solidify the meanings or rationales of each included piece.

With these standards and many guiding initiatives at the national, state, and district levels, it is unfortunate to see that only a little over half of the U.S. teachers surveyed in 2010 said that they are supportive of technology use in the K-12 classroom (Walden, 2010). Furthermore, many of the standards promote fluency instruction, but are ambiguous in their descriptions of how fluency should be taught in the classroom. Recall the difference between technology literacy and fluency: literacy is taught as a subject (e.g., computer skills, keyboarding), whereas fluency must be learned in a more fluid manner, interwoven throughout the curriculum (NCES, 2002; Trilling & Fadel, 2009). The following section discusses one teaching method through which teachers can support their students' development of fluency with technology: technology integration.

Technology Integration

Definition

We have learned that technology literacy skills are a good first step, but are insufficient because technology changes frequently. Technologically fluent individuals, on the other hand, can be more flexible and adaptable than literate people when it comes to technology use in a variety of situations. However, as fluency is more comprehensive and complex than literacy, it cannot be taught through a subject-specific class section as literacy can (Earle, 2002). Methods of teaching that include technology must be employed, and technology integration is one such method (Ertmer, 1999).

Where literacy and fluency can be described as outcomes of education, integration is more of a framework for education: the result of applying those skill sets to curriculum design and implementation. Technology literacy and many aspects of fluency can each be achieved by learning specific skills and how to use those skills properly. In contrast, the National Center for Education Statistics [NCES] says that that technology integration ought to be a "goal-in-process," not an end state," (2002, p. 75). Integration is not a skill set that can be memorized and recalled: it can be more accurately defined as a teaching philosophy by which we can generate technology fluent students. According to the NCES, technology integration can be defined as "the incorporation of technology resources and technology-based practices into the daily routines, work, and management of schools," going on to say that "it is important that integration be routine, seamless, and both efficient and effective in supporting school goals and purposes," (2002, p. 75). In other words, integration means using technology regularly across the curriculum to promote fluency, not separately as a function of teaching technology literacy. Multi-faceted types of use, modeling and instruction interwoven with context are more important than teaching technology skills to students directly (Hammond & Manfra, 2009; Pierson, 2001). Through integrated instruction, students learn about technology as a tool of their academic lives—not as an extra subject they need to master.

Ertmer describes integration as a focus on "what we do with technology rather than the kinds of equipment with which we do it;" she places the focus on the learning, rather than the equipment, (1999, p. 49). Likewise, Dockstader defines integration as "organizing the goals of curriculum and technology into a coordinated, harmonious whole," asserting that a properly designed integrated curriculum would allow students to learn more deeply about the subject area while also giving them experience using technology "purposefully and creatively," (Dockstader, 1999, p. 73). To contrast, integration does not happen when "it has been a case of fitting the curriculum to the computer rather than the computer to the curriculum," (Earle, 2002, p. 5). In other words, if a teacher tries to fit instructional technology into a lesson as an afterthought (possibly because it is in the room and he or she was told it must be used), this would not be an integrated lesson.

Roots in constructivism. The preceding definitions of technology integration have presented the idea that integrated technology tools allow students to use technology in context with their lessons, allowing them to develop greater understanding of the subjects (rather than being told to use the technology for a specific and possibly disconnected purposes). Many of these tenets reflect ideas that are collectively referred to as constructivism. Constructivism is an epistemology, though it is sometimes mistaken for a learning theory (Jonassen, Cernusca, & Ionas, 2007). Constructivists believe that learning takes place when learners build (i.e.,, construct) knowledge to fit their own understanding in meaningful ways. Knowledge is developed and retained as students make sense of it–it is not collected from outside sources and delivered to the student (Driscoll, 2005; Ormrod, 2008). Constructivists believe that learners learn to think critically and solve problems, resulting in learning experiences that enable the learners to build their own reality (Jonassen, 1991).

Constructivism is mentioned here because technology integration most often takes the form of constructivist methods. Consider how the definitions of integration and of constructivism relate. Integration involves using technology as a tool that enhances students' learning experiences while also giving them skills they will need in our technologically connected society. Rather than being taught a set of skills, students develop skills that can be used in a range of ways. Even when integration methods do not align with constructivism, they do align with the development of 21st century skills, and the development of 21st century skills, and constructivism encourages this type of learning (Trilling & Fadel, 2009). Students develop knowledge of their world through activities and projects, rather than being told what they need to know (Driscoll, 2005). In this way, the technology is a tool used in the inquiry approach to solving problems during designed lesson plans.

Some researchers have found evidence for the connection between constructivist learning methods and technology integration in the classroom. In a study of the teaching philosophies and technology use characteristics of Singaporean service teachers, Teo, Chai, Hung, & Lee (2008) found that raising awareness of the benefits of constructivist learning methods—including those involving technology—would lead to an increase of technology integration. To teach with constructivist methods means spending time to create appropriate learning environments for students depending on their age group and aptitude (Bruning, Schraw, Norby, & Ronning, 2004; Vannatta & Beyerbach, 2000); a lot of preparatory time has to be spent by teachers who trying to integrate technology experiences as well (Davis, 2003), this is because teachers must pay attention to whether the subject matter is being taught, and also how the technology is being used to improve or enhance the learning experience. Well-known constructivist education reformer John Dewey has asserted that no subject should be isolated from other subjects (2009); technology is a subject that may be isolated from others by teachers intending to teach students technology skills.

Importance of Integration

Technology integration is a complex topic, but we can derive a key goal from its definitions: technology must be part of the learning context, not random or isolated. The concern is that without lessons including technology as part of the subject matter, students will reach adulthood and will be exposed to a different type of technology use than they have seen in the classroom (Lowther & Morrison, 2009). Integration, as we have seen, is a method that addresses this concern. In the classroom, students may use technology strictly for certain purposes, with set tasks designed to teach them how to type (for example) or other single skills. Yet, we have seen how the increased connectivity and functionality of technology in recent decades has led to a technology-immersed society in which more is available, more must be known, and many more things must be continually learned. In other words, while students in the past were able to learn about or experience everything they would need to know to do their life's work, this type of approach is impossible for young people of the 21st century (Siemens, 2004). The amount of information available through the use of technology means that no teacher could possibly know every relevant fact, and the diversity of applications for technology means that every student's experience and need for technology may be different (Collins & Halverson, 2009). Instead of delivering uniform instruction through technology (e.g., students watch a documentary), students instead need to become fluent with technology, learning how to access and interpret information in a manner that supports the ways they will use technology in the 21st century (Collins & Halvorson, 2009). Integration leads to these outcomes (Lowther & Morrison, 2009).

While the development of technology literacy and fluency are important, the primary goal of properly integrated instruction is to enable students to learn the subject matter (Earle, 2002). Research shows that when technologies are used as tools to enrich students' lessons or projects, student learning increases (An, Wilder, & Lim, 2011; Coley, Cradler, & Engel, 1998; Wenglinsky, 1998). Students may be asked to use various classroom tools—including technology—to solve or explore a problem or to learn about a topic (Lowther & Morrison, 2009). When students are actively engaged to learn their subjects, they are more likely to understand and retain what they have learned (Cuban, 1989; Lowther & Morrison, 2009; Papastergiou, 2008). Thinking back to the intended outcomes of P21's 21st Century Skills, remember that creativity, critical thinking, and problem solving were important outcomes; P21 recommends the skills be developed in integrated ways, along with the core subject matter (P21, 2009). Retention, then, would include not only that of core subject matter, but also developing 21st century skills. Consider this description of technology integration without an educational context: "not only can technology not be separated from the activities that surround it, a technology cannot be separated from other technologies…they only add value as integrated systems," (Iansiti, 1998, p. 1). Iansiti's description holds true to the values educators seek when integrating technology in education: technology cannot be separated from the rest of the classroom; it is not a separate entity. A teacher would probably not ask a student to write on the chalkboard for the purpose of learning "chalk skills," and this reasoning should not be applied to a computer in the classroom either.

Methods of teaching with technology, including technology integration, should allow for learning experiences that were not possible without technology, and these experiences should be engaging and informational for both the students and the teacher (Earle, 2002). Earle further asserts that integration is not about technology; it is about instructional design that improves pedagogy (rather than attempting to superficially add computers to a lesson plan). In an integrated setting, technology should blend in to the classroom like any other tool (Davies, 2011; NCES, 2002). Teachers do not set aside special class sessions to teach students how to use a chalkboard: this tool is seen as an integral part of the classroom. If students are asked to write on it, this is usually done with a learning objective in mind. Gaining confidence (and handwriting skills) to present work in a large format on a written medium is a skill that may prove valuable to a student in many situations; seemingly random, unfocused chalk writing is not such a skill. The same should be true of technology.

When technology is integrated, it should enhance, deepen, broaden, or refine the teaching and learning process (Ashburn & Floden, 2006). The learning should be intentional, active, constructive, cooperative, and authentic (Jonassen, Peck, & Wilson, 1999). The students' learning outcomes should be reached or exceeded through the use of carefully chosen technology tools that have been integrated in to a lesson (not tacked on as a form of busy-work, or used independent to the context of the lesson). As an example: a study by McCormick found that students who completed lessons that integrated multimedia tools were up to 50% more competent in the subject, and also completed the lessons much faster (1999). In another study, Sadik reviewed projects completed by students who used integrated methods of digital storytelling and said of the projects: "the well-chosen points of view, unconventional content, and varied resources indicate that students…reflected on their own thoughts and engagement with the subject, visually and aurally," (Sadik, 2008, p. 502). In these examples, students creatively used technology resources as tools through which they completed projects. McCormick's students were studying social studies, whereas Sadik's students were asked to select and expand upon a topic from their textbooks. In each case, they had to learn to understand intricacies of the technologies they chose to used (e.g., 21st century skills, fluency), while also learning about the subjects. Recall that U.S. society is technology-immersed: we saw earlier that computers, the Internet, mobile devices, and other types of technology are prevalent in almost all sectors of personal, professional, and academic life. Those routine, seamless, effective, and efficient uses of technology in the schools provide important and ongoing experiences that will help students become fluent with technology as they grow up.

We have established that technology should not be the focus of integrated lessons, but it is important not to forget that literacy is a part of fluency: technical skills are important for students to have (Lin, 2000). Grabe & Grabe describe a scenario in which a student struggles to complete a task because he or she does not understand the subject matter or how to use the technology. A lack of domain knowledge prevents the student from moving forward with the assignment, and a lack of technology skills prevents the student from focusing on the assignment he or she needs to understand (2007). This situation can be applied to anyone trying to accomplish something with technology they do not understand: they find themselves focusing on the technology as much as the task and their performance suffers (Grabe & Grabe, 2007). To help students gain fluency skills (including literacy skills), Lowther and Morrison suggest an "inquiry-based approach in which students use computers as a problem solving tool," (Lowther & Morrison, 2009). Use of technology in this way—in which students use computers or other tools to solve problems, research answers, or complete projects—is more likely to mirror what students will experience in their lives outside of the classroom (Lowther & Morrison, 2009; Cheung & Slavin, 2011). In Lowther & Morrison's approach to integration, students may be given direction about how to use technology so they can build their skills, but this assistance is not the focus of the lesson. Technology integration introduces students to technology as a set of tools for many purposes, rather than a roadblock they must overcome in order to complete a task; if they understand the tool, they can use it to improve—rather than allowing it to inhibit—their learning (Grabe & Grabe, 2007).

Schools are becoming particularly invested in technology integration as a method because as we have seen, the integrated use of technology has been shown to improve students' learning experiences, including retention, problem solving, and the depth of their learning (Berson, 1996; Mann, Shakeshaft, Becker & Kotkamp, 1998; Sivin-Kachala & Bailo, 1998; Wenglinsky, 2005). The report by Sivin-Kachala and Bailo says that while technology was consistently shown to enhance student achievement, the use of technology could not be measured in isolation from other topics. Wenglinsky (2005) arrives at the same conclusion, also asserting that technology must be used in constructivist ways (such as integration). This is consistent with what we have seen in the literature: the technology must be integrated. The U.S. Department of Education is invested in findings such as these: a primary goal of its *Enhancing Education Through Technology Act of 2001* was "to improve student academic achievement through the use of technology in elementary schools and secondary schools," (2001a, Sec. 2403). In another report by the U.S. Department of Education—this one published five years prior to the Act—former U.S. Secretary of Education Richard Riley addressed congress by stating: "[by teaching with technology], we will give a generation of young people the skills they need to enter this new knowledge- and information-driven economy," (U.S. Dept. of Education, 1996, p. 3). The use of technology-integrated methods has been called "an inseparable part of good teaching," (Pierson, 2001, p. 414).

Inservice Teachers and Integration

Knowing that being technology-fluent allows one to think critically and creatively about technology, it is logical to think that being fluent would greatly aid a teacher as he or she developed an integrated curriculum. Since teachers may have various technology resources from which to choose, a fluent teacher's familiarity with many different types of—and uses for—technology would save him or her a lot of research time. Still, a teacher who has qualities of technology fluency will not necessarily know how to integrate technology (Davies, 2011; ISTE, 2008).

Integration of technology is a pedagogical process, not a solely technological one: it may involve technology, but involves it in the same way a curriculum design would involve any other teaching tool (Dockstader, 1999; Graham, Culatta, Pratt, & West, 2004). Yet, when teachers learn to use technology they are often taught to adhere to standards that follow a basic definition of literacy (computer skills) or fluency (computer skills plus critical thinking) instead of being taught methods of how to integrate technology in to their teaching (Graham, Culatta, Pratt, & West, 2004). Thus, teachers may not know how to integrate technology, or may think they are already doing so when in fact, their lessons align more with literacy. One study found—in a school that was reputed to integrate technology well—the class days were in fact scheduled with computer sessions on weekly or daily bases, during which a technology specialist would come in to the classroom and help the children learn about computers (Cartwright & Hammond, 2007).We will later see how teacher education—at both the inservice and the preservice levels—is of great importance when determining whether or not technology integration occurs.

Integration has now been discussed as a process that is likely to lead to fluency and to the development of the 21st century skills that people need to be successful in our technology-immersed society. So if technology-integrated methods can lead to all this, why do inservice teachers struggle with adopting these methods (Hart, Allensworth, Lauen, & Gladden, 2002)? There are many issues, and this study focused on the issue of barriers: problems that make integrated teaching methods challenging for teachers to implement (Ertmer, 1999).

Barriers to Technology Integration

Researchers have sought reasons that teachers have not used integrated methods as widely as administrators and policymakers have hoped (Grabe & Grabe, 2007). In this process, researchers have identified several obstacles that keep teachers from integrating technology for teaching (Bromme, Hesse, & Spada, 2005; Ertmer, 1999); obstacles that they refer now as barriers.

The concepts of barriers find their roots in the work of Fullen & Stiegelbauer (1991). In their study of change, they found that for educational change to happen, there were internal and exterior elements needed to be addressed. Exterior elements were elements not related to an individual (e.g., environment, tools, resources); internal elements were elements inside the individual (e.g., thoughts, feelings, beliefs). The value of this work was recognized by Brickner, a doctoral student studying computer use in mathematics. He posited that these internal and exterior elements could actually be two types of barriers to educational change (Brickner, 1995). Recognizing the value of this work for understanding technology integration in the classroom, Ertmer went on to further define these barrier types as they related to technology integration (Ertmer, 1999). She related first order barriers to exterior elements. These are external to the teacher: they may include issues with resources or physical environment, such as a lack of computer workstations. Second order barriers, then, are related to internal elements, internal to the teacher and encompassing such factors as teaching philosophies and attitudes, confidence or fear, and lacking knowledge about technology (Ertmer, 1999). First order barriers have also been described as extrinsic barriers; second order barriers have been called intrinsic (Maguire, 2005).

Because barriers may prevent teachers from integrating technology in their lessons (thereby stunting the fluency development of their students), it is important to understand what causes barriers and how they can be either avoided or solved (Ertmer, 2005). The sections that follow will explore common first and second order barriers, what progress has been made to solve them, and what still needs to be addressed.

First Order Barriers

First order barriers to technology use are those that involve issues that are out of a teacher's control (Brinkner, 1995; Ertmer, 1999). These issues prevent a teacher from using technology (or make technology use difficult), but they are not issues related to the traits or qualities of the teacher (Ertmer, 1999).While there could theoretically be an unlimited number of first order barriers, the most common types are access, technical problems, policy concerns, and time constraints. For each of the first order barrier types, proposed solutions (or workarounds) will also be indicated, if they exist.

Access. Access to appropriate technology tools is one of the most common first order barriers (Butler & Sellbom, 2002; Ertmer, 1999). If computers, the Internet, or other tools are not accessible by teachers and their students, teachers will not plan lessons that include the tools (Butler & Sellbom, 2002; Gotkas, Yildirim, & Yildirim, 2009; Robinson & Sebba, 2010). Access was a more common first order barrier a decade ago—when computers and the Internet were beginning to become popular for personal use.

Grants provided by the government have helped to bring technology to schools that did not previously have it (U.S. Department of Education, 2001). Furthermore, technology companies including Apple, Microsoft, and many others provide computers and computer applications at a discount to academic institutions (Apple, 2011d; Microsoft, 2011). Table 2 shows the increase in access to computers and the Internet since 2000.

Table 2.

Computer and Internet Access in K-12: 2000 vs. 2008

Percentage of schools that have:	**2000**	**2008**
Percent with 1+ computer with Internet access	77%	98%
Ratio of students to computers	6.6 to 1	3.1 to 1

Note. Adapted from “Educational Technology in U.S. Public Schools: Fall 2008” by the NCES, 2010, Table 108.

Schools may not have a computer for each student, but the three-to-one ratio could be an acceptable amount, if we remember that collaboration and group work are important components of the 21st century skills (P21, 2009). Furthermore, students’ learning is enhanced when they work together to understand the domain (Lowther & Morrison, 2009). A group of seven students to a computer (as in the 2000 statistic) would be too large; the best size for a collaboration group is small—up to five students per group (Gall & Gillett, 1980).

The ease of computer access can also be a first order barrier: if computers are locked in a lab, or are difficult for teachers to schedule time on, they will go unused (Ertmer, Addison, Lane, Ross, & Woods, 1999). Laptops may be brought in to classrooms or other areas on carts. NCES reported at 58% of schools in 2008 had at least one laptop cart (NCES, 2010). The laptops can be brought in to a classroom for students to use individually or in groups, making it easier for teachers to employ technology-integrated lessons (Brush & Hew, 2007). Many schools have employed one-to-one laptop initiatives, with the goal of each student and teacher having a laptop to use in the classroom (Donovan, Hartley, & Strudler, 2007; Lowther, Ross, & Morrison, 2003).

So, there are enough computers and widespread internet access available to most teachers that access is no longer the common barrier that it was in the last decade. Although technology is now more physically accessible, it is not necessarily problem-free.

Technical problems. Access was a lack of physical resources as we just saw, but the technical reliability of those resources can also be an issue. If equipment is available but it does not work properly or reliably, that becomes a barrier for teachers. In a 2002 study of 125 participants, researchers found that instructors most commonly listed unreliability as a reason they did not want to use technology for teaching (Butler & Sellbom, 2002). Of Butler and Sellbom's study participants, 30% reported that equipment failure was their most common problem. When technology becomes a frustration to faculty and students, and when things go wrong unexpectedly or are not kept maintained, teachers will not be as likely to use the technology (Maddux & Johnson, 2010; Tichenor, 2001). Likewise, if a teacher has to spend a significant amount of time figuring out how to make the technology function, the teacher may decide that using the technology is too much trouble (Tichenor, 2001).

Technology does not remain problem-free without support, so this barrier is not truly solved. It can be downplayed, however, with a few cautious measures. One proposed workaround for technical support issues is an increase in available technical support and personable support staff (Hicks, 2011). These technical staff members need to be diligent about maintaining equipment, keeping supplies on hand, and being available when teachers need assistance with technology (Butler & Sellbom, 2002). The idea here is to minimize the amount of time teachers must spend dealing with technical issues, in order to avoid frustration. Another way to avoid frustration is to provide teachers with minor troubleshooting skills that can help them if they encounter an issue (Stein, Ginns, and McDonald, 2007). Hicks provides a helpful example of such a skill: “be sure that everything is plugged in.” (2011, p. 191). Although technology repairs are inevitable, it appears that this barrier can be managed through organized support channels.

Policies. Schools have policies governing the use of technology for a variety of security and other reasons. The U.S. Department of Education promoted policies for security, access, and Internet use in its 2002 report about technology use in schools (NCES, 2002). Implementing technology according to policy places an extra burden on the teacher, who must understand and comply with those policies (Lowther & Morrison, 2009). Thus, teachers may perceive policy knowledge as a barrier to technology integration. Even when they do understand the policies, such policies may constrain the ways in which technology is used, making it harder to use the technology. For example, some policies may ban access to certain sites such as YouTube—which is a video sharing site—and Wikipedia—an information site—both of which can be used for valuable educational purposes (Kaplan & Debrick, 2009; Mullen & Wedwick, 2008). Other policies restrict access to social networking or blogging websites and communication tools; the goal here is to prevent students from using these tools for “cyber bullying”—harassing each other online (Cross, Monks, Campbell, Spears, & Slee, 2011). Teachers may be wary of policies and possible violations, choosing not to do anything rather than risk running afoul of the policies or taking the time to seek them out and understand them.

New teachers especially may be wary to begin using technology in their classrooms (Walden, 2010). These teachers do not inquire about technology use because they are unaware of their school's policies regarding technology use and do not want to overstep a boundary. A 2007 study of teachers also found that new teachers were less likely than veteran teachers to use technology, due to unfamiliarity with their school's rules (Russell, O'Dwyer, Bebell, & Tao, 2007). Furthermore, computers and the Internet have their own legal and ethical policies, and teachers need to understand and follow these, too (Maddux & Johnson, 2010; Palfrey & Gasser, 2008). Recall that many of the technology standards that have been developed—as well as the framework for 21st century skills—include teachers' responsibility to teach students how to understand these policies in order to use the Internet and online media conscientiously (P21, 2009; ISTE, 2008). When all of this responsibility regarding policies is placed on teachers, it becomes a barrier, at which time they may determine that the easiest way to deal with it is to avoid technology use all together.

Policies are not a barrier that requires a solution necessarily: rules are necessary to keep students safe online and offline. Still, teachers must consider these policies when planning class activities and projects for their students, making sure policies are followed and that students are able to access the resources they need without breaking any rules. To help overcome the policies-barrier, Russell, O'Dwyer, Bebell, & Tao suggest that new teachers especially should be informed by school administrators of the policies regarding technology in the schools (2007). The NETS-A standards developed for administrators by the ISTE also place policy-related responsibility on school administrators: they should provide a school environment that promotes responsible technology use by students and teachers (ISTE, 2009). This administrative understanding, support, and environmental or cultural encouragement play key roles in determining whether teachers decide to integrate technology (Johnson, 2000). The responsibility for lessening the occurrence of this barrier falls on administrators because they are often responsible for the development of policies (ISTE, 2009).

Time. A lack of time is a commonly referenced barrier that could probably be classified as both a first and a second order barrier, since some would argue that individual teachers have control over their time and priorities (and remember: second order barriers are intrinsic to the individual). Teachers have referenced time—their class time as well as their personal time—as a primary reason they do not integrate technology in to their lessons (Beggs, 2000; Bunch & Broughton, 2002). Time is perceived as a first order barrier in a few ways. Teachers may find that it takes too much time to access the technology because of technical issues or its location in the building (Butler & Sellbom, 2002). Technology-integrated lessons can also take up more class time because it can be harder to keep students on task (Bauer, 2005). Teachers may also not be given the amount of time they feel is necessary to plan lessons that include technology (Bingimlas, 2009). Learning about the proper uses of technology and keeping up with technology skills also takes time, and this is time many instructors simply do not have to spare (Butler & Sellbom, 2002; Graham, Culatta, Pratt, & West, 2004). If curricula are already in place (and do not currently include technology), time is required to redesign the lessons to include technology in an integrated way (Brzycki & Dudt, 2005).

Unfortunately for teachers who are not able to set aside enough time, there is nothing that can be done to increase the hours in a day. Still, this barrier can be overcome in a few ways. For example, school administrators can encourage technology use by alleviating some of the other burdens on teachers' time: reducing how many lessons they teach every day, or lengthening the time allowed for those lessons (Bingimlas, 2009). Some teachers have overcome the barrier of time by being patient: they wait for other teachers to develop workable technology-integrated curricula, and then begin to use it themselves after the early adopters have worked out the issues (Bunch & Broughton, 2002). In other words, priorities are key in overcoming time-related first order barriers.

The preceding barriers involving time were considered first order because they are outside of the teacher's control. Since an individual's time is a personal issue, we can also consider how time could be construed as a second order barrier. Namely, teachers' beliefs and internal concerns about appropriate ways to spend their time can come in to play. Teachers may believe that technology tools do not save time, and in fact may take more time than other methods of instruction (such as lecturing) due to lesson preparation and handling what to do if the technology fails to work (Bauer, 2005; Tichenor, 2001).

Time is not the only first order barrier with second order potential: personal reservations and teacher beliefs can play a part in barriers related to policy and technical issues as well. Second order barriers can be caused by experiences with first order barriers, and thus they are difficult to solve without first addressing those first order barriers (Brush & Hew, 2007). Unaddressed first order barriers interfere with efforts to address the second order barriers: they give the affected teacher an excuse to continue to hold the second order barrier as truth even if it is false (Biech, 2008). Encountering first order barriers may even contribute to the development of second order barriers (Ertmer, 1999). For example, if a teacher believes technology is not a valuable tool because it is difficult to use, and the technology that teacher uses happens to frequently break down (first order barrier), the teacher's belief (second order barrier) has been validated. Furthermore, if a teacher has seen these things happen in their preservice education (i.e., a college instructor had negative experiences that were observed by the preservice teacher), this can also feed in to those beliefs. The beliefs a teacher has relate to their philosophy about teaching, their attitude, and their education, all of which are second order barriers.

Second Order Barriers

First order barriers are either solvable or otherwise able to be worked around through attention by staff, administrators, and teachers. For example, the NCES reported a much-improved rate of computer and Internet access in the schools between 2000 and 2008. Solutions for technical issues, policies, and time constraints have also been suggested by researchers. With many solutions available for first order barriers, second order barriers have become more important to address (Ertmer, 2005). Second order barrier are the barriers that affect the individual teacher: they are internal to the way teachers think, and may be emotional or psychological in nature (Ertmer, 1999). Beliefs developed through dealing with first order barriers do feed in to second order barriers, but each teacher may have different second order barriers that inhibit their use of technology

(Brush & Hew, 2007; Lisowski, Lisowski, & Nicolia, 2006). These barriers are generally not overcome by changing the physical environment or technology equipment of the school (Ertmer, 2005; Tichenor, 2001).

Some solutions have shown promise in lessening second order barriers to technology integration for some teachers, but there is still more to learn and address (Ertmer, 2005). Second order barriers include teaching philosophies and attitudes, and these are both interrelated with another second order barrier: education.

Teaching philosophy. Teaching philosophies and beliefs about learning can come in to play when a teacher is facing the integration of technology (Ertmer, 1999). Technology integration is rooted in constructivist methods of teaching and learning: methods in which students construct their own knowledge through contextual situations (Ormrod, 2008; Teo, 2009). Teachers who are not as supportive of constructivist methods of teaching may be less likely to support meaningful use of technology in the classroom (Teo, Chai, Hung, & Lee, 2008). They may view technology integration as a threat to the way they teach (Bunch & Broughton, 2002; Tichenor, 2001). If they decide to use technology, they are also likely to use technology "to attain the traditional goals under the same conditions" (Teo, Chai, Hung, & Lee, 2008), not to expand or change the curriculum or ways of learning. This type of teacher may use technology only as a delivery method for knowledge, in an instructor-led manner where the teacher presents the information to the students (Lowther & Morrison, 2009).

Teachers' pedagogical beliefs are not easy to change because this process involves changing the way teachers think about their content and their own roles as educators (Ertmer, 2005). Thus, this second order barrier does not have a simple solution. However, Ertmer suggests that educating teachers about technology use and exposing them to technology may encourage them to include technology as part of their teaching philosophy (2005). In fact, education can act as a full or partial solution for each of the second order barriers; opportunities for education (both inservice and preservice settings), as we will see later. The cultural importance of technology use in the school can also be a catalyst for change: administrators should show that technology is important and exemplify its use (ISTE, 2009; Walden, 2010). Administrators can also help by providing inservice training and workshops about the technology—teachers are more likely to see the value if they see technology used in various types of lessons, and can envision how they might use it for their own lessons (Russell, O'Dwyer, Bebell, and Tao, 2007). Again, the preceding are suggestions that have shown promise in the research; they are not definite solutions to this barrier. A teaching philosophy develops over time, and is connected to one's experiences as well as their attitude (Russell, Bebell, O'Dwyer, & O'Connell, 2003), another second order barrier to technology integration.

Attitude. Several years ago, one attitudinal second order barrier was the fear that technology would take over education, replacing teachers (Novek, 1996). While the literature of the past decade no longer addresses this as an issue, some teachers do still have negative attitudes about technology in education. Since technology integration does require teachers to develop a working knowledge of the tools, and to take extra time to develop technology integration lessons, teachers feel they should be offered incentives (Brown, Davis, Onarheim, & Quitadamo, 2002). In a 2005 study, teachers who did not use technology said it was because they did not have the support to use it—that is, there was not a reward for using it (Schoepp, 2005). They may also not be motivated to learn about technology and its related concerns (like Internet security, copyright, etc.). An attitude shift can also occur when teachers do not understand potential risks and applicable policies; mistakes "give rise to the belief that the IT staff are little more than 'technology police' whose main function is to tell faculty members what they cannot do" (Maddux & Johnson, 2010, p. 72). In other words, teachers may do the wrong things, be reprimanded for it, and develop negative attitudes toward technology as a result. Related to attitude, confidence issues are another type of second order attitudinal barrier (Bingimlas, 2009; Maddox & Johnson, 2010). Confidence issues are related to a lack of training: Graham, Culatta, Pratt, and West (2004) and Christiansen (2002) found that teachers did not feel confident teaching with technology in front of students who might be more technology savvy than they are. Teachers were concerned that students' technical skills would surpass their own, making them look foolish (Christiansen, 2002; O'Hanlon, 2009).

Research has shown that attitudinal barriers can be already in place when teachers are in their preservice education programs (Lei, 2009). In his quantitative study, Lei found that preservice teachers had good attitudes about technology in education, but they were concerned about their abilities to use it to teach. In an unpublished pilot study of college students' technology characteristics, students were asked to complete surveys on which they reported statistics related to their technology use, knowledge, and experiences (Salentiny, 2010). Results of this unpublished study found that preservice teachers were not among the most technology savvy students when compared to other majors. Students with majors in mathematics, engineering, and sciences were found to use the most technology and were the most confident in self-reporting their understanding of technology. Students with majors in education, languages, and arts were found to use the least amounts of technology and reported the least confidence in their understanding of technology. These findings may indicate that second order barriers may be forming or already in place for preservice teachers before they graduate.

Addressing attitudinal barriers of teachers is complicated, but some solutions have been suggested. For teachers who are negative about technology or unmotivated to make changes, incentives such as additional funding or professional enhancements may provide motivation to overcome these barriers (Brown, Davis, Onarheim, & Quitadamo, 2002; Rao & Rao, 1999). For teachers with confidence issues, inservice training methods are an option. Dougherty, Clear, Cooper, Dececchi, Richards, and Wilusz found that a course to increase teachers' fluency was a viable solution to increase their confidence with technology (2002). Education is a solution to this and some of the other barriers, and as such, a lack of education can be a barrier in itself. It is further discussed in the next section.

Inadequate education. Improper teacher training is another second order barrier that keeps teachers from integrating technology. The aforementioned 2010 teacher survey (Walden, 2010) found that about half of teachers did think that they (as a whole) had been prepared to teach in these ways by their teacher education programs. So if first order barriers in the schools are no longer major issues, this means that half of the current teachers do not feel prepared to teach with technology because of their education. If they did receive education about integration of technology, it is also possible that they did not receive enough education and experience to feel ready to do it themselves (Hadley & Sheingold, 1993).

Education relates to teaching philosophy and attitude in that these barriers may be developing because of improper or inadequate education (Bai & Ertmer, 2008). Teachers may not know they are avoiding integration at all; some believe that they are integrating technology when in fact they are only using it for delivery of instruction or for arbitrary classroom tasks, bookkeeping, or other non-integrated purposes (Judson, 2006). Alternatively, perhaps these teachers did not receive their training in context. That is to say, their teacher education instructors may not have used integrated methods to teach them. This could be because their instructors in college faced the same barriers as inservice teachers, or because they (the instructors) were improperly educated on the subject themselves. Technology education is often just literacy training, separate from curricular subjects (Pitler, 2006). This is the same type of education teachers are supposed to avoid delivering to their students. Instructing preservice teachers on how to use technology integrated methods is a complex topic, but before we discuss it, we must continue to consider what can be done in the inservice setting.

Inservice education solutions. More than two-thirds of administrators who took part in the 2010 survey by Walden University said they thought teachers were prepared and supportive of teaching with technology (Walden, 2010). Only half of teachers said the same; meaning that administrators are misinformed about the inservice training needs of their teachers. Many schools are not providing professional development for their teachers on how to use technology tools appropriately (Pitler, 2006). This is another situation in which first and second order barriers are closely linked: a lack of training may also result in first order barriers like time (if they need time to learn the tools), second order barriers like negative attitudes (if technology confuses or frustrates them), and confidence issues when they try to teach with technology.

Inservice training with emphasis on fluency, integrated methods, benefits of technology use, and school policies are recommended to help teachers gain the knowledge they need to overcome education barriers (Butler & Sellbom, 2002; Brzycki & Dudt, 2005; Ertmer, 2005). Many teachers receive inservice training, but it has been delivered as literacy training—learning to use tools for specific technical purposes (Carlson & Gooden, 1999; Teo, Chai, Hung, & Lee, 2008). This training is often delivered through a single technology course (Dougherty, Clear, Cooper, Dececchi, Richards, and Wilusz, 2002; Graham, Culatta, Pratt, & West, 2004), which while helpful is not enough: several years of technology integration education and experience is recommended to master technology integration (Hadley & Sheingold, 1993). Teachers also need to learn about the benefits of integrated technology use, and they should be educated in the methods of how to design and teach integrated lessons (Gotkas, Yildirim, & Yildirim, 2009). They need to experience this technology in context and witness the positive outcomes the technology delivers (Mueller, Wood, Willoughby, Ross, & Specht, 2008).

It is also useful for inservice teachers to see examples of lessons or activity types that depict appropriate use of technology; it is preferable that these examples show application in various school subjects (Harris, Mishra, & Koehler, 2009). This type of training helps teachers to see the value in technology for their own lessons, making the technology meaningful to them. Otherwise, it would be easy for a teacher to believe that technology works for other subjects, but is perhaps not useful for the subjects they teach. According to one researcher, "training appears to foster meaningful use by teachers in the classroom, which, in turn, fosters student computer enjoyment and later a perception of importance of computers," (Christiansen, 2002, p. 431). In other words, educating the teachers about integration will lead them to integrate technology in ways their students will enjoy and benefit from, in turn showing their students that technology can be used for many positive and useful purposes.

The types of training we have just discussed are helpful for inservice teachers (Harris, Mishra, & Koehler, 2009). Still, more focus needs to be placed on technology integration in the preservice setting (Pitler, 2006). Misdirected assumptions about the technology beliefs and fluencies of young people may play a part in the way technology is (or is not) taught in preservice teacher education programs, but before discussing those concerns, we must first explore what is going on in preservice education programs.

Preservice education challenges. It stands to reason that the most important place to address technology integration as a teaching skill, and the formation of second order barriers, is at the point at which teachers first learn to become teachers. Further, we will see that the most effective way to do this is for instructors to model technology integration. Unfortunately, research shows that at the higher education level, instructors are not themselves integrating technology in to their curricula consistently (Graham, Culatta, Pratt & West, 2004; Walden, 2010). Not surprisingly, the implications of inconsistent (or in some cases, absent) technology-integrated teaching in preservice education programs negatively affects preservice teachers (Gulbahar, 2008). In Gulbahar's 2008 study, preservice teachers who were not exposed to technology integration in methods courses and lessons during their preservice education programs were likely to believe technology was not a commonly used resource for teaching. In other words, the lack of technology integration training leads directly to the formation of second order barriers. In a 2005 study, similar results were reported: researchers found significant difference between the technology knowledge, attitudes, and integration rates of new inservice teachers who were exposed to integrated preservice education programs for three years, in relation to those who were not exposed to integration in their preservice education programs (Mayo, Kajs, Tanguma, 2005). The students who were exposed to the integrated program were “significantly more positive with regard to a sense of efficacy” initially, and remained so in a later follow-up (Mayo, Jajs, & Tanguma, 2005, pp. 11-12). Another study found that new inservice teachers emulated what they learned in their preservice education program: they would not creatively integrate technology unless they were taught to do so (Wright & Wilson, 2007).

Instructors may not integrate technology in the curricula of their preservice education courses for many reasons, including a lack of training, lack of interest, and lack of knowledge about technology integration and its benefits (Gotkas, Yildirim, & Yildirim, 2009). In a 2001 study, instructors likewise cited lack of knowledge, training, and time to learn about or implement technology-integrated lessons (Cuban, Kirkpatrick, and Peck, 2001). Cuban, Kirkpatrick, and Peck found that when technology was available to the instructors, but they were not formally trained or guided by their institution regarding its use, they were likely to use it in only minor ways (and to achieve the same results they traditionally achieved). These instructors did not think technology use was practical for their courses, nor were they prepared to work with other instructors in order to create integrated lessons (Cuban, Kirkpatrick, and Peck, 2001).

In a 2008 study, the majority of faculty felt that it should be the university's responsibility to train them—they should not need to learn and implement these practices on their own (Georgina & Olson, 2008). You may notice that these concerns are similar—if not identical—to the second order barriers that many K-12 teachers identify with as they encounter technology in their schools. These barriers hold back the widespread development of curricula that include meaningful technology use (Ertmer, 1999; Pitler, 2006). It is thus important to see what instructors know about integration and what they believe about it in order to halt second order barriers before preservice teachers develop them.

Some studies have shown that adding a technical skills class to preservice teacher education program helped these students to feel more confident with technology use (Smith, 2001; Teo, 2009; Whetstone & Carr-Chellman, 2001). Yet, when preservice teachers' technology courses are segregated from their teaching methods courses–especially if the technology courses are elective–it is difficult for them to draw connections between technology use and teaching (Stubbs, 2007). Compare this to what happens in classrooms at the inservice level: when technology is not integrated there, students at that level also have trouble relating technology to other subjects (Lowther & Morrison, 2009; NCES, 2002). If a course promoting fluency is part of the curriculum, the students should be encouraged to apply what they learn throughout the rest of their program in order to reinforce the importance of fluency (Dougherty, Clear, Cooper, Dececchi, Richards, & Wilusz, 2002).

Instructors should encourage fluency in preservice teachers in order to promote the use of integrated methods, and at the same time, they should portray positive attitudes and beliefs about technology integration. Preservice teachers' beliefs about teaching and learning are affected, at least slightly, by the beliefs their instructors have (Bai & Ertmer, 2008). Negative or apathetic views of technology can also be passed from college instructors to students who observe the instructors struggling, voicing negative opinions, or failing to use technology at all (Russell, Bebell, O'Dwyer & O'Connor, 2003). A 2008 study found that this attitudinal relationship between preservice educators and preservice teachers may be minor, but does exist (Bai & Ertmer, 2008). Some preservice teachers have reported negative attitudes toward technology in relation to learning because they have had negative experiences, leading them to believe that technology use is detrimental to the learning process (Russell, Bebell, O'Dwyer, & O'Connell, 2003). Attitudes may only be a minor concern, but actions are a major one: we will see that preservice teachers tend to copy what their instructors do, and this means it is important to make sure those instructors are doing the right things.

We now know that inservice teachers are expected to teach with technology in an integrated way, following standards to teach 21st century skills (and along with those, technology skills) to their students. We have also seen that inservice teachers are not prepared to do this. Inservice training is a solution for them, but issues must also be addressed in preservice education. Researchers have observed that many preservice teachers are not being exposed to technology integration in their courses, and their preservice education instructors may face the same second barriers to technology use that these preservice teachers will face as they become inservice teachers. Instructors must overcome their barriers and teach integration as a method, throughout the preservice education program. Through their modeling of this type of use, preservice teachers can relate to the methods being used and learn to apply them in their future classrooms. The following sections will discuss technology integration as a method, modeled by preservice education instructors.

Integration modeled and mentored. Integration is best taught through example: preservice or in-service teachers need to experience integration themselves through context-relevant technology use (Harris, Mishra, & Koehler, 2009; Teo, 2009). New teachers copy what they observed during their formal education, and that includes the ways their college instructors used (or did not use) technology as part of the curriculum (Carlson & Gooden, 1999). Going back in history to the 1960s, psychologist Albert Bandura and his colleagues found that learners observe and mimic what they see others do, though they may not understand the reasons for doing it (Bandura, Ross, & Ross, 1961). Applying this to teachers, they are likely to remember the way their instructors use technology and try to use it themselves when they teach (Jackson, Gum, Jackson, & Helms, 2011; Russell, O'Dwyer, Bebell, & Tao, 2007). Since preservice teachers do tend to copy their instructors' use, several creative methods should be implemented by preservice educators (Wright & Wilson, 2005).

Additionally, preservice teachers should receive instruction that models meaningful technology use in all of their classes. Consistent, positive experiences with technology-integrated teaching encourage preservice teachers to use technology in their own future classrooms (Strudler & Wetzel, 1999). Preservice teachers who are exposed to many technology integration methods in their courses have been found to be more confident with technology integration than students who are not as heavily exposed to these methods (Fleming, Motamedi, & May, 2007). In a 2004 study of preservice teachers, evidence of technology modeling success in college methods courses was reported. The study found that students exposed to modeling of integrated methods were more likely to pick appropriate technology tools to fit the context of their lessons than others who were not (Angeli, 2004). Likewise, a 2002 study found that incorporating technology use into preservice teachers' methods courses lead to these students answering more confidently about their ability to use various technology tools for teaching; when technology was separated from teaching, it was difficult for them to envision the tools in the classroom (Pope, Hare, and Howard, 2002). Changes in college program and course curricula—including the ways in which methods courses are taught—can improve preservice teachers' perceptions and exposure to technology (Overholtzer & Tombarge, 2003; Stetson & Bagwell, 1999).

Preservice teachers' technology use was found to be more effected by their college instructors' use than their student-teaching-mentor's use (Fleming, Motamedi, & May, 2007), but mentorship of technology integration practices is still recommended as a part of preservice education (Carlson & Gooden, 1999; Hammond et. al, 2009). Since observation and replication does not equate to an understanding of an activity (Bandura, Ross, & Ross, 1961), mentoring of preservice teachers should become a component of their education. Carlson and Gooden (1999, p. 5) found that "a major factor in the use of technology is the behavior of those near them who are in instructional or supervisory roles...[and] more than two-thirds of the student teachers reported that their supervising teacher never used any of the technologies except for word-processing." As with classroom modeling from their instructors, preservice teachers benefit from modeling and guidance of their mentors (Hammond, et. al, 2009).

Consider what we have just discussed: essentially, preservice teachers learn and apply technology integration methods if these methods are encountered in an integrated way (as a part of their program, not as a separate concept or topic). We can draw a parallel to the importance of technology-integrated lessons taught by inservice teachers: children absorb more about technology fluency and about their core subjects if their teachers emphasize context (Lowther, & Morrison, 2009). It seems, then, that this issue is circular in nature: if technology-integrated methods are used to instruct preservice teachers, those preservice teachers will be more likely to become fluent with technology and to use integrated methods in their own classrooms when they become inservice teachers. Their students, in turn, will be more likely to become fluent with technology. Still, studies have shown us that integration is not yet happening in higher education or in K-12—at least not consistently. Preservice teachers may instead be given lessons in computer skills—literacy, in essence—and then be expected to figure out how to transfer those skills to integration on their own, perhaps in part because their teachers assume these students are digital natives. Recall that in 1999, the NRC came out with a report on education and technology. One assertion of that report was that colleges and universities would be the best starting point through which to facilitate changes in the way technology is taught in K-12 classrooms. Part of their reasoning was: "K-12 teachers are themselves schooled in colleges and universities. In the long run, fluency efforts that reach university graduates are an important enabler for efforts to promote such fluency among K-12 students," (NRC, 1999, p. 51). The government was right back in 1999: students at the college level need to be educated properly in order to pass positive attitudes and proper techniques on to the children they will eventually teach.

*Interest in technology for pedagogy***.** Preservice teachers know that they need to understand how to teach their lessons with technology. In a 2009 survey of freshmen preservice teachers, about 60% of them said they were interested in learning about new technologies in general. Another third were neutral, while 10% of the respondents said they were not interested in learning about technology. However, when they were asked if they were interested in learning about "technologies that will help me teach in the future," 100% of the preservice teachers said they were interested (Lei, 2009, p. 89). Lei reported that the students were strongly positive about technology, but only moderately interested in it or confident about their ability to use it. These findings indicate that the preservice teachers believe that technology is positive and important—especially for education—and want to learn more about it for their careers (even though they are not strong or enthusiastic technology users). They also imply that preservice teachers may have already developed—or begun to develop—second order barriers to technology, indicating that more integration-centered preservice education should be the focus. Instead, some research presents a case for the opposite course of action, insisting that 21st century preservice teachers do not need to learn about technology at all.

Education for the new generation. Oddly enough, one of the proposed answers to technology integration in the schools is to do nothing. An assumption is that older teachers are lower users of technology and are less likely to integrate it (Inan & Lowther, 2008). In contrast, we have seen earlier that today's children use technology from a young age; some researchers believe that these young people are fluent with technology

(Prensky, 2001). These students' higher technology use has led some researchers hypothesize that second order barriers will disappear as young teachers replace older teachers in the schools; research surrounding this digital native generation has been debated.

In actuality, students surveyed in an Educause report of over 30,000 college students did not have exceptionally positive things to say about their technology skills and confidence, even though they owned and used a lot of technology (Smith, Salaway, & Caruso, 2009). Preservice teachers surveyed in the earlier-mentioned study by Lei echoed these responses (Lei, 2009). So, the students in these studies possessed some literacy with specific devices that they owned, but they were not fluent with technology. These findings about the technology confidences and attitudes of young people are problematic if it will be up to these preservice teachers to encourage fluency through integration in their future classrooms.

Still, there is a contrasting view: the idea that—due to the technology-immersed society in which they have grown up—the next generation of teachers are already technology fluent and equipped with 21st century skills. Therefore, they will automatically be able to integrate technology without encountering the barriers that troubled their predecessors.

The Digital Natives Issue

We saw earlier that children use technology from a young age; the assumption is that these children are already technology-savvy. If this is true, how much does the young generation need to formally learn about technology? Are they already literate? Fluent?

From some researchers' standpoints, these students already know all that they need to know, and they have not learned it in a formal education setting. Walden University reports: "most schools still limit or ban student access to some Web resources and technology, especially the smart, mobile devices that students increasingly prefer to use in their daily lives outside of school," (2010, p. 5). Likewise, a recent longitudinal study of 1000 children—who were randomly selected at birth from 10 U.S. cities and observed in grades 1, 3, and 5, in 737 classrooms, in 302 districts, located in 33 different states—showed that these children used or learned about computers less than 2% of the time in their classrooms (Pianti, Belsky, Houts, Morrison, NICHID Early Child Care Network, 2007).

Some researchers believe that students' technology use while at school is insignificant when compared to their technology use outside of school: in fact, they feel they must slow down in the classroom (Prensky, 2006). Marc Prensky has become famous for his writings about digital natives: a generation he says has been immersed in technology, resulting in kids who know more about technology than any previous generation (2001; 2006). These digital natives, he argues, are different from older generations in their communication, their recreation, and their workflow (Tapscott, 2009; Prensky, 2001). Digital natives like to participate in the formation of their world, sharing everything they can online and expecting others to do the same (Palfrey & Gasser, 2008; Tapscott, 2009; Richardson, 2008). Prensky asserts that digital natives may be seen to others as demanding and having little attention span, but they are actually excellent multi-taskers, doing several things at once because this is the way their in-depth use of technology enables them to think and learn (2005b). These students understand much more about technology than older generations do, and easily become bored if their high standards of engagement are not recognized by teachers, parents, and others (Prensky, 2005a; Prensky, 2006). Digital natives are not afraid of technology tools; they learn by doing, unafraid of clicking the wrong item or pushing the wrong button (Oblinger & Oblinger, 2005).

Surveys about technology-use demographics would seem to back these claims of a digitally native generation. Almost all of today's college students own laptop computers (Smith, Salaway, & Caruso, 2009). These are students who do not wear watches because their mobile devices tell the time, and who prefer to use other communication methods than email because email is too slow (Beloit College, 2011). They are the most frequent users of text messaging (Pew Internet Research Center, 2011b), and the vast majority of them—over 90%—use social networking tools such as Facebook (Pew Internet Research Center, 2011a; Smith, Salaway, & Caruso, 2009). They are the most prominent users of smart phone technology (Deloitte, 2011). About half of students report owning smart phones or smart devices, with more planning to buy such a device soon (Smith, Salaway, & Caruso, 2009). They have never lived in a world where computers and the Internet did not exist (Prensky, 2001), or where cable and satellite television—not to mention online streaming television and music—were unavailable (Bahanovich & Collopy, 2009; Beloit College, 2011). However, does all of this technology use translate to a sufficient understanding of technology? Is this generation automatically prepared to successfully participate in the information-driven society in which they have been raised?

There are several problems with the assumptions that it does, and that they are. First, digital native proponents have mistaken literacy for fluency, and conflated fluency with 21st century skills. We have already established that literate students do not become fluent without guidance and designed instructional experiences. Likewise, fluent students do not exhibit 21st century skills, although there is some overlap between the two. Second, digital natives are not even necessarily literate or fluent—these attributes, as we have seen, vary greatly from individual to individual, to the point that it can hardly be said that digital natives as a homogenous class even exist.

Native Literacy

The digital native concept is attractive to many, but lacks evidence to support its claims (Bennett, Maton, & Kervin, 2008). Many researchers feel it is unfair to assume that an entire generation has these traits, simplifying what is actually a complex issue (Jones & Czerniewicz, 2010). Socioeconomic and cultural differences lead to varied technical experiences among young people of similar ages (Li & Ranieri, 2010; Sanchez, Salinas, Contreras, & Meyer, 2011). Reed & Giessler (2002) found similarly that students experience with computers did not automatically transfer to useful computer skills. Guo, Dobson, & Petrina observed students at four universities over a three-year timespan, also conducting pre- and post-surveys that questioned students about their demographics and technology use. They were specifically looking for differences by age, and no significant differences were found in technology competency between students who would be identified as digital natives and those who were not a part of that generation (Guo, Dobson, & Petrina, 2008). Students of this digital native generation have not been found to have a broad, shared base of technology knowledge or skills (Kennedy, Judd, Churchward Gray, & Krause, 2008; Teo, 2009).

Native Fluency

Their skill-sets may vary, but many young people are literate with some technology tools and may use these tools on a frequent basis. Oblinger and Oblinger assert the existence of digital natives (students they refer to as the "net generation"), but they also warn that this generation's high technology usage rate does not equate to an understanding of its proper use (2005). "Exposure to technology does not make someone a technology expert any more than living in a library makes a person a literary expert," (Davies, 2011, p. 47). They also do not know how to use technology for learning or professional benefit; their skills are often literacy-only (Oblinger & Oblinger, 2005). That is, they may know which buttons to push, but they do not fully understand the reasons and implications tied to pushing them.

Recall that proponents of 21st century skills place importance on digital citizenry, which includes the ethical and responsible use of the Internet. Palfrey & Gasser warn that students who identify as digital natives may not know enough about the consequences of sharing information online or sharing copyrighted content (2008). In contrast to the concerns Palfrey & Gasser had about ethical and legal use of Internet tools, most of the technology-savvy students in the Educause study said they understood how to use it responsibly in this manner (Smith, Salaway, & Caruso, 2009). Still, it is difficult to measure whether these students' claims are accurate, especially when they are reporting about their own skills. Will their skills transfer to their future professions?

Native 21st Century Skills

Skills and adaptability with technology do not automatically lead to using technology for teaching. Even young people who are fluent with technology may not understand the flexible ways to apply technology, or the critical thinking and problem solving skills described as necessary in the 21st century skills framework (Kaminski, Switzer, & Gloeckner, 2009; P21, 2009a). They need to be given opportunities to apply the knowledge they have and develop the skills to expand their knowledge (Silva, 2009). "Students have limited understanding of what tools they could adopt and how to support their own learning. These findings challenge the proposition that young people have sophisticated technology skills, providing empirically-based insights into the validity of this assertion" (Margaryan, Littlejohn, & Vojt, 2011, p. 439). Research about technology integration often focuses on its practice in K-12 schools, asserting that technology needs to be integrated with subject matter for children of all school levels—from kindergarten onward. Through integration, the technology becomes transparent to children—taking a place in their lives as a useful resource rather than an entertaining novelty (Behrman & Shields, 2000; NRC, 2002). Still, young people have varied backgrounds and differing experiences with available technology both at home and in school, so it cannot be assumed that they (as a whole) own or have used certain technologies or that those experiences have the same value as proper academic or career-related technology experiences (Kaminski, Seel, & Cullen, 2003).

These varied backgrounds and experiences include an important demographic characteristic: gender. The differing technology characteristics of young women in comparison to young men will be discussed in the following section.

Native Women

The majority of teachers are female, and the gender gap in the field has been growing for decades. Nearly 80% of K-12 teachers in the United States are female, (Ingersoll & Merrill, 2010, p. 18). Thus, as we discuss technology and education, the gender of educators must be discussed. The issue is that studies involving students and other young people have shown several differences between males and females concerning technology use. Studies specific to the technology use of women in education-related fields are scarce, but studies concerning gender in general and gender in technical majors or career fields have shown differences between males and females. In a 2007 study, males were found to be twice as likely to explore new technologies as women were, with women more likely to be "technophobes" (Morahan-Martin & Schumacher, 2007, p. 2237). In a 2009 study of college students, this result was mirrored: "more than half of males (53.8%) claimed they are early adopters or innovators, whereas only one-fourth of females (25.4%) did so," (Smith, Salaway, & Caruso, 2009). These differences in male and female enthusiasm toward technology are sometimes attributed to women's lesser exposure to technology and to female technology role models (e.g., their mothers) when they are growing up (Varma, 2009).

Another factor may be the "sociocultural influences" women with technological interests experience from family, friends, peers, and other important figures in their lives (Trauth, 2002, p. 114; Viadaro, 2009; York, 2008). Young women may also be influenced by teachers and counselors who direct them away from technical careers (Adya & Kaiser, 2005) and toward careers that are more family- or socially-oriented (Viadaro, 2009). While teaching in most disciplines may not be considered to be a technical career by most people, the 21st century skills described earlier do include technology-related tasks and demand that teachers be prepared to integrate technology (NCES, 2002; US Department of Education, 2001).

While many have found that women use technology less frequently or have less skills, not all research supports this claim. Some recent studies have found results in contrast to research stating that women are lower users of technology. Chan & McLoughlin (2008) found that females were actually higher users of some technologies than males. Specifically, females studied were higher users of social networking and other Web 2.0 tools than were the male participants in this study. The Pew Research Center recently reported: "young adult women ages 18-29 are the power users of social networking; fully 89% of those who are online use the sites overall and 69% do so on an average day," (2011a, p. 3). Likewise, McEuen (2001) found that female students used the computer more often to get in touch with friends, while males used it more often for entertainment. Another study's results were similar: it found that males tended to use technologies such as video games more than females (Chan & McLoughlin, 2000). In another study, female students were found to use the Internet for academic purposes more often than males (Selwyn, 2008). McEuen's survey results showed that female students were less technology-knowledgeable than males in several ways, including learning new software or technology tools, understanding how HTML or e-mail works, and understanding social issues involving technology (e.g., copyright), (2001, pp. 11-13). These findings contrast with the idea of an entire generation of technology-savvy people.

As discussed earlier, Ingersoll & Merrill predicted that the number of teachers who are female in the K-12 school system could continue to increase, up to 80% by 2012 (2010). Because of this demographic trend, gender may be a very important factor in determining how well preservice teachers are prepared to use technology.

Implications for Preservice Teacher Education

The flawed assumptions made about this generation of digital natives—an apparently technically-savvy bunch that do not need formal education on the subject—have been translated into the domain of preservice teacher education. If preservice teachers are digital natives, they will automatically know how to integrate technology (Richardson, 2008). Likewise, because many also believe that students in K-12 schools are also digital natives, it is less necessary to help them develop technology fluency or 21st century skills (Prensky, 2006), thus making the need to provide training to preservice teachers even less critical. We have seen that this is a flawed argument: the digitally native generation is a myth; young people have variable literacy of basic technology, possibly with little or no fluency or knowledge of 21st century skills. Still, with research about this digitally native generation of students circulating, their university instructors and future employers may be expecting a type of young person they do not, in fact, receive:

> So, where were all those knowledgeable, hip, computer-savvy students that we were reading about in the newspapers? Where were the students who, according to the press, had such a firm grip on this tool of the future? They certainly weren't in my classes! (Tichenor, 2001, p. 4)

If we are to go by a generational cutoff of the early 1980s birthdate, these students began to enter the higher education system in or around the year 2000 (Oblinger & Oblinger, 2005; Prensky, 2006; Richardson, 2005). Some of these individuals have since graduated from college and gone on to their teaching careers—21% of today's teachers are under the age of 31 (National Center for Education Information, 2011). Some people believe that this influx of digitally native professionals will solve technology integration issues: as new teachers enter the schools and veteran (non-digital native) teachers retire, technology will naturally become a part of the classroom (Richardson, 2008, Walden, 2010). One university technology center director asserted: “tech-savvy teachers [will begin] to push education to accommodate and embrace technology,” (Schaffhauser, 2009, p 29). Statements such as this might lead higher education institutions and school administrators to believe that there is not a need to educate preservice teachers about technology integration. Other research disagrees with this position.

In a 2004 study of teachers who were starting a graduate program, Andrew Topper found that the teachers studied had “only a smattering of basic skills and knowledge of technology, and lack[ed] many of those assumed to be present in graduates of a preservice program,” (2004, p. 308). In a quantitative study of freshman preservice teachers conducted in 2007, Lei found that the vast majority of these students (96%) had begun using technology such as computers prior to their 6th grade year. These students were positive about technology, but reported being concerned about their abilities to use it in the classroom (again, note that these were first year students who may be taught these methods as they progress in their majors, but had not been taught them yet). Still, recall that confidence is a second order barrier, and findings like these suggest that it needs to be addressed in preservice education. Lei’s sample reported that the students used social networking more than any other activities, and Lei found that simple technologies were well-understood while the students did not report proficiency in the more advanced technologies (Lei, 2009). In a 2010 survey, teachers who had graduated from their preservice education programs after the year 2000 said they did not feel prepared to teach with technology or 21st century skills (Walden, 2010). The low level of skills students do tend to share—perhaps basic technical literacy skills at best—indicate that there is not a simple fix or approach to integration education for future teachers (Kennedy, Judd, Churchward, Gray, & Krause, 2008). The Walden study also found that teachers did not understand the concepts of 21st century skills nearly as well as their administrators assumed they did, and this communication lapse led to a lower level of meaningful technology use in the classrooms (2010).

It seems that one goal of preservice teacher education programs is to produce inservice teachers without second order barriers, who understand the differences between literacy and fluency, who are fluent themselves, and who understand how to teach with technology—including methods of technology integration—in order to cultivate their students' development of 21st century skills. Preservice teacher education programs must then provide a teaching and learning environment that includes integration. Integration by instructors not only effectively models the methods for preservice teachers, it has been shown to be an effective way to change negative or apathetic attitudes toward technology too (Lowther & Morrison, 2009)—particularly in young women (Van Eck, 2006) who make up a majority of preservice teachers. But if instructors believe their students (the preservice teachers) have more technology skills than they do, or if they mistake fluency and literacy for integration, change is not likely to happen. Instructors may also be unable to make changes because they face barriers of their own. Preservice teachers, then, would then continue to face barriers because they have not been empowered (by education and their instructors) to overcome the issues that lead to barriers. So, we need to find out what preservice education instructors believe about preservice teachers and technology, what preservice teachers believe about technology and their instructors, and what, if any, issues each group has that are indicative of the development of barriers. This study sought to explore those characteristics.

Summary and Research Questions

This chapter has explored how the saturation of technology including computers, mobile devices, the Internet, software, applications, and other tools for business and personal use have led our society to become immersed in technology (Eisenberg, 2008; Murnane & Levy, 2004). Technology has been described as a necessity, one of the core understandings students will need to embrace as they become adults and enter the 21st century world (P21, 2009a). Researchers, independent organizations, and the U.S. government alike agree that instructional technology—any technology that can be used to foster teaching learning—needs to be used regularly and properly as a part of formal education in order to help prepare students for the workplace and society (ISTE, 2008; Lowther & Morrison, 2009; U.S. Department of Education, 2001a).

Young people need to acquire a versatile set of skills they can use to navigate their technically immersed society as they become adults; these have been aptly defined as 21st century skills. They include skills of critical thinking; problem solving; social, cultural, and ethical awareness; technical competency; and more (P21, 2009a). The creators of the P21 framework assert the importance of these skills due to the connectedness of our information-and-technology driven society (Trilling & Fadel, 2009). The importance of these skills has been accepted by school administrators who understand how thoroughly technology has become embedded in American society, and how that technology connects so many people, groups, and business sectors (Walden, 2010). The nature of these skills is best understood in conjunction with the research in this area of the last quarter century, with specific attention paid to the concepts of technology literacy and fluency, and the method of technology integration.

Technology literacy has been defined—for the purposes of this study—as the lowest level of attainable technology skills (Kaminski, Seel, & Cullen, 2003). It is exactly that—a skill set which may be taught to students. They might learn how to turn on a computer or how to install a software program. A deeper form of technology learning is fluency, commonly defined as a knowledge of technology skills that includes the ability to think critically and solve problems using technology (McEuen, 2001). Fluency with technology—referred to by some researchers as being FIT or having FITness—is better than literacy because it embraces the ability to adapt to changing technologies (Lin, 2000; NRC, 2001). Since new discoveries and more efficient technology tools are released often, the higher-order thinking skills possessed by a fluent person are valuable.

We can then think of technology integration as a vehicle through which students can learn to be fluent. In a technology-integrated lesson, students would ideally use a technology tool or set of tools to solve a contextual problem, or expand their knowledge of a subject (NCES, 2002). A technology-integrated lesson is not achieved by the superficial addition of a computer or technical device to classroom activities (e.g., practicing computer use for 30 minutes) (Dockstader, 1999; Ertmer, 1999). Technology integration requires knowledge of a variety of technologies (so it is helpful if the teacher is technology fluent) and how they can be used for teaching and learning (Pierson, 2001). The proper integration of technology will lead to lessons or assignments that demonstrate meaningful technology use. Technology is integrated when students are working with the technology to serve a meaningful purpose: deepening, broadening, or enriching their knowledge (Lowther & Morrison, 2009).

The United States government values technology integration and 21st century skills. Its recent initiatives and reports include the NRC's Being Fluent with Information Technology report (1999), the Enhancing Education Through Technology Act of 2001 (part of NCLB), the NCES' Technology in Schools Taskforce report on integration (2002), the National Education Technology Plan (2010), and the very recent launch of the Digital Promise organization (2011). Some technology-education standards have also been developed by some research groups and organizations, with a common desire to give technology access to school children in hopes that they will become fluent technology users, possessing skills such as those described by P21. One such set of standards is the NETS, originally developed by ISTE in 1998, with versions revised in 2007, 2008, and 2009. The CCSSI and the AASL's Standards for the 21st Century Learner are two others. All of these standards have in common a great deal of value placed on the use of technology as a tool for responsible citizenry, learning, and life—not the acquisition of an abstract technology skill set.

The research showed that technology tools—even when available to teachers and students—are not being integrated in to lessons as often as researchers and policymakers had hoped (Walden, 2010). Ertmer (1999) attributes this to the presence of barriers, building off the work of Brickner (1995). First order barriers are problems that are external to the teacher, such as access to resources, technical issues, time, and policies. These barriers can sometimes be solved with creative use of technology by a teacher (i.e., designing group assignments if not enough technology tools are available to accommodate every student), but they often must be solved by the school district (Bromme, Hesse, & Spada, 2005; Ertmer, 1999; Robinson & Sebba, 2010). As such, while important, first order barriers are less of a challenge because they have been solved or we know how to solve them. Second order barriers are more complex: these are barriers that are internal to the teacher (Ertmer, 1999). These include a teacher’s beliefs or teaching philosophy, their knowledge of technology, their confidence (and relatedly, self-esteem related to technology) and their attitude about technology (Ertmer, 1999; Teo, Chai, Hung, & Lee, 2008). These barriers are more difficult to resolve, and often require education and support, including workshops or inservice days and technical or instructional support staff availability (Ravitz, Wong, & Becker, 1999; Walden, 2010; Wild, 1996).

Inservice training and support is helpful to current teachers, but what can be done in regards to barriers encountered by young people who intend to become teachers? Little is known about what preservice teachers believe when they enter their teacher education programs, making it hard for instructors to know what needs to be taught. Some researchers such as Marc Prensky believe that a new generation of students—the oldest of which are now adults nearing age 30—is no longer facing second order barriers to technology use (Oblinger & Oblinger, 2005; Prensky, 2001; Tapscott, 2009). This generation has been referred to as digital natives. Prensky and others assert that this generation is fluent with technology: naturally having more ability to adapt to technology than their parents or other adults. In contrast with this digital native concept, studies have shown that this generation is not uniformly fluent with technology at all (recall that fluency requires critical thinking and problem solving). Teen and young adult technical skills have been found to be basic at best, with students of the same sample groups varying wildly in their usage and understanding of technology (Li & Ranieri, 2010; Sanchez, Salinas, Contreras, & Meyer; 2011). Furthermore, approximately half of the digital native generation are females, and female teens and young adults have been shown to have less fluency than males of the same ages (Morahan-Martin & Schumacher, 2007), and different technology use characteristics (Chan & McLoughlin, 2008; McEuen, 2001).

What does this mean for education? First, recall that some researchers hypothesized that as older teachers retired and younger digital native teachers replaced them, concerns about school technology integration would be solved. This has not happened. On the contrary, although this digital native generation has been in the workforce for nearly a decade, preservice and inservice teachers polled have responded that they did not feel prepared to teach with technology (Lei, 2006; Topper, 2004; Walden, 2010). Additionally, a large majority of inservice teachers are women, and that number is rising (Ingersoll & Merrill, 2010); women, even digitally native ones, were found to be less technology literate and fluent than their male peers (Chan & McLoughlin, 2008; McEuen, 2001). Yet, preservice teacher education programs generally do not focus on technology fluency or integration; they operate on the assumption that students are already fluent, and fluency will automatically lead to integration (Graham, Culatta, Pratt & West, 2004; Smith, 2001).

Having established that digital natives do not exist—at least not with the technology fluency they have been reported to have—the task now lies in figuring out what the technology characteristics of our preservice teachers actually are. Recall that a pilot study by this author found differences in preservice teachers' technology characteristics when compared to students studying other majors (Salentiny, 2010). Their characteristics, which were less positive than what was reported by other students, indicated that they may not be fluent and may have second order barriers to technology integration.

In order to determine the best solutions for the second order barriers that preservice teachers may face, we need to know who our preservice teachers are. There is a gap in the research about preservice teachers' personal technology skills, usage, and perceived competencies, however. Findings including those reported by Walden University and by the previously mentioned unpublished study suggest that teachers may be low users of technology before as they begin their education to become teachers (2010). The pilot study indicated that preservice teachers did not use or understand technology as much as their peers in other majors of study. This, and other research, suggests that it is important to see how they use technology and to explore their confidence levels with it. How, when, and for what purposes do they use technology? Do they believe they are fluent? What are their beliefs about technology use in education? If they are low users of technology, it may be because they have an unenthusiastic, perhaps even negative attitude toward technology to begin with. If true, efforts to encourage technology integration by offering inservice professional development will likely be less effective than anticipated. There will also be significant implications for how we design our preservice education curriculum as well. Further, the beliefs and attitudes of instructors, both their own and their perceptions of their students, have important implications. What do instructors believe about technology? About their students? How accurate are these beliefs? This study set out to answer these questions.

Since literacy is a precursor to fluency, it is important to find out how and for what purposes these students use technology to begin with. Exploring their confidence levels with technology helps to see whether they possess fluencies and what (if any) second order barriers they face. Discussing their beliefs about technology as an educational resource helps to determine whether they understand the concept of integration, and whether they have any experiences regarding 21st century skills. Instructors' perceptions of preservice teachers' beliefs and fluencies were also a concern, mainly because of the popularity of the claims about digital natives. Do instructors' perceptions of their preservice teachers' technology beliefs and fluencies differ from what preservice teachers report about themselves? With these inquiries and more in mind, research questions were developed for qualitative and quantitative exploration. Each is listed here with brief commentary and applicable hypotheses.

Question 1: Do preservice teachers differ in technology use and attitudes based on demographic characteristics (e.g., sex, age)?

It was assumed that most of the preservice teachers surveyed would be in their late teens or early twenties because young adults often go to college directly after completing high school. Since the literature showed that these preservice teachers belong to a generation of digital natives, some researchers assume they all have similar technology characteristics. The majority of researchers disagree, having found that students may have similar basic skills, but do not use technology in similar ways or have analogous attitudes about technology. Since the majority of the research points to variable technology characteristics among students with similar traits, the hypothesis is that there are significant differences between preservice teachers by age. Since these students' ages will likely increase along with their class standing (e.g., freshman, sophomore, etc.), the hypothesis is that there are significant differences in preservice teachers' technology characteristics depending on their class standing. The literature showed that by gender, females may express more negative technology attitudes or lower/more basic technology skills than their male peers. There was also evidence that female young people used some aspects of technology more often than males. The hypothesis is that are significant differences between preservice teachers' technology use and attitudes by gender. Significant differences in these demographic characteristics could indicate that certain preservice teachers (e.g., females, underclassmates) are more likely to develop barriers to technology integration than their peers.

Related alternative hypotheses 1-6:

1. Younger preservice teachers use more technology than older preservice teachers do.
2. Younger preservice teachers have better attitudes about technology than older preservice teachers do.
3. Underclass preservice teachers use more technology than upperclassmates do.
4. Underclass preservice teachers have better attitudes about technology than upperclassmates do.
5. Male preservice teachers use more technology than female preservice teachers do.
6. Male preservice teachers have better attitudes about technology than female preservice teachers do.

Question 2: How do instructors and preservice teachers differ in terms of technology use characteristics and attitudes toward technology?

Since personal technology use has not been a factor in many research studies about instructors' technology characteristics, it is important to see what they use and how they feel about technology. Barriers to technology integration included negative attitudes toward technology, sometimes caused by low exposure or inappropriate exposure to technology (Ertmer, 1999). The digital natives research tends to rely on the idea that older generations have a lower frequency of use and generally less positive opinions of technology than younger generations (Prensky, 2006). However, research also indicated that preservice teachers may be lower users of technology than their peers of the same age (Lei, 2009; Salentiny, 2010). Because of this research, the hypotheses are non-directional, though a difference between preservice teachers' use and attitudes is expected. It is also assumed (but was not measured) that students may not have careers, family obligations, or other constraints on the time they have for technology use, whereas instructors may have these constraints.

Related alternative hypotheses 7-8:

7. There is a significant difference in the frequency of technology use by instructors compared with that of preservice teachers.
8. There is a significant difference in the technology-related attitudes of instructors compared with those of preservice teachers.

Question 3: How often do preservice teachers observe their instructors using instructional technology tools in class, and how often do they use it themselves?

The literature explored how instructors' teaching philosophies concerning technology use were a key predictor to whether or not they would integrate technology in to their lessons: teaching philosophies that conflicted with technology integration were a type of barrier. Additionally, inservice teachers were found to be likely to mimic the teaching methods and the philosophies of their preservice teacher-educators. Since the research showed that technology is not being integrated at a high rate in K-12 classrooms, the hypothesis is that preservice teachers do not see instructors modeling technology regularly. The literature also showed that younger people are more frequent technology users than older people. However, it was also asserted that this generation may not know how to use technology for purposes of learning or other benefits aside from personal enjoyment. Thus, the hypothesis is that preservice teachers do not use technology regularly for class assignments.

Related alternative hypotheses 9-10:

9. Preservice teachers do not see their instructors use technology in the classroom on a daily basis.
10. Preservice teachers do not use technology for class assignments on a daily basis.

Question 4: Are there differences in the perceptions of how often tools are used by instructors or assigned for use by preservice teachers?

Aside from insinuations of instructors' definitions of technology differing from students' definitions of technology, research did not indicate that preservice teachers and instructors would perceive educational technology tools in different ways. However, younger generations may perceive different tools to be technology (e.g., smart phone), versus what older generations may consider to be technology (e.g., dvd player) (Oblinger & Oblinger, 2005). Thus, we could infer that instructors may think they are modeling a lot of technology in their classrooms, whereas preservice teachers do not benefit from this modeling due to their differing perceptions about technology. Since prior research does not directly discuss this possibility, the hypothesis is that preservice teachers observe the same amount of technology that instructors report they are using, and that preservice teachers use the technology tools in their classes approximately as often as instructors assign such tools.

Related alternative hypotheses 11-12:

11. There is not a significant difference between the amounts of instructor technology use reported by the instructors versus what was observed by the students.
12. There is not a significant difference between the amounts of technology use assigned by the instructors versus that which is reported by the preservice teachers.

Question 5: What do instructors believe about the importance of the use of technology tools by themselves and by preservice teachers?

Researchers, the U.S. government, private organizations, school administrators, parents, children—everyone asserts that technology experience is important for children in schools. Furthermore, research about teacher education emphasizes the importance of strategies of technology modeling and mentorship to help preservice teachers learn to teach with technology-inclusive methods including integration. The hypotheses here are that instructors believe that technology is important for preservice teachers to see and use in their classes.

Related alternative hypotheses 13-14:

13. Instructors believe it is important for them to use technology when teaching.
14. Instructors believe it is important for preservice teachers to use technology when completing assignments.

Question 6: What do instructors and preservice teachers believe about the students' career readiness in regard to technology?

Studies including the one by Walden University have shown that inservice teachers felt that they had not been prepared by their teacher education programs to use technology in the classroom. The hypotheses are that the majority of preservice teachers do not believe that they are being prepared for their careers, but the majority of instructors believe the preservice teachers are being adequately prepared. The explanation for the latter hypothesis stems from the logical assumption that if instructors did not think their students were prepared, they would have taken action to address that concern.

Related alternative hypotheses 15-16:

15. The majority of preservice teachers do not believe that they are being prepared for their careers.
16. The majority of instructors believe that preservice teachers are prepared for their careers.

CHAPTER III

METHODOLOGY

This study explored the technology uses and beliefs of preservice teachers and their instructors. The research showed that inservice teachers' technology experiences, beliefs, and attitudes about technology may lead to the development of barriers to technology integration. Furthermore, it is possible that these barriers may develop during preservice teacher education, but we do not know whether this is true. Additionally, instructors in colleges and universities can face the same barriers as inservice teachers, and these barriers—or the beliefs and attitudes that lead to them—may be passed on to the preservice teachers they instruct. Knowing more about technology uses, beliefs, and attitudes would provide valuable background for what should be done to overcome barriers. Thus, the objective of this study was to explore technology characteristics of preservice teachers and their instructors, specifically looking at their beliefs and uses of technology, and comparing the two groups for similarities and differences. The approach was mixed-methods: quantitative data was collected via survey and analyzed. Then, results of these analyses were used to develop further questions that were asked through qualitative methods; attitudes were also primarily addressed through the qualitative methods. The mixed-methods approach ensured that explanations could be gathered for the results of the surveys, and it bridged gaps that immerged during survey data analysis.

Participants

Preservice Teachers

The student sample for this study is from a rural public Midwestern university with an enrollment of approximately 14,000 students (11,000 undergraduates). The university's education department is accredited by NCATE (the National Counsel for Accreditation in Teacher Education), and there are five other colleges and universities within 150 miles that also offer NCATE-accredited education or teaching-related baccalaureate degrees. Three of these institutions are in the same state as the target university; two are in the neighboring state. All institutions except one are public (state-funded) schools.

As reported by the research department within the target university, 87 students graduated with undergraduate degrees from the education department during the 2010-2011 academic year (includes degrees granted in August, December, and May). This number included 61 recipients of undergraduate degrees in in Elementary Education, 13 students with Early Childhood Education undergraduate degrees, and 13 students with Social Science Education undergraduate degrees. (See Figure 2.)

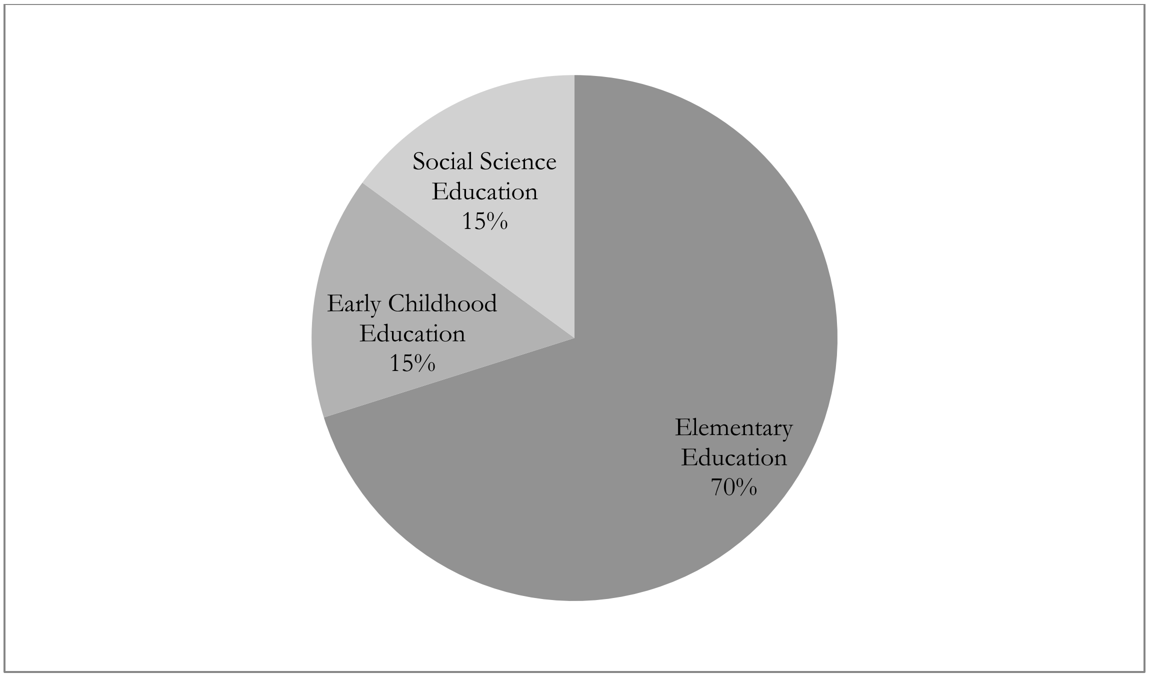


Figure 2. 2010-2011 target university education degree recipient types.

Additionally, four students graduated from the university's music department with undergraduate degrees in Music Education during the 2010-2011 academic year. This is worth noting because students reporting majors in Music Education were included in this study as part of the sample of students with preservice teaching majors. In the five previous academic years (between the 2005-06 academic year and the 2009-10 academic year), between 92 and 125 students were awarded bachelor's degrees from the education department each year; this number does not include students who received undergraduate degrees from the music department.

According to a database manager at the education department of the target university, there were 221 pre-major students and 229 students with declared preservice teaching majors in March, 2011. (Pre-major students must meet GPA requirements, credit hour and coursework requirements, application requirements, score requirements for the

Pre-Professional Skills Test/PRAXIS I exam, and provide a successful Professional Dispositions Report prior to declaring the major.) Thus, the potential sample for this study contains 450 undergraduate students with a major or intended major in preservice teaching.

Survey Demographics. The survey was administered in 16 classes within the education department at the target university throughout a three-week period in April and May, 2011. 34 instructors and seven graduate teaching assistants who taught courses in this department were identified by contacting the department secretary. These 41 individuals were contacted for their cooperation in recruiting participants. Some were unable to devote class time to the administration of the survey due to the precedence of curricular obligations, but six instructors and six graduate teaching assistants did agree to allow the activity, for a response rate of 29.3%. There were 50 courses meeting regularly during the semester (others were independent study or field-experience-based courses, and thus not meeting regularly). The 16 courses surveyed comprised 32% of possible courses. (See Figure 3.)

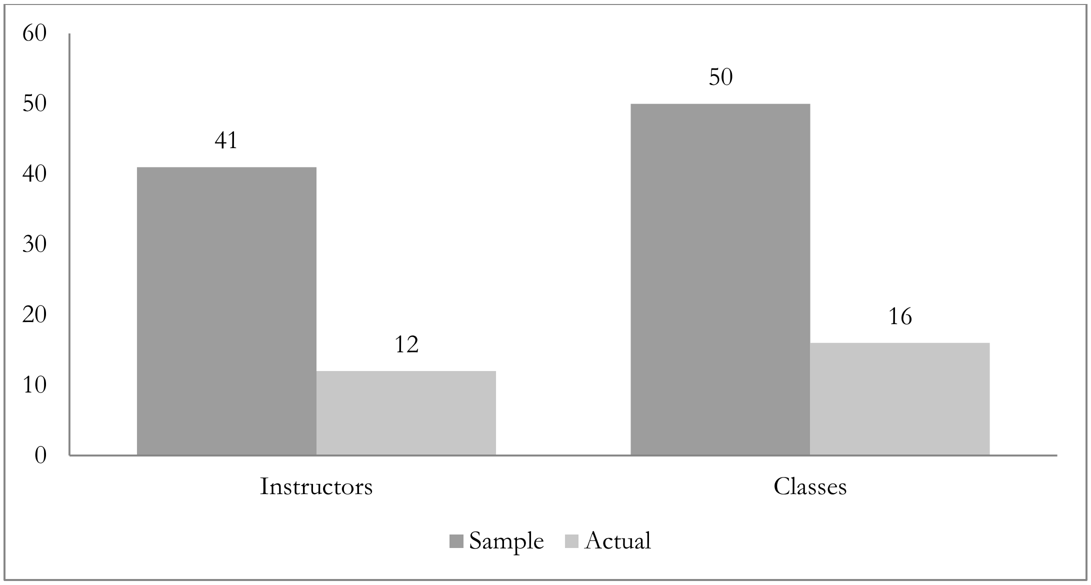


Figure 3. Survey distribution response rate.

275 students completed the survey, for a total of 61.1% of the total possible sample. However, some students who responded were not from the education department. After removing outliers and including only students within the education department (n = 198), the response rate from the original sample of preservice teachers was 44%. (See Figure 4.)

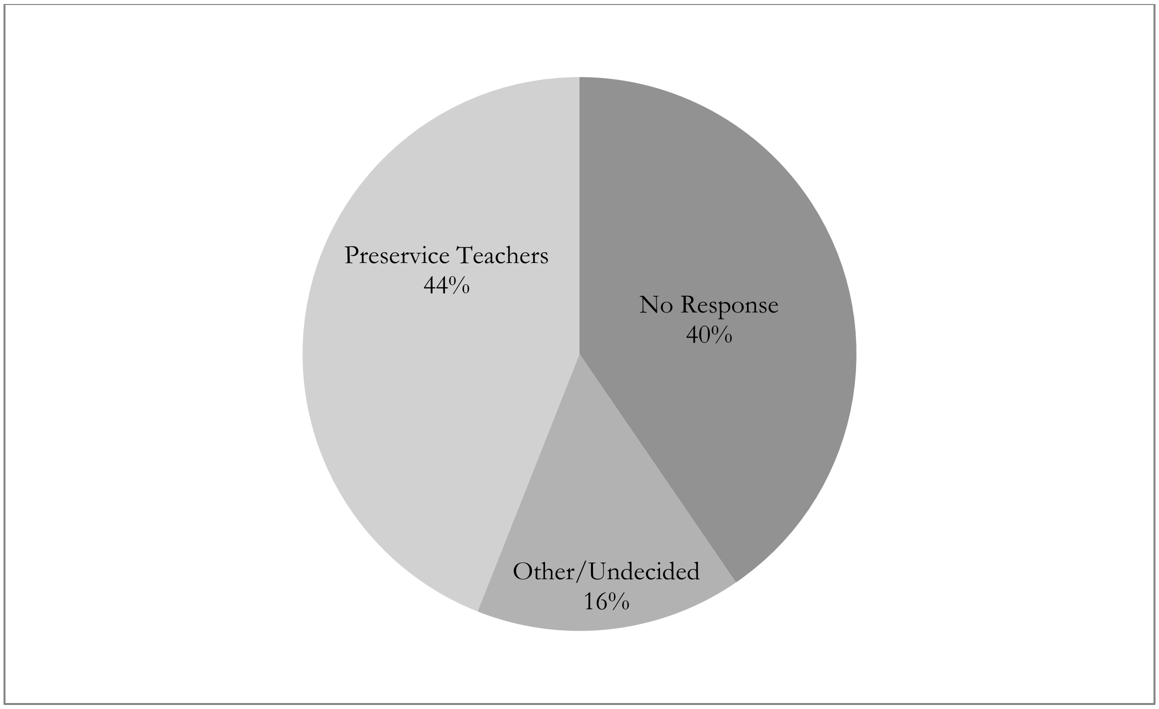


Figure 4. Preservice teacher survey response rate.

Preservice teachers were asked to participate regardless of age or year in college (they reported both demographics on the survey). It was expected that some students would be enrolled in multiple classes to which the survey is administered, and this was true. Students were asked not to complete the survey a second time and they complied—this was verified by examining the consent forms for identical names; none were found.

Other majors. Fifty students reported majors other than education, and 20 students were undecided or did not list a major (see Figure 5). Outside of the education department, 20 other majors (including “undecided”) were represented.

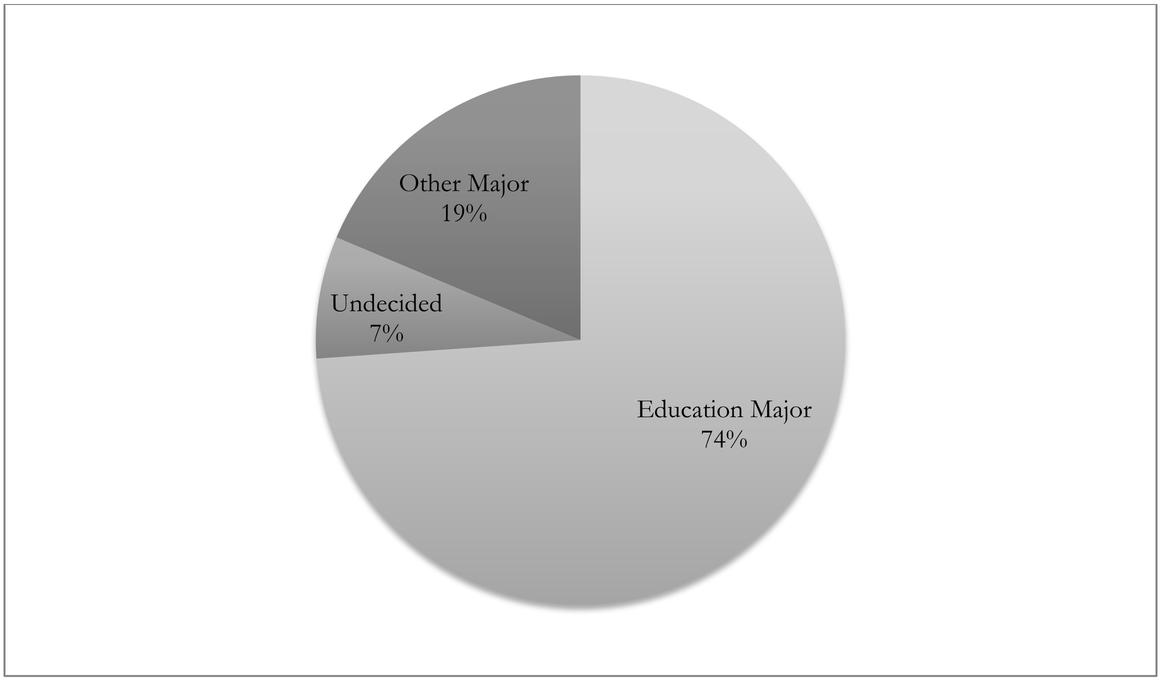


Figure 5. Student participant demographics by major of study.

The study focused on students who are majoring in education, so analyses reflect only their responses—not the responses of non-majors and undecided majors. Table 3 presents the demographics of the preservice teachers who responded, and the following describe this information.

Table 3.

Preservice Teacher Survey Demographic Information

	Category	*n*	Percentage (%)
Age	18-19	50	25.5
	20-21	95	48.5
	22-23	36	18.4
	24-29	7	3.6
	30+	8	3.6
Class Standing	Freshmen	22	11.2
	Sophomores	74	37.6
	Juniors	56	28.4
	Seniors	45	22.8
Major Status	Declared	128	64.6
	Pre-Major	70	35.4
Gender	Male	40	20.3
	Female	157	79.7
Major Type	Early Childhood Ed.	19	9.6
	Elementary Ed.	100	50.5
	Middle Level Ed.	10	5.1
	Secondary Ed.	55	27.8
	Music Ed	4	2.0
	Composite Social Science Ed.	4	2.0
	Physical Ed.	6	3.0

Pre-majors. In alignment with the sample description, students were asked to report whether they were pre-major students or whether they had a declared major in education. Of the 198 preservice teachers, 70 (35%) reported pre-major status.

Gender. The majority of the preservice teachers were female (79.8%); and 20.2% were male (see Figure 6).

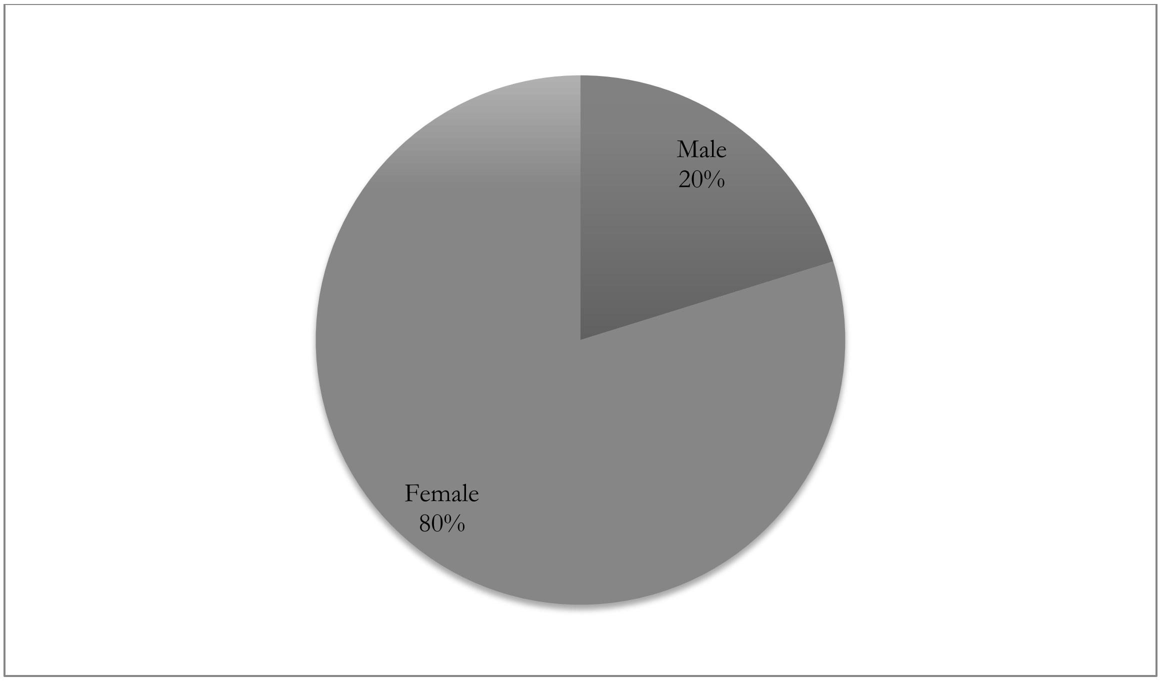


Figure 6. Preservice teacher participants by gender.

Age and class standing. Preservice teachers were asked to report their age (in years) on the survey. Age-related data were calculated by combining the ages in to categories. The majority of the preservice teachers were what could be considered traditional college age: 18-19 (25.3%), 20-21 (48%), and 22-23 (18.2%). Seven were between ages 24 and 29 (3.5%), and there were eight participants over age 30 (4%). See Figure 7.

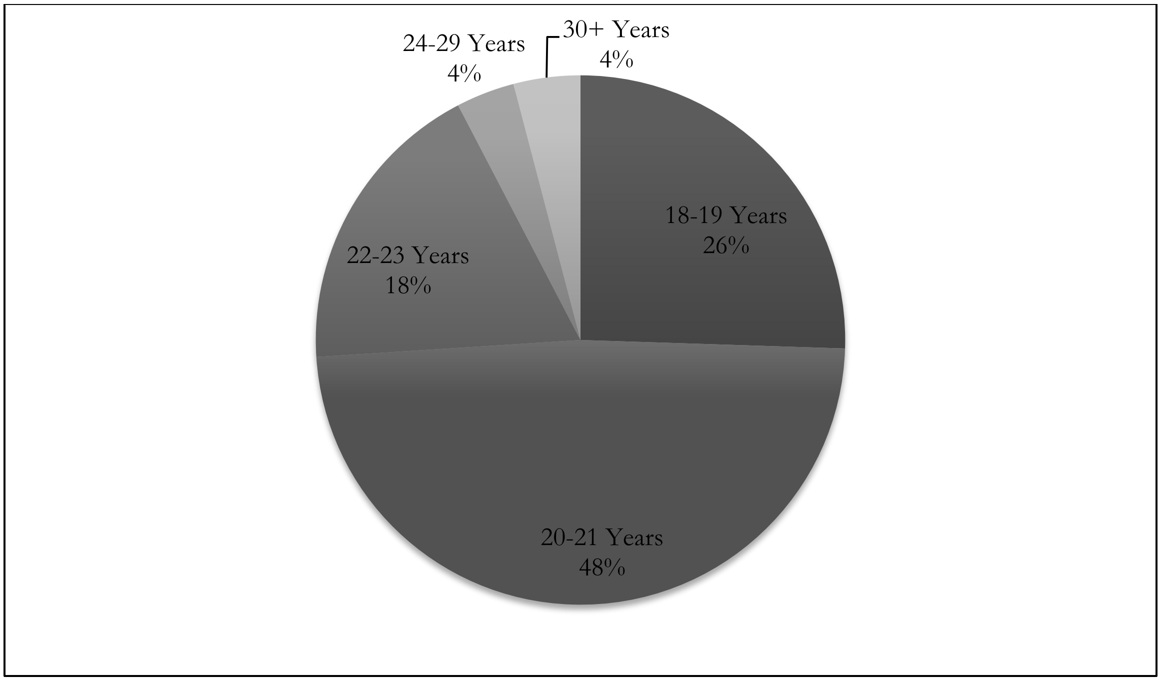


Figure 7. Preservice teachers by age.

Preservice teachers also chose a class standing of freshman (11.1%), sophomore (*37.8%*), junior (*28.4%*), or senior (22.7%) when filling out the survey (see Figure 8).

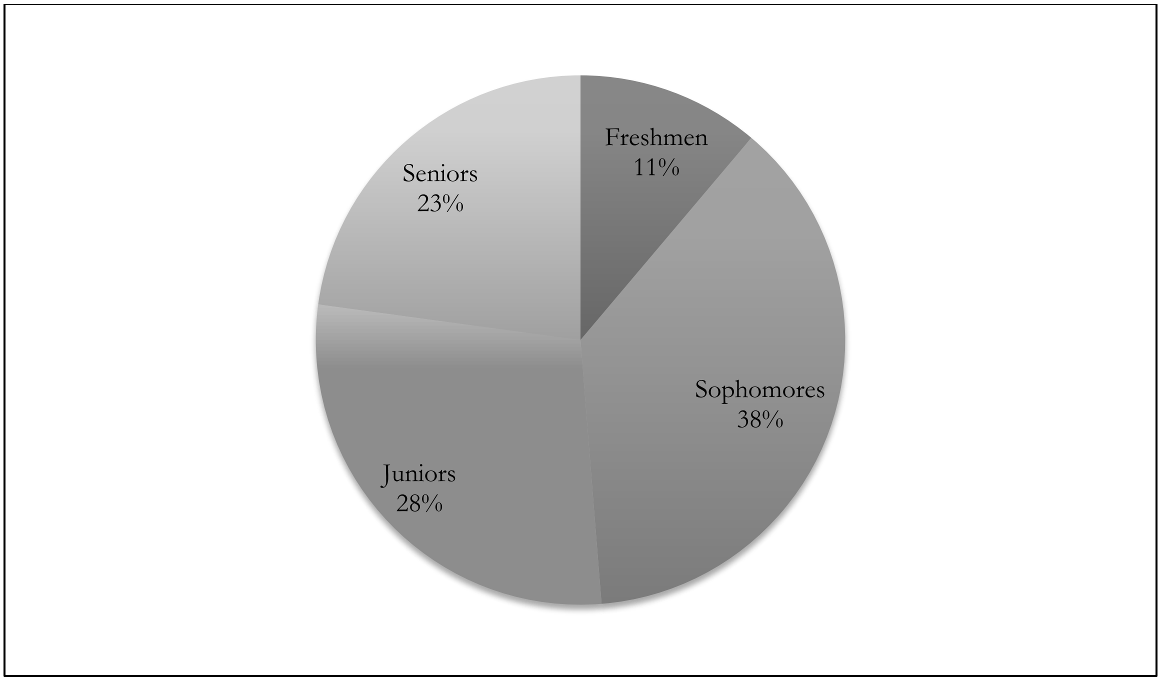
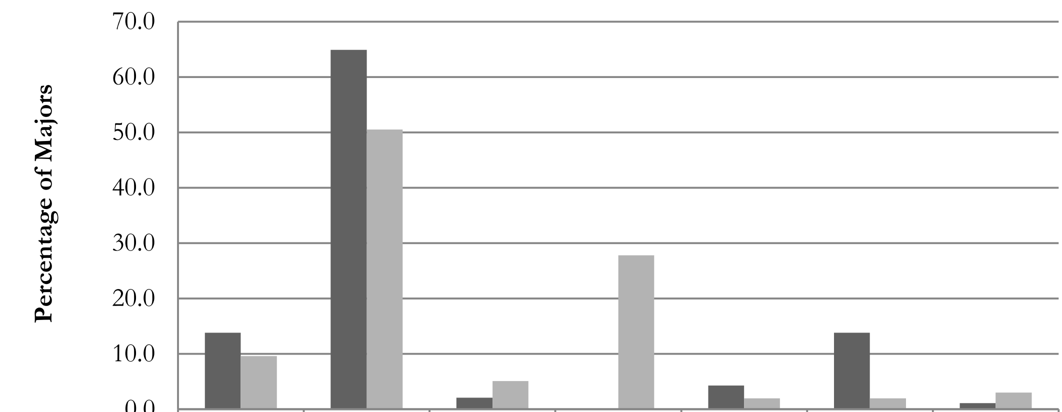


Figure 8. Preservice teachers by class standing.

Types of preservice majors. The participants were asked to identify themselves as being a specific type of preservice teacher. Different types of preservice teachers might presumably take different types of courses that would then shape their technology experiences. Likewise, different types of careers in education will likely have different levels of technology-knowledge demand. Students reported to be focusing on one of seven different areas of study: Early Childhood (9.6%), Elementary Education (50.5%), Middle Level Education (5.1%), Secondary Education (27.8%), Musical Education (2%), Composite Social Science Education (2%), or Physical Education (3%). Participants were also given choices including Art Education and Composite Science Education, but no students who participated in this survey identified with either of those areas of study. Figure 9 compares the percentage of major types who responded to this survey with the percentage of degrees awarded for those major types in 2010. (Data was not available for 2010 graduates in Secondary Education.)



	Early Child	Elem.	Middle Level	Secondary	Music	Comp. Soc. Sci	Phys.
Grads (2010)	13.8	64.9	2.1		4.3	13.8	1.1
Participants	9.6	50.5	5.1	27.8	2.0	2.0	3.0

Figure 9. Compared major types in sample vs. recent degrees awarded.

Focus group demographics. Qualitative data were collected to corroborate trends that were found in the quantitative portion of the study. For the qualitative portion of the study, two focus groups were formed in the fall of 2011. These students were recruited from a pool of 49 students who consented to be contacted when they filled out the quantitative survey in the spring. In gathering current contact information, it was discovered that two of the 49 students had graduated in the spring or summer of 2011 and 14 others had reported majors in disciplines other than preservice education. Therefore, the pool was reduced to 33 possible participants. All of these students were invited by email to attend the focus groups. Five students attended the first focus group and four students attended the second focus group, for a response rate of 27.3%. Table 4 shows the focus group participants' detailed demographics.

Table 4.

Preservice Teacher Focus Group Demographic Information

	Category	*n*	Percentage (%)
Age	19	3	33.3
	20	3	33.3
	21	3	33.3
Class Standing	Freshmen	0	0
	Sophomores	5	55.6
	Juniors	3	33.3
	Seniors	1	11.1
Major Status	Declared	6	66.7
	Pre-Major	3	33.3
Gender	Male	2	22.2
	Female	7	77.8
Major Type	Early Childhood Ed.	1	11.1
	Elementary Ed.	4	44.4
	Middle Level Ed.	0	0
	Secondary Ed.	2	22.2
	Music Ed	1	11.1
	Composite Social Science Ed.	0	0
	Physical Ed.	0	0

The focus group participant group was much smaller than the survey participant group, they were demographically similar in most ways. Figure 10 compares focus group demographics to survey demographics, by percentage. (Keep in mind that the focus group participants were a selection of the survey participants. This means that if a student was a freshman when they took the survey, he might be a sophomore as a focus group participant.)

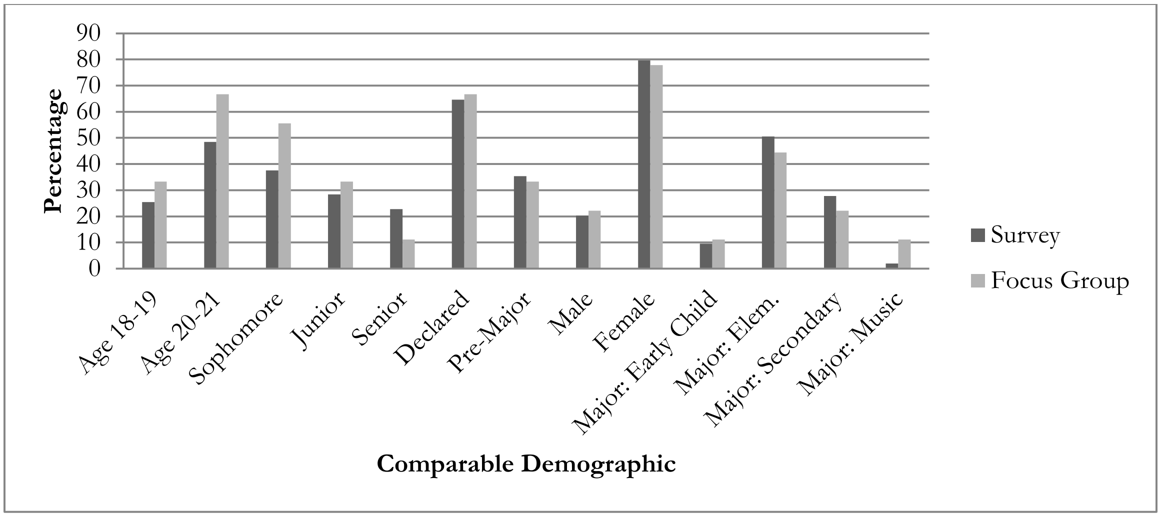


Figure 10. Compared preservice focus group and survey participant demographics.

Aside from size, one difference in focus group demographics, versus survey demographics, was that there were no freshmen in the focus group. This was because all focus group participants were chosen from the consenting group of survey participants. (I.e., Students who were freshmen in spring 2011, when they took the survey, they were sophomores in the fall.) There were also some majors completely missing from the focus group sample, and one that was over-represented (Music Education). However, since the focus group size was so small, this overrepresentation occurred because one Music Education major attended.

Instructors

The faculty sample for this study comes from the same medium-sized, public Midwestern university from which the student sample was derived. There were 34 instructors teaching classes in the teacher education department for the university during the spring of 2011. Graduate teaching assistants were not included as part of the sample because teaching education classes may or may not be their intended career path.

Survey demographics. Twenty-one instructors responded to the survey, for a response rate of 61.8%. The survey was sent to all instructors teaching undergraduate courses in the department in question.

***Gender*.** Females made up the majority of the faculty respondents (81%), with three males (14%) and one person not reporting gender. This distribution was expected: among faculty in the available sample of 34, 20% were male and 80% were female. (See Figure 11.)

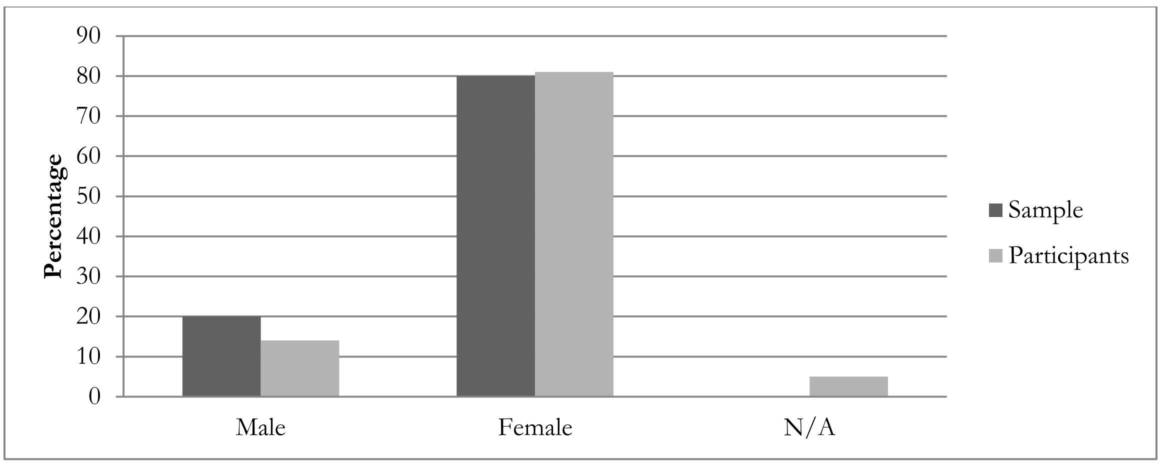


Figure 11. Compared instructor participants and sample gender.

***Years as an educator*.** Instructor participants were asked to report the number of years they had been college educators as well as the number of years they had been teaching in this department at this campus. The minimum reported years involved in education was 0 years, and the same person reported 0 years teaching in this department. The maximum reported years educating was over 37 years, both for overall educating and for teaching in this department. Since most instructors reported unique numbers of years teaching, these responses were sorted into categories by computing a new variable in

SPSS. 23.8% of the respondents had been at the department for 0-5 years (n=5), 23.8% reported 6-10 years (n=5), 19% had been there 11-15 years (n=4), 28.3% had been there 16-20 years (n=5), and 9.5% of the instructors had been at the department for 21 years or more (n=2).

The years they reported having been a college teacher indicated that some of the instructors had been college educators at other institutions prior to coming to this one. 9.5% of the instructors had been college educators for 0-5 years (n = 2), 23.8% reported 6-10 years of college teaching (n = 5), 19% reported 11-15 years (n = 4), 33.3% reported 16-20 years of teaching (n = 7), and 14.3% of instructors had been college educators for 21 or more years (n = 3). (See Figure 12.)

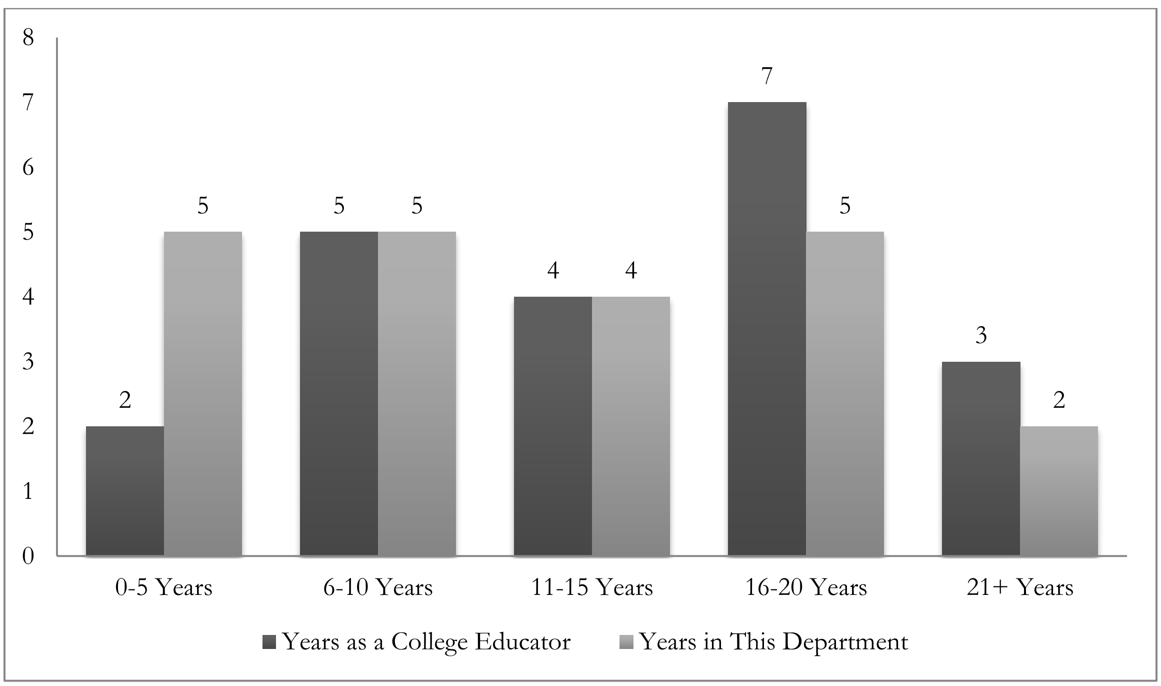
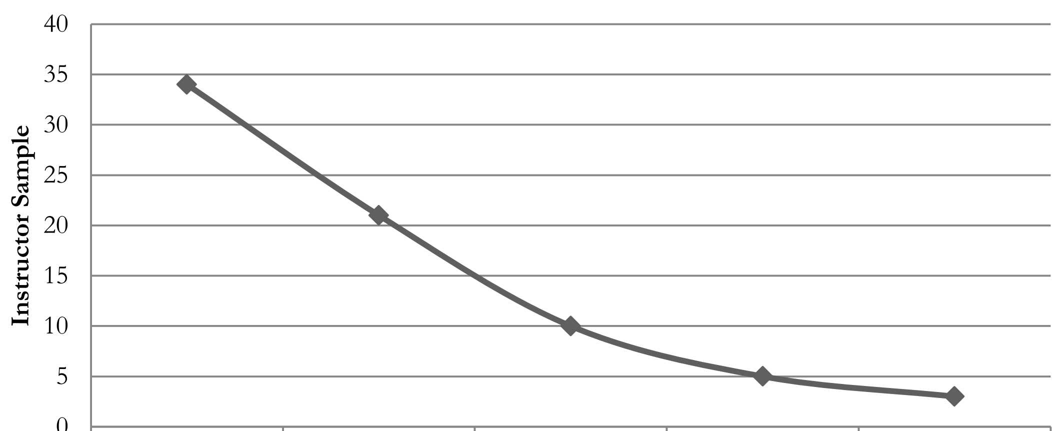


Figure 12. Instructor career longevity.

Interviewee demographics. As with the student participants, qualitative data were collected from instructors as a means to help understand the trends found in the faculty data, and to get their thoughts and opinions on the trends found in the student data. Instructors indicated whether they would consent to be interviewed when they took the online survey. Ten of the 21 instructors who took the survey consented to be interviewed, for a response rate of 47.6%. These 10 instructors were contacted using the contact information they provided on their surveys. Of the 10 instructors who consented to be contacted, five instructors responded. Three instructors who responded to the contact were interviewed; two of the individuals who responded had participated in a previous study with the researcher in which they were asked similar questions about technology use and pedagogy. Those two instructors were not interviewed for this study. (See Figure 13.)



	Sample	Took Survey	Consented to Interview	Responded to Interview Request	Interviewed
n	34	21	10	5	3

Figure 13. Instructor interviewee selection process.

Two of the interviewees were female (66.7%), one was male (33.3%). Two had been college educators (and at this institution) for between 16 and 20 years; one had been a college educator for 6-10 years, with the majority of those years at this institution, in this department. (See Table 5.)

Table 5.

Instructor Interviewee Demographic Information

	Years	*n*	Percentage (%)
Gender	Female	2	66.7
	Male	1	33.3
As Educator	6-10	1	33.3
	16-20	2	66.7
At this Department	6-10	1	33.3
	16-20	2	66.7

As with the preservice teacher focus groups, the group of instructors interviewed was much smaller than the group who completed the survey. For both groups, there was a majority of female participants versus male (the survey participants were a higher majority female). The percentage of interviewees who had been in the department, and had been educators, for 16-20 years was also higher than the overall percentage of those surveyed. Figure 14 compares demographics of the two groups. (Again, recall that the instructors interviewed were also members of the survey participant sample, so their demographics are represented twice in the table.)

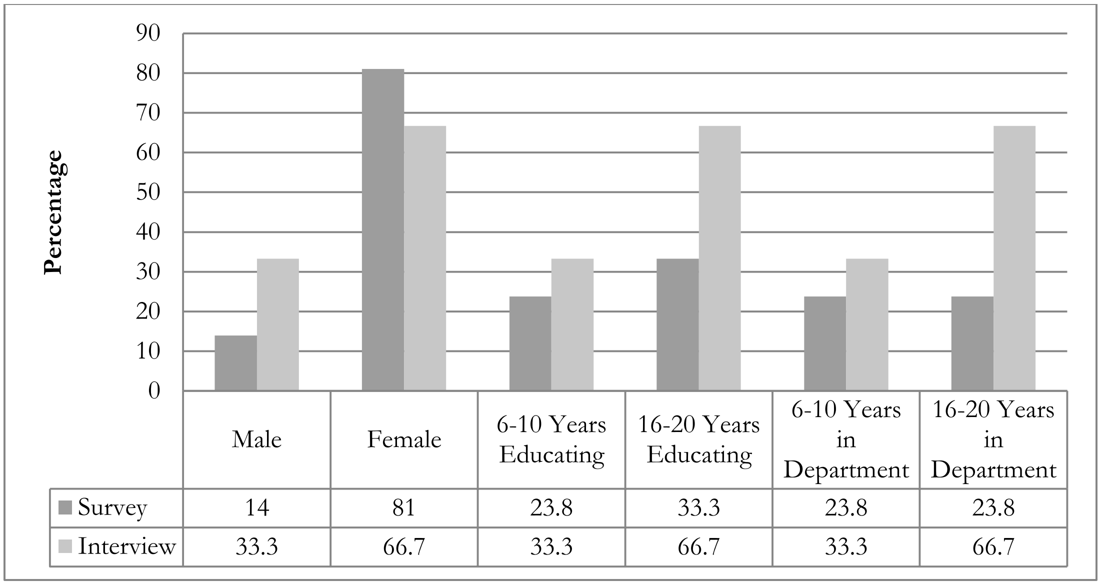


Figure 14. Compared instructor interview and survey participant demographics.

Research Design

There were six research questions guiding this study and from those emerged sixteen alternative hypotheses:

1. Younger preservice teachers use more technology than older preservice teachers do.
2. Younger preservice teachers have better attitudes about technology than older preservice teachers do.
3. Underclass preservice teachers use more technology than upperclassmates do.
4. Underclass preservice teachers have better attitudes about technology than upperclassmates do.
5. Male preservice teachers use more technology than female preservice teachers do.

6. Male preservice teachers have better attitudes about technology than female preservice teachers do.
7. There is a significant difference in the frequency of technology use by instructors compared with that of preservice teachers.
8. There is a significant difference in the technology-related attitudes of instructors compared with those of preservice teachers.
9. Preservice teachers do not see their instructors use technology in the classroom on a daily basis.
10. Preservice teachers do not use technology for class assignments on a daily basis.
11. There is not a significant difference between the amounts of instructor technology use reported by the instructors versus what was observed by the students.
12. There is not a significant difference between the amounts of technology use assigned by the instructors versus that which is reported by the preservice teachers.
13. Instructors believe it is important for them to use technology when teaching.
14. Instructors believe it is important for preservice teachers to use technology when completing assignments.
15. The majority of preservice teachers do not believe that they are being prepared for their careers.
16. The majority of instructors believe that preservice teachers are prepared for their careers.

A sequential mixed methods approach was used. The quantitative research and analyses were dominant over qualitative research, with some exceptions to be described in this section. The hypotheses above led to the exploration of the following constructs:

- technology use types,
- technology use frequency,
- classroom technology use by instructors,
- classroom technology use by preservice teachers,
- technology attitudes,
- technology importance, and
- career readiness.

The study was designed with the intention of measuring each of the constructs quantitatively, and then expanding upon a selection of those findings with qualitative follow-up inquiries. Alternative hypotheses 1-7, 11, and 12 are comparisons of technology characteristics by demographic, focusing on the constructs of technology use types and technology use frequency. These were targeted by the quantitative instruments. Follow-up qualitative questions were asked about these results mainly as a way to personify the data: to ask “why” instructors and preservice teachers thought these differences—if differences were found—existed.

Alternative hypotheses 9, 10, and 13-16 were also explored primarily by the quantitative instruments. These hypotheses focused on the constructs of career readiness, technology importance, and classroom technology use by preservice teachers and by instructors. While analyzing the results, however, it was determined that the survey questions designed to measure those hypotheses could have been interpreted in different ways by different participants. So for these hypotheses, qualitative follow-up questions played a more significant role in the interpretation of the quantitative results.

The construct of technology attitudes was an exception to the research design in that qualitative methods became the primary measure for this construct. It was initially inferred that a Technology Knowledge, Interest, and Skills subscale in the survey instruments (described in the Instruments section, below) would quantitatively measure the attitudes of preservice teachers and their instructors. However, the results from this subscale and further research in this area indicated that skills and technical knowledge may not be valid (or complete) gauges of a positive (or negative) attitude about technology. In this case, the quantitative results were used secondarily, while qualitative questions were developed to explore the construct of technology attitudes more accurately.

Instruments

The pilot study mentioned in *Chapter 2* included a survey developed with the goal of examining student technology use, technology access, technology skills, and their perception of instructors' technology skills (Salentiny, 2010). A modified version of that survey was used in this study, and is described below. See Appendix A for the survey in its entirety.

Preservice Teacher Survey

The preservice teacher survey instrument was a 48-item self-report survey including four demographic questions and seven subscales. Each of the subscales was designed to explore one or more of the constructs identified as important to the research design. (See Table 6.)

Table 6.

Preservice Teacher Survey Subscale Relations to Hypotheses, Constructs

CONSTRUCT	HYPOTHESIS	SURVEY SUBSCALE
Technology use types	1-7, 11, 12	Internet Use; Technology Use; Technology Access
Technology use frequency	1-7, 11, 12	Internet Use; Technology Use
Classroom tech by instructors	9, 10, 13-16	Instructor Classroom Technology Use
Classroom tech by preservice teachers	9, 10, 13-16	Student Classroom Technology Use
Technology attitude	2, 4, 6, 8	Technology Knowledge, Interest, and Skills
Technology importance	9, 10, 13-16	-
Career readiness	9, 10, 13-16	Career Readiness

Internet use. The Internet Use subscale was designed to explore the constructs of technology use types and technology use frequency. It contained 13 fill-in-the-blank questions in which participants were asked to write in numerical estimates of how many hours per week they used each technology type (e.g., time spent on social media, time spent on homework, time spent downloading music). These items were influenced by those asked in the *Annual Gadgets Survey* by Princeton Survey Research Associates International for the Pew Internet and American Life Project (PSRAI, 2007). This instrument was chosen for inspiration because it had been distributed widely to the United States population, and as U.S. society is the target society of this study, it was likely that the technology tools in that survey would be applicable to this study’s sample. Still, the Annual Gadgets Survey was not targeted at preservice teachers, or even at digital natives, and the most current version of the survey was over three years old at the time this study was designed. For this reason, specific questions from that instrument were not used. Instead, the *Annual Gadgets Survey* was a reference to assist in identifying specific technologies that needed attention in the survey, and how to ask about these technologies. Specifically, the *Annual Gadgets Survey* asked participants how often they engage in specific types of Internet use: email, reading the news, researching health and medical information, shopping online, downloading video files, downloading music files, and watching video files online. While participants in the *Annual Gadgets Survey* were asked how often they used various tools on scale of days, students in this study were asked to answer these questions by estimating how many hours they spent using each tool or device on a weekly basis. The Internet Use subscale in this study was also expanded to include types of Internet use that were not included in the *Annual Gadget Survey*: Internet use for school, online gaming, social networking, use for work, and use for chatting. The Chronbach's alpha for the 12 items in this subscale was .684.

Technology use. The Technology Use subscale was also developed based on the questions in the aforementioned *Annual Gadgets Survey* (PSRAI, 2007). It was also designed to explore the constructs of technology use types and frequency. Where the Internet Use subscale asked preservice teachers to estimate how many hours per week they spent using the Internet for specific reasons, the Technology Use subscale was broader: five fill-in-the-blank items prompted preservice teachers to estimate how many hours per week they spent using technology or computers for different purposes (e.g., work, academic). This subscale had a Chronbach alpha of .636.

Technology access. To additionally explore the construct of technology use types, preservice teachers were asked about their ownership of five different types of technology in the Technology Access subscale. This subscale contained 5 items with checkboxes of possible responses. It could be answered with "yes," "no," or "I have this but do not use it to access the Internet." This was also based on the *Annual Gadgets Survey* also asked about ownership of the following devices: a computer, a cell phone, a PDA, an mp3 player, a digital camera, a video camera, a webcam, and a digital video recorder. The survey in this study asked about ownership of similar devices, but was updated to reflect recent propagation of new devices and technologies. For example, many computers include a built-in webcam, and most cell phones include the ability to take pictures and video as well as play digital music. Additional technology tools such as the *Amazon Kindle* and the *Apple iPad* were not asked about in the *Annual Gadgets Survey* because these technologies were not available in 2007 when that survey was conducted; they were included in this study. This study also includes use of public labs because these are available on the campus in which the study takes place. Because the items within it did not relate, consistency was not calculated for this subscale.

Technology knowledge, interest, and skills. The construct of technology attitude was measured by the Technology Knowledge, Interest, and Skills subscale. This seven-point technology subscale—with likert-type checkbox responses—is also found in the survey of *Preservice Teachers' Knowledge of Teaching and Technology* developed by Schmidt, Baran, Thompson, Koehler, Mishra, and Shin (2009a). It is the "TK"—technology knowledge—portion (p.2). This subscale was used because these researchers were studying factors that lead to technology integration, and technology knowledge was identified as one of the factors contributing to whether teachers integrate technology. The target population for the *Preservice Teachers' Knowledge of Teaching & Technology* survey was preservice teachers, making the subscale appropriate for this study. Research about barriers indicated that low knowledge or skill levels could lead to development of second order barriers related to attitude or education (Ertmer, 1999); this was another reason this subscale was used. Schmidt et al reported the alpha for this subscale as .82. The alpha calculated from this study's student data was comparable at .881.

Instructor and student classroom technology use. The constructs of classroom technology use by preservice teachers and classroom technology use by instructors were measured by two subscales: Instructor Classroom Technology Use and Student Classroom Technology Use. They are described here together because they are identical with one exception: the former asks students how often they have observed their instructors using certain technology tools, while the latter asks students how often they have used the same tools. Each of these is a 7-item subscale with Likert-type response checkboxes. The technology types listed were chosen by looking at the tools listed in the *Annual Gadgets Survey* (PSRAI, 2007), the technology tools covered in the education department's Technology for Educators course, and the tools available within the target university's learning management system. The target university's learning management system was *Blackboard*, and this was included as a technology in the subscale. Although generic names for popular technology tools (e.g., word-processing software, presentation software) were used for most items, it was decided that survey respondents might not be familiar with the term "learning management system." For this reason, *Blackboard* was referenced by name. These subscales were considered important because the modeling of technology by instructors (Harris, Mishra, & Koehler, 2009; Strudler & Wetzel, 1999; Teo, 2009) and the use of technology in methods courses (Overholtzer & Tombarge, 2003; Stetson & Bagwell, 1999) have been shown to help preservice teachers understand the use of technology for pedagogy. The Chronbach's alpha for Instructor Classroom Technology Use was .713, and it was .714 for Student Classroom Technology Use.

Career readiness. The construct of career readiness was deemed important because of research that showed that preservice teachers felt unprepared to teach with technology (Walden, 2010). The Career Readiness item (it is only one item, not a subscale of items) asked: "Do you think you are learning how to work with the technology you will need for your future career?" A five point checkbox response was provided for this question. As this was only one item, internal consistency was not able to be calculated.

Reliability. As noted in the description of each subscale, Chronbach's alpha was calculated for the subscales of Internet Use, Technology Use, Technology Knowledge, Interest, and Skills, Instructor Classroom Technology Use, and Student Classroom Technology Use. Chronbach's alpha was also calculated for the variables representing the totals of the Instructor Classroom Technology Use and Student Classroom technology use subscales. (Total columns and other data analysis are discussed in *Chapter 4*.) Table 7 presents all of the Chronbach alpha reliability ratings from this study.

Table 7.

Internal Reliability for Subscales within the Student Survey

SUBSCALE/VARIABLE	CHRONBACH'S ALPHA	*N* OF ITEMS
Internet Use Subscale	.684	12
Technology Use Subscale	.636	5
Technology Knowledge, Interest, and Skills Subscale	.881	7
Instructor Classroom Technology Use Subscale	.713	7
Student Classroom Technology Use Subscale	.714	7
Instructor Use Total & Student Use Total	.807	2

Internal consistency was also not calculated for the Technology Access subscale because it was assumed that if students preferred to access the Internet one way, they may not access it other ways, and thus their answers to these questions would not be connected.

Instructor Survey

The 46-item instructor survey instrument contained four demographic questions, followed eight subscales. These were largely the same subscales as the preservice teacher survey, with a few changes. The surveys were similar to allow comparison between preservice teachers and instructors across specific subscales. Like the preservice teacher survey, different subscales explored different constructs from the research design. (See Table 8.)

Table 8.

Preservice Teacher Survey Subscale Relations to Hypotheses, Constructs

CONSTRUCT	HYPOTHESIS	SURVEY SUBSCALE
Technology use types	1-7, 11, 12	Technology Use; Technology Access
Technology use frequency	1-7, 11, 12	Technology Use
Classroom tech by instructors	9, 10, 13-16	Instructor Classroom Technology Use
Classroom tech by preservice teachers	9, 10, 13-16	Student Classroom Technology Use
Technology attitude	2, 4, 6, 8	Technology Knowledge, Interest, and Skills; Knowledge Comparison
Technology importance	9, 10, 13-16	Technology Importance
Career readiness	9, 10, 13-16	Career Readiness

The instructor survey was worded slightly differently (to reflect the different sample) and contained different demographic questions. As an example of the shift in demographic questions, it did not ask for instructors' majors, or year in school as these would be irrelevant. Instructor age was not requested because it was thought that, due to the small sample size, instructor privacy would be compromised if ages were known. While research about digital natives indicated that age is an important factor to technology use (Prensky, 2006; Tapscott, 2009), other research indicated that age does not play a part in the technology beliefs of instructors (Russell, O'Dwyer, Bebell, & Tao, 2007). Russell et al reported that length of time at an institution was predictive of technology beliefs; the instructor survey thus asked instructors to report how long they had been teaching in general, and at this institution. Please refer to Appendix B to view the in the instructor survey in its entirety.

Technology use. The Technology Use subscale in the instructor survey was identical to the subscale of the same name in the preservice teacher survey. It was intended to measure the constructs of technology use and technology frequency. The Technology use subscale had a Chronbach's alpha of .713 for its 5 items.

The Internet use subscale—which in the preservice teacher survey asked about specific types of internet use Including social networking, use for school, and online gaming—was omitted from the instructor survey. While this information would have been interesting, the review of the literature had not indicated a link between higher education instructors' personal technology use (i.e.,, watching online videos, using social networking) and their pedagogical beliefs related to technology. Another subscale (see Technology Importance, below) was added in order to study the construct of the same name, so Internet Use was left off of the instructor survey to avoid the risk of making the survey too long for instructors to consider completing. It was determined instructors could be asked about what they do on the Internet during the qualitative portion of the study.

Technology Access. The Technology Access subscale in the instructor survey was also the same as the Technology Access subscale in the preservice teacher survey. It, too, was designed to explore the construct of technology use. Reliability data was not calculated for this subscale because its items did not relate to one another.

Technology knowledge, interest, and skills. The seven-question Technology Knowledge, Interest, and Skills subscale in the instructor survey was also identical to the one in the preservice teacher survey. This was the subscale that was developed using a portion of the survey by Schmidt, et. al. (2009a). Although the original survey was aimed at preservice teachers, not instructors, the subscale was included in the instructor survey because it was intended to measure technology attitude, and the research had shown that instructors may pass their attitudinal barriers on to preservice teachers. Also by including this subscale, instructor responses could be compared to preservice teacher responses to this subscale on their survey, to determine which sample reported more knowledge, interest, and skill with technology. The technology attitudes construct was related to this question. Recall that the Technology Knowledge, Interest, and Skills subscale was reported to have an alpha of .82 (Schmidt, Baran, Thompson, Koehler, Mishra, and Shin, 2009b). An alpha of .861 was calculated for the Technology Knowledge, Interest, and Skills subscale in the instructor survey for this study.

Instructor and student classroom technology use. The Likert-type subscales of Instructor Classroom Technology Use (7 items) and Student Classroom Technology Use (7 items) were included in the instructor survey as well as the preservice teacher survey, but with altered wording to reflect each audience. As an example of a wording difference, the preservice teacher survey asks: “Overall, how often do your instructors use the following technologies in class?” The instructor version of the survey presents the same choices, but asks “Overall, how often do you use the following technologies in class?” These subscales relate to the constructs of classroom technology use by instructors, and classroom technology use by preservice teachers. The subscale of Instructor classroom technology use was found to have internal consistency of .687; the Student Classroom Technology use subscale internal consistency was .753.

Technology importance. A 9-question Technology Importance subscale was included in the instructor survey, but absent from the student survey. The literature said that the use of technology (by instructors and students) was important in preservice teacher education (Strudler & Wetzel, 2009; Teo, 2009). With this in mind, the first two items in the subscale used Likert-type checkbox responses to ask instructors whether they thought student use and instructor use of educational technology were important. The remaining 7 items asked about the importance of each of the specific types of technology that were listed in the Instructor Classroom Technology Use and Student Classroom Technology Use subscales. The Technology Importance subscale related primarily to the construct of technology importance, and secondarily to the constructs of technology use by preservice teachers and by instructors. The alpha for the Technology Importance subscale was .839.

Knowledge comparison. The Knowledge Comparison item was unique to the instructor survey asked instructors to rate whether they believe their students are more or less knowledgeable about technology than they are. This question was asked because some of the research showed that instructors tended to feel uncomfortable teaching with technology to students whom they thought were technically more adept than they were (Brown, Davis, Onarheim, & Quitadamo, 2002; Christiansen, 2002; Graham, Culatta, Pratt, & West, 2004). This question targeted the construct of technology attitudes. Internal consistency was not calculated because this was one item.

Career readiness. The Career Readiness item on the instructor survey was nearly identical to the Career Readiness item on the preservice teacher survey. A wording change related it to instructors, rather than students: it whether instructors thought preservice teachers were being prepared for their careers. (The Career Readiness item on the preservice teacher survey asked students whether they thought they were being prepared.) This question was included to determine if there was a discrepancy between what preservice teachers anticipate experiencing in their future careers, and what instructors thought they would experience. The Career Readiness item primarily related to the career readiness construct, with secondary ties to technology importance and technology attitudes. As with Knowledge Comparison, this was one item, so internal consistency was not calculated for it.

Reliability. In review, Chronbach's alpha was calculated for the subscales of Technology Use, Technology Knowledge, Interest, and Skills, Instructor Classroom Technology Use, Student Classroom Technology Use, and Technology Importance. To determine whether the Instructor Classroom Technology Use and Student Classroom Technology Use subscale results were related, Chronbach's alpha was also calculated for the total columns of the items from each of these scales. (The processes for totaling subscale items is discussed later in this chapter.) Table 9 displays all of the reliability data for the instructor survey subscales.

Table 9.

Internal Reliability for Subscales within the Instructor Survey

SUBSCALE/VARIABLE	CHRONBACH'S ALPHA	*N* OF ITEMS
Technology Use Subscale	.713	5
Technology Knowledge, Interest, and Skills Subscale	.861	7
Instructor Classroom Technology Use Subscale	.687	7
Student Classroom Technology Use Subscale	.753	7
Instructor Use Total & Student Use Total	.898	2
Technology Importance Subscale	.839	9

The Technology Access subscale was not measured for internal consistency because ownership of (or access to) one device does not necessarily predict ownership of another.

Preservice Teacher Focus Group Questions

The majority of the questions asked in the focus groups were developed as follow-up mechanisms, to explain the results of the surveys. The goal of these qualitative measures was to identify some of the underlying reasons for any points of interest or disparities found in the data. The origin of the questions is now discussed by construct and in relation to the survey subscales, with some of the questions described as examples. Table 10 presents the constructs, focus group questions, and survey subscales; see Appendix D for a complete list of the questions asked during the focus groups.

Table 10.

Preservice Teacher Focus Group Question Relations to Survey Subscales, Constructs

CONSTRUCT	FOCUS GROUP QUESTIONS	SURVEY SUBSCALE
Technology use types	4, 3, 11, 20	Internet Use, Technology Use; Technology Access
Technology use frequency	20	Internet Use, Technology Use
Classroom tech by instructors	14, 15, 18	Instructor Classroom Technology Use
Classroom tech by preservice teachers	1, 12, 17, 18	Student Classroom Technology Use
Technology attitude	2, 3, 7, 9, 10, 11, 14, 21, 22	Technology Knowledge, Interest, and Skills;
Technology importance	5, 6, 7, 8, 10, 16, 23	-
Career readiness	7, 16, 23	Career Readiness
[Limitation: environmental]	13	-

Technology use types. The Internet Use, Technology Use, and Technology Access subscales were used to measure types of technology use on the survey. Qualitative questions were not specifically targeted at this construct because the survey responses to these questions indicated the types of technology preservice teachers own and use, and some basic reasons why (for work, for school, for personal use). Still, some questions were asked for the purpose of following up, to elaborate on the survey responses. For example, Question 4 asked whether the preservice teachers have had, or do have, a job, and whether they use technology in that job. “How did you learn the skills for it? Can you think of ways you could, or have used those skills to do other things?” This question was intended to foster a discussion of whether or not these preservice teachers had personal technology skills they thought would transfer to a professional environment, or how they preferred to learn about technology. Questions 3, 11, and 20 also target the construct of technology use types.

Technology use frequency. The Internet Use and Technology Use subscales on the survey measured the technology use frequency construct primarily (with support from the Instuctor Classroom Technology Use and Student Classroom Technology Use subscales). Qualitative questions about this construct were asked for the purpose of expanding the results from the survey. Question 20 asks the preservice teachers whether they think they, or their instructors use technology more frequently.

Classroom technology use by preservice teachers. The Student Classroom Technology Use subscale survey responses indicated that preservice teachers did not use technology during or for every class. Focus group questions were designed to elicit explanations of what was used, why it was used, whether they enjoyed the use, and what they thought the purpose of the use was. Question 14 asks what technology they have used, whether they were familiar with that technology or if they needed help with it, and whether they could see themselves using it when they became teachers. Questions 15 and 18 were also related to this construct.

Classroom technology use by instructors. Survey responses to the Instructor Classroom Technology Use subscale indicated that preservice teachers did not see their instructors use instructional technology during every class. Focus group participants were asked: “What do you think about the amount of technology being used—and how it is being used—in your program? Would you like to see more/less technology use?” This is Question 12 on the survey. The primary goal of this question was to find out if students thought the current levels of technology they had observed were appropriate for their program. The secondary goal of the question was to find out how technology was being used by instructors: as a delivery method, or in a more in-depth manner? Additional questions to explore classroom technology use by instructors were Questions 1, 17, and 18.

Technology importance. The construct of technology importance was measured by a quantitative subscale, but this question only appeared on the instructor survey, not the preservice teacher survey. As a result, qualitative questions were developed to find out preservice teachers' views on technology importance. One such question asked "What—if anything—do you think technology use adds to kids' learning experiences?" This is Question 6 on the survey. Additional questions that addressed the technology importance construct were questions 5, 7, 8, 10, 16, and 23.

Career readiness. The Career Readiness subscale in the preservice teacher survey asked preservice teachers whether they thought their program was preparing them for their careers as teachers. The majority of students believed they were prepared. To elaborate on whether this was true, qualitative questions were designed to find out what kind of preparedness they thought they needed. For example, Question 23 asked whether they thought they would use technology in their classrooms, and to describe situations where technology use would or would not be appropriate. Questions 7 and 16 also addressed the construct of career readiness.

Technology attitudes. The Technology Knowledge, Interest, and Skills subscale in the preservice teacher survey was designed to measure preservice teachers' attitudes about technology. Preservice teachers' responses to the Technology Knowledge, Interest, and Skills subscale of questions indicated that they had overall neutral attitudes about technology. Thus, a corresponding qualitative question was developed. It asked "What do you think of your own technology skills? Can you describe them? What kinds of things are you comfortable doing with technology?" This question was designed to explore the student attitudes and comfort levels associated with technology, with a goal of identifying some reasons why so many of them had neutral responses to the survey questions. This is Question 9 on the survey. It was inferred that different participants may have interpreted items on the Technology Knowledge subscale in different ways, so several questions in the qualitative measures were related to attitudes in order to explore this construct further. Other survey questions relating to attitude are questions 2, 3, 7, 10, 11, 14, 19, 21, and 22.

Environmental limitation. This study was completed in two phases, the first of which took place during the construction of a new building. During the first phase of the study, participants had not experienced the new building, the design for which included new technology and a different layout. (A comparison of the renovated building and the original building is provided in Chapter 5 *Limitations*.) Some of the preservice teachers had never been inside the previous building, which had not been updated in many years. However, the second phase of the study took place after the building was opened, and when preservice education courses were taking place in it. Since this this building was seen as a possible limitation to the study (described in *Chapter 5*), a question about the building was asked during the focus group sessions. See Question 13 in Appendix D.

Validity. Researcher bias was a concern to validity of this study, but some steps were taken to avoid this from affecting the results. Questions were written to solicit open-ended responses and discussion—not to lead the participants in to providing the responses the researcher wanted to hear. Recorded transcripts provided rich data, which allowed the research to reflect on what was going on during the focus group, rather than trying to what was observed through written notes (Becker, 1970). Triangulation was used to collect a variety of responses (Maxwell, 2005), in this case, from nine people in two separate focus groups.

Instructor Interview Questions

As with the preservice teacher focus group questions, the instructor interview questions were each developed with a construct in mind. The intention for most of these was to gain perspective on the quantitative responses. Interview questions are described here, by construct and in relation to the subscales on the instructor survey. (See Table 11.) Appendix E contains a complete list of the instructor interview questions referenced in this section.

Table 11.

Instructor Interview Question Relations to Survey Subscales, Constructs

CONSTRUCT	INTERVIEW QUESTIONS	SURVEY SUBSCALE
Technology use types	3, 12	Technology Use; Technology Access
Technology use frequency	12	Technology Use
Classroom tech by instructors	1, 6, 8, 9, 10, 17	Instructor Classroom Technology Use
Classroom tech by preservice teachers	6, 8	Student Classroom Technology Use
Technology attitude	2, 3, 4, 5, 10, 11, 13, 14, 15, 16	Technology Knowledge, Interest, and Skills; Knowledge Comparison
Technology importance	4, 10, 17, 19	Technology Importance
Career readiness	4, 16, 18	Career Readiness
[Limitation: environmental]	7	-

Technology use types. The Technology Use and Technology Access subscales measured types of technology use on the instructor survey. As with the student focus group questions, qualitative questions were not targeted at this construct because the survey responses to these questions indicated the types of technology instructors own and use. Qualitative questions were asked in order to elaborate on the survey responses. As an example, Question 3 asked instructors to describe their favorite type of technology, including how they learned about it and what they do with it. Question 12 was also related to the construct of technology use types.

Technology use frequency. Like technology use types, frequency was measured primarily by the Technology Use subscale on the instructor survey. Question 12 of the interview questions asked about frequency as a means of follow-up: a comparison of survey results of students and instructors had shown that instructors spend far more of their time using various technology tools (i.e.,, computers and the Internet) than students do. The interview question asked instructors how they thought their use differed from how their students use technology.

Classroom technology use by preservice teachers. The Student Classroom Technology Use subscale survey responses indicated that instructors did not give technology-inclusive assignments to preservice teachers for in every class. Interview questions were designed to ask instructors when and why they thought technology use was appropriate in their classrooms. As an example, Question 6 asks: “Describe a typical class session where you use technology. What do you do? What do students do?” Question 8 also relates to the construct of classroom technology use by preservice teachers.

Classroom technology use by instructors. The Instructor Classroom Technology Use subscale indicated that instructors did not use technology during every class. A corresponding interview question asked instructors: “Do you give assignments that involve technology? Why or why not? What are considerations you would have if you were thinking of giving such an assignment?” The goal of this question was to determine the thought processes and concerns that instructors may have as they design their lessons to include technology (or not). It is Question 8 in the list. Additional questions to explore classroom technology use by instructors were questions 1, 6, 9, 10, and 17.

Technology importance. The Technology Importance subscale measured technology importance on the instructor survey, and the results were that the instructors did believe technology was important for preservice teachers to see and use during preservice education. Qualitative questions were developed to elicit the "why" aspect of this response. Question 19 asked instructors what they think technology adds to K-12 learning experiences, and whether they thought their students (the preservice teachers) should be focused on learning to teach with technology. Questions 4, 10, and 17 also explored the construct of technology importance.

Career readiness. The Career Readiness subscale in the instructor survey asked instructors whether they thought their program was preservice teachers for their careers. About half of the instructors thought the students were being prepared, with a quarter saying they were not, and the other quarter unsure of whether students were being prepared or not. Qualitative questions for thus construct were designed with the goal of finding out reasons why instructors might feel that students either were or were not being prepared. For example, Question 18 asked whether instructors thought preservice teachers would use technology in their classrooms after they graduated. Questions 4 and 16 also prompted instructors to discuss career readiness.

Technology attitudes. The Technology Knowledge subscale in the instructor survey was designed to measure instructors' attitudes about technology, along with the Knowledge Comparison item. Instructors' responses to this subscale indicated that they had overall neutral-to-negative attitudes about technology. Thus, a corresponding qualitative question was developed. Question 13 asked: "What do you think of your own technology skills? Can you describe them? What kinds of things are you comfortable doing with technology?" This same question was asked of preservice teachers in their focus groups, and it was designed with a goal of identifying some reasons why instructors had low responses to the survey questions. Other survey questions that related to the technology attitudes construct were questions 2-5, 10, 11, and 14-16.

Environmental limitation. As discussed for the preservice teacher focus group instrument, this study was completed in two phases, the first of which took place during the construction of a new building. The design of the building included new technology. Prior to the construction, most of the instructors in the sample had been teaching and working from offices and classrooms in the building. (This is known because the construction took approximately three years, and 76.2% of instructor participants reported 6 or more years of teaching at this department.) The second phase of the study took place after the building was opened, and when preservice education courses were taking place in it. Since this building was seen as a possible limitation to the study (described in *Chapter 5*), a question about the building was asked during the interviews. Question 7 asked: "What do you think of the new building? Do you think it has changed anything about the way you think about technology? Do you think it might change the way your students think about education and technology?"

Validity. As with the preservice teacher focus group questions, instructor interview questions were written to avoid research bias, looking instead to solicit open-ended responses and discussion. Recorded transcripts provided rich data (Becker, 1970), and triangulation was used to collect a variety of responses (Maxwell, 2005), in this case from three people in three separate situations. Respondent validation was also used to solidify meaning of comments that were made during the interviews (Maxwell, 2005).

Procedure

Phase 1

Phase 1 of this study consisted of the quantitative data collection: surveys of preservice teachers and for instructors. This phase began on April 6, 2011, and the last of the data was collected on May 13, 2011. This span of time was chosen because these were the concluding weeks of the university's spring semester; the term ended on May 13 and many students and instructors left campus for the summer. Surveys of preservice teachers and instructors were completed concurrently; logistics of the preservice teacher surveys will be discussed first because their distribution required coordination with course instructors, and thus it was the first process to begin.

Preservice teacher surveys. Preservice teacher surveys were given on paper—rather than in an online format—to prevent a possible skew of results. The concern was that an online survey distributed via email would be more likely to be answered by preservice teachers who were elevated users of technology; those who used little technology or did not have regular access to it would be less likely to respond to an online survey.

Contact: April 6-13, 2011. On April 6, thirty-four instructors were contacted by email to ask for their assistance with this research project. The email explained that the researcher was conducting a study about "undergraduate students and faculty in teacher education," and was "looking to distribute a short survey to students and collect it either during the first or last few minutes of a class period." The email went on to explain that this process would take approximately 10 minutes of the class period, during which time consent forms and surveys would be distributed and collected.

Seventeen of the contacted instructors replied to the email, and six of them were able to offer time for the researcher in one or more of their classes. One of these instructors suggested that the researcher should contact graduate teaching assistants, who also teach several undergraduate education courses. On April 13, seven graduate teaching assistants were contacted. Six of these contacts were able to offer class time for the research to give the surveys. Table 12 presents instructor and graduate teaching assistant contacts, responses, and participation rates.

Table 12.

Contacts for Preservice Teacher Survey Administration

	CONTACTED	RESPONDED	PARTICIPATED	PARTICIPATION RATE
Instructors	34	17	6	17.6%
Graduate Teaching Assistants	7	7	6	85.7%
Total	41	22	12	29.3%

Preservice teacher survey administration: April 13-May 5, 2011. The preservice teacher survey data were collected in 16 individual classrooms between April 13 and May 5, 2011. Meeting dates, times, and locations were arranged through email correspondence with the 12 participating instructors and graduate teaching assistants. Specific dates and times of survey administration are presented in Table 13.

Table 13.

Dates and Times of Preservice Teacher Survey Administration

DATE	DAY	TIME	STUDENTS PRESENT
April 13, 2011	Wednesday	2:00 PM	10
April 13, 2011	Wednesday	4:00 PM	20
April 18, 2011	Monday	6:30 PM	20
April 19, 2011	Tuesday	11:00 AM	25
April 20, 2011	Wednesday	5:00 PM	25
April 20, 2011	Wednesday	4:00 PM	15
April 21, 2011	Thursday	11:00 AM	20
April 26, 2011	Tuesday	10:30 AM	20
April 26, 2011	Tuesday	1:30 PM	20
April 26, 2011	Tuesday	2:45 PM	15
April 26, 2011	Tuesday	4:00 PM	20
April 27, 2011	Wednesday	1:00 PM	15
April 28, 2011	Thursday	12:30 PM	15
May 4, 2011	Wednesday	4:00 PM	20
May 5, 2011	Thursday	9:30 AM	30
May 5, 2011	Thursday	12:30 PM	60
		STUDENTS PRESENT	350

Note: Students present is based on the estimates given by the instructor in control of each class. Furthermore, all students present may not have chosen to take the survey.

The researcher went to each classroom at the agreed-upon time to administer the survey.The researcher brought photocopied surveys, consent forms, and pens that would be available for students to use. In each classroom, the researcher was introduced by the instructor of the course prior to distributing the consent form and survey. Instructor of each class delivered a variation of the same dialogue: that the research was a graduate student looking to collect data. The researcher was then given the floor, and stressed the following sentiments in each case:

- Participation is voluntary not related to coursework or grades.
- Students should not complete the survey unless a consent form is also signed.

- The consent form contains an optional portion in which interested students may consent to participate in a future focus group. Students may choose to consent to take the survey and not consent to the focus group.
- Students may choose to keep a copy of the consent form, but must also turn in a signed copy if they have taken the survey.
- Responses are anonymous, names should not be written on the survey.
- If a student has taken the survey as part of another class, they are asked to refrain from taking it again.
- Students may stop taking the survey at any time, or skip any question they do not wish to answer.
- Pens are available if any student needs to borrow one to complete the consent form and survey.

A double-sided, two-page consent form (see Appendix C) was passed out to the students, followed immediately by the double-sided, one-page survey. Students were instructed to leave the pages blank if they did not wish to consent, and that they were free to work on something else if they desired. At least one student in each class requested to use one of the researcher's pens. It was asked that the room remain quiet while students completed the surveys or worked on other things; most students complied with these requests.

Approximately 10 minutes after distributing the surveys and consent forms, the researcher asked if anyone needed more time. If additional time was not requested, the researcher asked that all papers be passed in, unsorted. No distinction was made between surveys or consent forms, or whether they had been filled out. Sorting, collation, and data entry are discussed later in this chapter.

Instructor surveys. The instructor surveys were administered over the Internet. Recall that the preservice teacher survey was distributed in-person by bringing paper surveys to classrooms, and this was done to avoid collecting responses only from technologically savvy preservice teachers. The same concern existed about instructors, but this department had a unique situation during this study: it was lacking a central office space or college building. (This is a limitation to the study; its effects were addressed through qualitative measures and it is discussed fully in *Chapter 5*.) Due to construction, instructors were scattered across several buildings on campus. Thus, it was unlikely that there would be a central place where they could be found and surveyed in person. A departmental meeting was an option, but the complications of identifying the specific instructors in the sample (and separating them from those outside the sample) seemed problematic. Another option was to locate each of the instructors at their respective office space; this seemed like too pressured an environment, leading the instructors to take the survey when they did not feel comfortable doing so. This option would also eliminate any sense of anonymity, as the researcher would know exactly which instructor filled out which of the surveys. It is for these reasons that an online survey format was chosen.

The instructor survey was created in Survey Monkey. Survey Monkey was chosen because the researcher had access to it through her department. The consent form was created as a part of the survey: this allowed instructors to click on one link to access first the consent form, and then the survey. (See Appendix C: the consent form for instructors and preservice teachers was identical.)

Contact and instructor survey administration April 13, 2011. The survey was distributed to 34 instructors by email on April 13, 2011. This email reminded instructors of the need to survey preservice teachers, and asked them to contact the researcher about participating in that portion of the study if they had not done so already. It went on to ask them for their responses to a survey directed at instructors who “are currently teaching undergraduates.” A link to complete the online survey was included in the email.

When instructors clicked on the link, they were taken directly to the online consent form. As with the preservice teachers’ consent form, the instructor consent form had a mandatory portion, followed by an optional portion in which instructors could consent to be contacted and interviewed at a later time. Once they had completed the consent form, instructors could continue with the survey. It is unknown how long it took each instructor to complete the survey, but instructors were asked to complete the survey by the end of the semester (May 13, 2011) if they wished to participate in the study.

Phase 2

Phase 2 consisted of the qualitative data collection: instructor interviews and student focus groups. This phase was conducted in the Fall of 2011. The time period was chosen because it was thought that preservice teachers and instructors would not be readily available for interviews during the summer semester. That time was used to develop qualitative questions, many of which were based on the results from the survey data that were collected in the spring.

Instructor interviews. Instructor interviews took place prior to preservice teacher focus groups because of logistics: focus group participants needed more notice of the dates and times so that they could plan to attend. Since instructor interviews were done individually, an agreeable time and date was chosen by each instructor.

Contact: October 6, 2011. Instructors who consented to be interviewed were contacted on October 6, 2011 using the preferred method they listed on their consent form. (Remember, the consent forms for the surveys included optional consent to be interviewed.) Two instructors were contacted through an email address they provided; one was contacted by phone. Each instructor was encouraged to choose a preferred location to conduct their interviews. Each of them chose to be interviewed in their own office on campus.

Interviews: October 7 and 11, 2011. The first instructor interview took place on October 7, 2011 at 11:00 am. The other two instructor interviews took place on October 11, 2011: one at 9:00 am, the other at 2:00 pm. Each office was in a quiet location, and in each instance the office door was closed during the interview to avoid interruption. Each interviewee was asked whether an audio recording device could be used, and all consented to allow this.

Each interview took approximately one hour. In each interview, the researcher began by explaining that these interviews were part of the data collection for a study about technology and education. The researcher brought a printed sheet of the interview questions to each interview (see Appendix D). After the brief explanation of the study, the researcher read the first question from the interview sheet and the instructor discussed that question. If the question was answered directly, the researcher read the next question. If the instructor reflected on related topics, the researcher allowed this. The conversations in some cases led the researcher and interviewee from question to question. The questions were not always asked in the order in which they appear in Appendix D. For example, one interviewee began to discuss the new building early on in the interview. The topic of the new building was not addressed in the interview questions until Question 13, but the researcher skipped ahead in this case, returning to earlier questions after this one had been discussed.

Preservice teacher focus groups. Focus group meetings took place in the student union at the target university, in a meeting room that was scheduled for that purpose. Soft drinks, bottled water, cookies, and candy were provided at each of the sessions.

Contact: October 6, 2011. Thirty-three students who consented to participate in focus groups were contacted on October 6, 2011, using email, which was the contact method each of them provided on their consent form. Five of the consenting students had not provided a contact method, and in each of these cases their email addresses were located in the campus directory. The email began by reminding them of the survey they had taken during the previous semester, asked for their participation in a focus group where they would "chat about technology." The email also announced the times and places of the focus groups, and indicated that refreshments would be provided.

Focus groups: October 12 and 18, 2011. Both focus groups took place in the same room. The first focus group took place on Wednesday, October 12, 2011, at 4:00

PM and was attended by five preservice teachers. The second focus group took place on Tuesday, October 18, at 4:00 PM and was attended by four preservice teachers.

To connect the focus group participants to the trends found in the quantitative data, each participant was asked to take the preservice teacher survey when he or she arrived to attend the focus group. These survey data were not used in further quantitative data analyses, as these students had all taken the preservice teacher survey in the spring already. The focus group participants' surveys were primarily used to record participants' demographics, and to eliminate the possibility that any of the focus group participants were outliers in terms of their technology use. (Upon later examination during the screening process, it was determined that none of the focus group participants provided responses that identified them as outliers.)

Preservice teachers were informed that the session would be recorded, and each of them verbally confirmed that this was acceptable. Each focus group session lasted approximately 1 hour and 30 minutes. The researcher began by explaining that these focus groups were part of the data collection for a study about technology and education. The researcher brought a sheet of the printed questions for reference (see Appendix E). After briefly explaining the study, the researcher read the first question and discussed it with the preservice teachers. If the question had been answered, the researcher moved on to the next question. If the preservice teachers' discussion subject related to a later question from the list, this question was addressed before returning to earlier questions on the list.

Data Entry and Screening

Preservice Teacher Survey Data

Initial sorting. At the time of survey administration, the preservice teacher surveys were collected along with the consent forms. No separation or organization of the surveys and consent forms was done on site. After the surveys had been administered to each section, they were brought back to the researcher's office and separated from the consent forms. Surveys and completed consent forms were counted to make sure that there was the same number of each. For each classroom, an equal amount of completed consent forms (with participant names) and completed surveys (without participant names) was collected. After comparing the number of consent forms to the number of surveys, the surveys were separated from the consent forms. The surveys were stored in the researcher's office until all survey administration was complete.

Consent form data entry. The consent forms were reviewed to see whether each participant had consented to participate in the focus groups (see Phase 2 above). A total of 49 students consented to participate. Their names and contact information were entered in to an Excel spreadsheet for future reference. The consent forms were stored in a file cabinet in the researcher's office, separate from the surveys.

Survey collation. When all preservice teacher survey data collection was complete, the researcher sorted the surveys. The surveys were sorted by major. This was done primarily to separate preservice teacher responses from other responses (other majors and undecided), and secondarily to streamline the data entry process. The surveys were sorted in to piles for each of seven types of preservice teachers, 26 other majors, and a pile for undecided. Eight participants left the major field unanswered, and these were filed as undecided. Two surveys were omitted from data entry: one was taken by a graduate student, and the other by a non-degree student. These two participants were not included because they fell outside the sample; they were stored separately from the other surveys.

With all of the eligible surveys sorted into these 34 piles, they were all three-hole-punched and stored inside a binder. Surveys from preservice teachers were placed in the front of the binder, followed by other majors, with undecided majors placed in the back of the binder. The researcher then went through the binder page by page and wrote a number in the upper right corner of each survey. This would be the participant number, used to tie the paper surveys to the electronic data once they were entered in to SPSS.

Data entry. SPSS software was used for data entry and analysis. For each survey, the participant number (the number the researcher had written on each survey) was entered as the first column. Variables were created for each of the survey responses; more variables would later be coded for total columns and other calculations. Appendix G lists the variables that were used—including calculated variables that are described in *Chapter 4*—and a brief description of how each corresponds to the survey. Numbers were also used to represent each of the demographic responses. For example: male was 0; female was 1. Age was entered numerically. Majors were assigned numbers 0-83. 0 was undecided. (Appendix I shows all majors with their numerical equivalents.)

Internet use and technology use subscales. For each of these subscales, the students wrote their hours of Internet use and hours of technology use. These hours were entered numerically in to SPSS.

Technology access subscale. There were three possible responses to the checkboxes in the technology access subscale. They were assigned numbers for entry in to SPSS (Do not have access = 0; Have access, do not use = 1; Have access, do use = 2). The assignment of numbers here was not arbitrary: after data entry, participants were assigned totals for each subscale, based on their survey responses. The higher their total, the more technical a person was considered to be.

Technology knowledge, interest, and skills subscale. These items on the subscale were entered with Likert scale checkboxes. As with the Technology Access subscale, each response was assigned a number, ascending to correspond with how positive the response was (i.e.,, "Strongly Disagree" = 0, "Disagree" = 1, "Neutral" = 2, and so on.).

Instructor classroom technology use and student classroom technology use subscales. These two subscales were answered with Likert-type responses, and were also assigned numbers which ascended by how frequently a certain type of technology was used by the instructor or the student. (So, "Never" = 0, "Once" = 1, "Sometimes" = 2, and so on.)

Career readiness item. This item also used a checkbox response for which numerical equivalents were assigned. The item asked students whether they thought they were prepared to teach with technology. This item was not assigned ascending numerical equivalence because responses were not on a positive-to-negative scale. This data was entered as follows: are being prepared: 4; not being prepared: 3; do not know: 2; already had the skills: 1; will not need the skills: 0.

Data screening. During the data entry process, it was observed that some participants' data was not within the guidelines requested at the time of survey administration. Some participants wrote in responses that were impossible, included multiple responses where only one was requested, or otherwise entered responses that fell outside of what was requested on the survey.

Multiple or nondescript majors. Some participants listed multiple majors within education (for example, early childhood and elementary education). To accommodate this, the SPSS spreadsheet was adjusted to allow up to three additional majors to be recorded. This was done in case these majors were needed for analysis. The primary major was entered as the highest grade level they would be able to teach. (After initial data-mining, it was determined that the primary major should be the focus of analyses.) Some middle school major and secondary preservice teaching major students listed a specific type of emphasis, such as chemistry. The education program offers a science emphasis (not chemistry), so answers like these were recorded using the closest official area of emphasis. (As another example, a written-in answer of 'French' was categorized as a foreign language emphasis.)

Hour ranges. In recording reported hours of Internet use, the top number in a range was entered. For example, if a preservice teacher wrote that they did an activity "1-2 hours per week," "2 hours" was entered in to SPSS. If an activity was left blank, the corresponding cell in SPSS was also left blank. Likewise, if a participant gave a nonquantifiable answer, the cell was left blank in SPSS. For example, one participant wrote "too much" when asked how much time he spends using social networking tools. Since "too much" could mean something different for any person, it was not possible to determine how many hours this student used the tool and thus, the cell for this variable was left blank.

Outliers. Some participants overestimated their hours to the point of impossibility. (An example, one participant reported that she used social networking tools for 500 hours each week, and additionally spent 300 hours each week using word-processing software.) A concern was that these answers were impossible, and would affect the validity and results during analysis. Outliers were found and removed from the preservice teacher data. Seven outliers were identified by using the Explore tool in SPSS. The variables for total hours using the Internet, and total hours using technology were displayed in box plots with outliers marked. Each case that was marked as an outlier in either one of these box plots was removed from the data. These cases were saved in a separate data file in case future reference was necessary.

Variable coding. There was a discrepancy between the numbers of male and female participants; a larger female sample was expected because the female population of teachers is higher than male. There were other variations in group size that—while somewhat representative of the sample--violated some assumptions of the statistics to be used. In some cases, categories could be combined to form categories with more equal Ns while preserving meaning and interpretation. These are discussed in this section, and Table 14 presents the original group sizes along with the combined groups.

Table 14.

Initial and Combined Student Sample Distribution

Label	Initial	*n*	Combined	*n*
Age	18-19	50	18-21	145
	20-21	95		
	22-23	36	22+	50
	24-29	7		
	30+	8		
Class Standing	Freshmen	22	Underclassmen	96
	Sophomore	74		
	Junior	56	Upperclassmen	101
	Senior	45		
Major Type	Early Childhood	19	Teach Younger Children	119
	Elementary	100		
	Middle Level	10	Teach Older Children	69
	Secondary	55		
	Composite Soc. Sci.	4		
	Music	4	Specialized Teaching	10
	Physical	6		

Age. Ages were combined in an effort to more evenly distribute the *n*s. Prior to combining the ages, consultation with a statistician led to the conclusion that without combining the ages, the groups of older students (ages 24-29, and 30+) were affecting the results of the calculations. The combined *n*s created larger group sizes, showing that there were 145 preservice teachers of ages 18-21 years old and 50 preservice teachers ages 22 and older.

Class standing. Similar to age, class standing groups of unequal size were combined after initial analyses were done. This was an effort to create more even *n*-sizes. Freshmen and sophomores (n = 96) made up one of the combined groups, while juniors and seniors (n = 101) made up the other group.

Major. Early childhood preservice teachers were grouped with elementary level preservice teachers because both of these majors involve teaching young children (n = 119). Secondary education, middle-level education, and composite social science preservice teachers were combined as students who will teach older children in their careers (n = 69). Music education and physical education preservice teachers were combined in a third group due to these special associations with other departments on campus (n = 10). They take education-related classes in other departments (e.g. Physical & Exercise Science, Music), and these classes may affect technology characteristics they have that are related to coursework. Since Music Education and Physical Education are not specific to younger or older children, these students could not be combined with either of those major groups. Consultation with a statistician indicated that the group size of 10 was sufficient in this case to produce reliable results.

Instructor Survey Data

Initial sorting. Because the instructor survey was delivered online, no physical sorting or collation process was necessary for these. The preservice teacher survey also needed sorting because there was no way to tell (at the time of survey administration) whether all of the participants were part of the sample. This was not true of the instructor sample—the survey was only sent to members of the sample, so no responses needed to be categorized as being outside of the sample.

Consent form data entry. The consent forms were completed online by the instructors, and were thus viewed online by the researcher. The researcher first verified that the number of consent forms matched the number of completed surveys (it did), and then reviewed the consent forms to determine which instructors consented to be interviewed. Ten potential interviewees were found; their contact information was entered in to the same Excel spreadsheet that was used to store the contact information of consenting potential student focus group participants.

Data entry. Survey Monkey—the online application used to deliver the instructor surveys—allowed the survey results to be exported as a Microsoft Excel file. This Excel file was then imported in to SPSS.

Participant numbers. The respondents were automatically given a participant number during the export process. However, future analysis would require combining preservice teacher data with instructor data. Thus, the researcher manually changed the instructor participant numbers so that they would not be duplicates of any preservice teacher survey participant numbers. The student participant numbers ended at 275; the first instructor participant was labeled 276.

Demographic information. Survey Monkey recorded gender numerically: Male was 0, female was 1. This was the same as the numerical entries used to record the preservice teacher survey data in to SPSS. Instructors typed in the numerical year for their years teaching and years in this department; these were transferred to SPSS 'as is.'

Subscales identical to the preservice teacher survey. The subscales of Technology Use, Technology Access, Technology Knowledge, Interest, and Skills, Instructor Classroom Technology Use, Student Classroom Technology Use, and Career Readiness (item) were identical to the subscales of the preservice teacher survey. Like the preservice teacher survey, the instructor survey prompted instructors to enter numerical responses for Technology Use. These were recorded by Survey Monkey and transferred to SPSS. However, Survey Monkey did not use the same ascending numerical pattern to record the other subscales. The preservice teacher data was recorded in an ascending numerical pattern, with the most positive responses assigned the highest numbers (i.e.,, “Strongly Disagree” = 0, “Disagree” = 1, “Neutral” = 2, etc.). For the instructor surveys, Survey Monkey had recorded the opposite: a descending numerical scale with the highest number representing the least positive response (i.e.,, “Strongly Disagree” = 4, “Disagree” = 3, “Neutral” = 2, etc.).

Instructor and preservice teacher responses to these subscales would be combined or otherwise compared during analysis, so it was important to make the data match. Thus, each of the Survey-Monkey variables was re-coded in to the same variable, swapping the numerical entries from a descending order to the ascending order that was used in the preservice teacher surveys. Where applicable, variables in the instructor survey data were given identical names to match the corresponding variables in the preservice teacher survey data. Appendix H lists the variables used to organize instructor data with brief descriptions of how they correspond to the survey items.

Technology importance subscale. Like the other instructor data, Survey Monkey recorded the responses to this subscale in a descending numerical fashion. Although this subscale was unique to the instructor survey, these responses were re-coded to an ascending numerical pattern (as described in the previous section). This was done to avoid confusion as data was analyzed, and so that higher totals in this subscale would reflect an overall more positive response to the importance of technology.

Knowledge comparison and Career readiness items. The Career Readiness item on the instructor survey was identical to the item of the same name on the preservice teacher survey and thus, its responses were re-coded in the same ascending numerical pattern described in the sections above. The Knowledge Comparison item was unique to the instructor survey, but its responses were also recoded—again, to avoid confusion and ensure that a higher number for any subscale or item meant a more positive response.

Qualitative comments. Instructors were permitted to enter some comments at the end of their surveys. Many of them did this, and these were stored as strings at the end of each participant's data. (See Appendix F.)

Data screening. In cases where instructors skipped an item on the survey, a blank cell was important in to SPSS (Survey Monkey recorded these responses in this manner). Instructor data were examined using the Explore tool in SPSS; no outliers were identified. (This was the same process used to identify the outliers in the preservice teacher survey.)

The instructor sample size was small, so there were no particularly large *ns* by any given demographic descriptor. Instructors' number of years teaching and number of years at this department were fairly evenly-distributed, with no particular group being large or miniscule. Gender was not evenly distributed, with females making up 80.95% of the instructors (and one not reporting gender). In analyses calculated on the combined preservice teacher and instructor data, instructors were included as one group without accounting for demographic differences within the instructor sample.

Variable coding. To protect instructors' privacy, their years of teaching and years at the target university—which had been entered numerically—were coded in to variables that made them less identifiable. For example, an instructor who had been teaching at the university for 12 years, and one who had been there for 14 years, were both categorized as "11-15 years." Again, this was done for privacy reasons, as it was determined that some of the instructors' responses could specifically identify them as having participated in this study.

Creating a common variable. Since some instructor data was going to be combined with, and then compared to, preservice teacher data, a common variable was needed to identify instructors versus preservice teachers once their data were combined. Since the preservice teachers (and others who took the preservice teacher survey) were initially sorted by their major—and these majors were recorded in SPSS numerically—a major variable was added to the instructor data sheet in SPSS. Instructors were assigned a numerical input of 100 for the variable "major" because this number was not assigned to any of the students' listed majors. (Each of the student majors were identified by either a single- or double-digit number.)

Combined Preservice Teacher and Instructor Survey Data

The subscales of Technology Use, Technology Access, Technology Knowledge, Interest, and Skills, Instructor Classroom Technology Use, Student Classroom Technology Use, and Career Readiness were identical on both surveys. This was done so that comparisons could be made between the responses from the two sampes.

To compare these, the variables representing this data were identified and then combined in a data sheet in SPSS. This was accomplished by creating a new copy of the preservice teacher data sheet. The merge tool in SPSS was then used to merge instructor data with the same variable names in to this new sheet. All analyses were calculated using some iteration of “major” as the independent variable, since instructors and preservice teachers were each identified by this variable.

Interview and Focus Group Data

The data entry process for qualitative data from preservice teachers and from instructors was identical, so procedures for both will be described in this section. All qualitative data were collected primarily using a digital audio recording device. Outlined notes were taken as a secondary measure, and were mostly used to record non-verbal communication such as nodding, hand gestures, and other responses that would not audible in the recordings.

Review of audio. Immediately following each interview and focus group, audio was transferred from the digital audio recorder to the researcher’s computer. It was then replayed by the researcher as a form of review. The recordings were played using an audio software product called VLC, chosen because of its ability to slow audio playback in order to compensate for typing speed.

Focus group voice identification. The review of audio was intended for two purposes. One was to help the researcher reflect upon what was said in each situation. The other was to identify the voices of the focus group participants while they were still fresh in the researcher’s mind. Gender-appropriate pseudonyms were assigned to each participant at this time, and were written down along with the times in which each participant was speaking. These pseudonyms and time-notes would be used in transcription of the audio. (Pseudonyms were also assigned to the interviewees.)

Transcription of audio. Audio recordings were transcribed to a Microsoft Word document by the researcher. A document was created for each transcript, for a total of five transcription documents (one for each focus group, one for each interview). In all cases, transcription took place on the weekend following the interview or focus group. Each interviewee and focus group participant had been assigned a gender-appropriate pseudonym to protect their identity, and these pseudonyms were used in the transcripts.

When pauses, sighs, and other audible non-verbal responses were present in the audio, these were written in the transcripts with indications such as [sighs] or [5 second pause]. Other non-verbal responses had been recorded in the paper notes during the focus groups and interviews. These were denoted in the same way at the appropriate points in the transcript. (i.e.,, [rolls eyes], or [waved hands negatively]).

CHAPTER IV

ANALYSIS AND RESULTS

Analysis

Preservice Teacher Survey

Totals. Preservice teachers were given several technology totals based on their answers: an overall technology use total, an overall Internet use total, and an overall technology skills total. The frequencies with which they observed instructor technology use, and the frequency they said they used instructional technologies themselves were also totaled. Technology access questions were not totaled, as it had been determined that responses students gave to one question would not predict their answers to another. Additionally, the research showed that having more technology tools was not a predictor of technology knowledge (Davies, 2011). Each of the totals gives an overview of the rates in technology use, knowledge, confidence, instructor observation, and educational use.

Internet use total. The Internet use total was calculated using items 1-12 on the survey: the items included in the subscale for Internet Use. This total was calculated by using SPSS to calculate a new variable, which totaled the hours students reported for each of those 12 questions. A higher number meant more hours of Internet use.

Technology use total. The technology use total was calculated using items 13-17 on the survey—labeled as 1-5 within the Technology Use subscale. This total was calculated in the same manner as the Internet use total: by using SPSS to calculate a new variable totaling the five numerical responses. A higher number meant more hours of technology use.

Technology knowledge total. The Technology Knowledge, Interest, and Skills subscale was 7 items, answered with a 5-point Likert scale. These were items 23-29 on the survey, labeled as 1-7 within the subscale. The technology knowledge total was calculated by using SPSS to calculate a new variable, which totaled the numbers that had been recorded as responses for each of these 7 items. A higher number meant a preservice teacher was more agreeable with these questions that were intended to measure their technology attitude.

Instructor classroom technology use total. This total was calculated from the 7 items in the Instructor Classroom Technology Use subscale—the questions which asked students to estimate how often they saw their instructors use technology for teaching. These were items 30-36 on the survey, labeled as 1-7 within the subscale. The responses were Likert-type, and SPSS calculated a new variable that totaled the numbers associated to each of the 7 items for each student response. The higher the number, the more frequently a preservice teacher reported seeing instructors using technology in the classroom.

Student classroom technology use total. This total was calculated from the 7 items in the Student Classroom Technology subscale—the questions that asked students to estimate how often they used technology for class-related work. These items were 37-43 on the survey, which are numbered 1-7 within the subscale. The responses were Likert-type—the same as those used in the Instructor Classroom Technology Use subscale. SPSS was used to calculate a new variable totaling the numbers associated to each of the 7 items for each response. The higher the number, the more frequently a preservice teacher reported using technology for class activities.

Because specific types of Internet and technology use could skew total Internet use scores, each of the Internet and technology types was analyzed separately in addition to being measured as part of a total score. This allowed possible high- or low- use areas to be isolated and explored for patterns as they arose.

Instructor Survey

Totals. As with the preservice teacher data, instructor responses were totaled to create new variables indicating total technology use, total technology knowledge, total instructional technology use, total instructional technology assigned, and total technology importance. Each of these totals gives an overview of the instructor responses to the subscales.

Technology use total. As was done with the preservice teacher total for the Technology Use subscale, SPSS was used to calculate a new variable totaling instructors' reported hours of technology use on items 1-5 of the technology use subscale. This new variable represented the technology use total.

Technology knowledge total. The Technology Knowledge, Interest, and Skills subscale was 7 items, answered with a 5-point Likert scale. These were items 11-17 on the survey, labeled as 1-7 within the subscale. SPSS was used to calculate the new technology knowledge total variable. It totaled the numbers that had been recorded as responses for each of these 7 items. A higher number meant an instructor agreed with the sentiments expressed in the items.

Instructor classroom technology use total. This total was calculated from the 7 items in the Instructor Technology Use subscale—the questions which asked instructors to estimate how often they used technology for teaching. These were items 18-24 on the survey, labeled as 1-7 within the subscale. The responses were Likert-type, and SPSS calculated a new variable that totaled the numbers associated to each of the 7 items for each instructor response. The higher the number, the more frequently an instructor reported using technology in the classroom.

***Student classroom technology use total*.** This total was calculated from the 7 items in the Student Classroom Technology Use subscale—the questions which asked instructors to estimate how often they gave students assignments or activities that included technology use. These items were 25-31 on the survey, numbered 1-7 within the subscale. The responses were Likert-type—the same as those used in the Instructor Classroom Technology Use subscale. SPSS was used to calculate a new variable totaling the numbers associated to each of the 7 items for each instructor response. The higher the number, the more frequently an instructor reported assigning technology for class-related activities.

Technology importance total. This total was calculated from items 34-40 on the survey, labeled as 1-7 in the Technology Importance subscale. The responses were

Likert-type. SPSS was used to calculate a new variable totaling the numbers associated to each of the 7 items for each instructor response. The higher the number, the more important an instructor considered technology to be for teaching and learning.

Preservice Teacher Focus Groups and Instructor Interviews

The qualitative data analysis process was identical for both the instructor interview data and the preservice teacher focus groups, so the process for both is described here. Transcription was completed for all three interviews and for both focus groups before any analysis of the transcripts was done.

Coding. After completing the transcription process, the Word documents were double-spaced and printed. They were each read and coded for keywords and subject matter triggers. Codes were placed wherever participants discussed topics that were relevant to the constructs, the research questions, and the hypotheses, as well as any other discussion of education, teaching, or anything related to technology. Similar or repeating topics were identified by the same code in multiple places. The coded words and phrases were indicated by circling or underlining the typed text, and hand-writing the code nearby.

Some codes appeared only in the focus group transcripts, others only in the instructor transcripts, but the researcher attempted to use the same codes for instructor responses and student responses, where applicable. For example, a code of “Us and Them” describes references students made to what they think about instructors, while the same code describes what instructors thought about students.

Categories. After the coding process was complete, a list of the codes was made. There were 27 codes. These were sorted in to eight categories. The researcher used differently colored highlighting pens to highlight text on the printed, coded transcripts that belonged to each of those eight categories. For example, codes of "Barrier," "Money," and "Negative" were sorted in to a category called "Barriers." Text labeled with any of these three codes was highlighted with an orange highlighting marker. Appendix J contains a complete list of the codes, categories, and their related themes.

Themes. Themes were developed after examining the qualitative data for codea and categories. Themes were used to summarize what the qualitative data said about the research. Themes were partially developed fluidly (by reading the transcripts and trying making inferences), and partially developed by observing the amount of certain colors (categories) that appeared in the printed transcripts. Three themes were identified. These themes were used by the researcher to relate to the constructs identified in the research design.

Positive attitudes. Instructors and preservice teachers all displayed positive attitudes about technology (in general and for education) throughout the interviews and focus groups. The categories of "Assumptions," "Change," "Barriers," "Demographic," "Preservice Education," and "Tech Tools," contributed to the formation of this theme. The theme relates to the constructs of technology attitude and technology importance.

Meaningful or integrated. Instructors discussed technology in education as meaningful (or genuine), but did not use the term "integration." Their elaborations of "meaningful" sometimes aligned with integrated teaching methods, but other times sounded more like fluency skills development (for preservice teachers, not for K-12 students). The categories of “Assumptions,” “Change,” “Demographic,” “Literacy or Fluency,” “Integration,” “Preservice Education,” and “Tech Tools” all contributed to the development of this theme. This theme relates to the constructs of classroom technology use by instructors, classroom technology use by preservice teachers, technology importance, and career readiness.

Literacy. Preservice teachers focused a great deal on the type of tools they could use, or needed to learn to use. They approached this from a skills-perspective. This theme was seen in the transcripts of both focus groups. It was seen less often (but was still present) in the instructor interviews. Categories of “Assumptions,” “Literacy or Fluency,” and “Tech Tools,” contributed to this theme. This theme relates to the constructs of technology use types, technology use frequency, technology attitudes, and career readiness.

Results

Question 1: Do preservice teachers differ in technology use and attitudes based on demographic characteristics (e.g., sex, age)?

The first question explored the constructs of technology use types, technology use frequency, and technology attitude. The differences among preservice teachers of different ages, genders, and class standings were analyzed. It should be noted that another demographic difference—related to class standing—was recorded on the preservice teacher survey: pre-major standing versus declared major standing. (This was discussed in *Chapter 3.*) Pre-major status was not covered in the research about preservice teacher education, and there were no significant differences found when comparing pre-major students to declared major students for any variable during initial data exploration. So, this demographic was not included in the analyses for Question 1.

To look for differences by age, class standing, and gender, univariate ANOVA tests were calculated. Fisher's LSD test was used to examine the specific differences within groups, if those differences were found to exist. There were six hypotheses related to this question, and the results are presented per hypothesis.

It should be noted that pre-major status was initially included as a subset of the first research question, no significant differences were found during initial exploration of the data. Because of this, and since research did not discuss pre-major preservice teachers in contrast with declared-major pre-service teachers, this demographic characteristic was not used in analyzing results. Thus, preservice teachers were treated as one group of 198 participants.

Null hypothesis 1. Younger preservice teachers do not use more technology than older preservice teachers do.

No significant differences were found between younger preservice teachers and older ones across the variables measuring of total Internet use or total technology use. The null hypothesis was retained.

While overall scores showed no difference by age, it is important to note that age is a variable with restricted range. Nearly three quarters (74.3%) of the survey sample was between ages 18 and 21. Preservice teachers in the focus group were between 19 and 21 years old. Furthermore, overall technology and Internet use totals may have masked individual technology differences. For example, it was observed during data entry that many students entered a lot of hours for social networking. The literature showed that young people use a great deal of certain types of technology, and social networking was one of these types. For this reason, individual types of technology on the subscale were studied for differences. A significant difference by age concerning social networking use was not found, but a there were four other significant results regarding specific internet and technology use (see Table 15).

Table 15.

Hours of Internet and Technology Use by Age

	18-21 Years Old			22 Years or Older				
Activity	*n*	*M*	*SD*	*n*	*M*	*SD*	*p*	*d*
Research	145	2.199	2.351	50	3.450	3.757	.007	.409
Videos	145	3.644	4.140	50	2.132	2.485	.016	.456
Work (Internet)	145	1.076	2.731	50	2.770	7.237	.019 (*.294**)	.340
Work (Computer)	143	2.601	5.683	50	5.380	6.832	.013	.444

*A non-parametric comparison using the Wilcoxon-Mann-Whitney two-sample rank-sum test revealed the value for Work Internet Use was not statistically significant.

A statistically significant difference was found by age for researching products and services on the Internet, $F(1,193) = 7.539$, $p = .007$. Older students ($M = 3.450$, $SD = 3.757$) did this activity more often than younger preservice teachers did ($M = 2.199$, $SD = 2.355$). The younger group watched significantly more online television, movies, and video clips ($M = 3.644$, $SD = 4.140$), than the older group ($M = 2.132$, $SD = 2.485$), $F(1, 193) = 5.918$, $p = .016$.

Older preservice teachers reported significantly more Internet use at work than younger students, ($M = 2.770$, $SD = 7.237$; $M = 1.076$, $SD = 2.731$), $F(1,193) = 5.657$, $p = .018$. Older preservice teachers also reported more overall computer use for work-related purposes than younger preservice teachers did, *(M* = 5.380, *SD* = 9.136; *M* = 2.601; *SD* = 5.683), $F(1, 191) = 6.297$, $p = .013$. These results are likely due to the type of jobs younger people may have, or it may be that younger preservice teachers are less likely to be employed than older preservice teachers are. The survey did not ask whether the preservice teachers were employed.

Null hypothesis 2. Younger preservice teachers do not have better attitudes about technology than older preservice teachers do.

Measuring the total technology knowledge score, no significant differences were found among the technology attitudes of preservice teachers of different ages. The null hypothesis was retained.

The Technology Knowledge, Interests, and Skills subscale was initially used to measure attitude because it was thought that knowledge, interest, and skills would predict participants' attitudes about technology. In the focus groups, preservice teachers were asked to describe their technical skills, and they used words like "pretty good," "average," and "I can do most things." Two of them suggested that a person with good technical skills would be able to "fix a problem, a broken computer." What was interesting was that the majority of focus group participants (6 out of 9) did not think that advanced technical skills were necessary for their future teaching careers. When asked to elaborate, the focus group participants did not believe they would be required to deal with what they thought were complex technological issues such as troubleshooting technical problems, or doing computer programming or coding. They felt that these types of skills would be reserved for the IT person or other technical staff member at their school. This assumption was present throughout all of the hypotheses related to attitude.

Null hypothesis 3. Underclass preservice teachers do not use more technology than upperclassmates do.

No significant differences were found between underclassmates and upperclassmates on the measures of total Internet use or total technology use. The null hypothesis was retained.

The literature had shown that young people used certain types of technology more than older people did, and for this reason individual types of technology on the subscale were studied for differences. Only one significant difference among individual technology use was found. Preservice teachers of different class standings had statistically significant differences in their hours spent watching online TV, videos, and clips, with underclassmates reporting more hours of use (M = 4.056, SD = 4.515; M = 2.461, SD = 2.841), $F(1, 195) = 8.898$, $p = .003$.

Null hypothesis 4. Underclass preservice teachers do not have better attitudes about technology than upperclassmates do.

In measuring the technology knowledge total by class standing, no significance differences were found among the technology attitudes of preservice teachers of different class standings. The null hypothesis was retained.

In the focus groups, one underclassmate preservice teacher alluded to a knowledge difference (but not necessarily an attitude difference): she thought older preservice teachers in her program might know more about technology, because these older students had been in college longer. Other focus group participants did not build-upon or echo these thoughts.

Null hypothesis 5. Male preservice teachers do not use more technology than female preservice teachers do.

The technology use totals and Internet use totals for male and female preservice teachers were measured; no significant differences were found. The null hypothesis was retained.

The literature showed that female preservice teachers tend to be higher users of some types of technology (e.g., email, social networking) and male preservice teachers tended to be higher users of other types of technology (e.g., video games). For this reason, specific internet use types (recorded as the Internet Use subscale) were compared. Exploring the Internet use data further produced some significant results related to specific technology types (see Table 16).

Table 16.

Hours of Internet and Technology Use by Gender

	Male			Female				
Activity	*n*	*M*	*SD*	*n*	*M*	*SD*	*p*	*d*
Email	40	2.590	2.399	157	4.184	4.056	.018	.494
Shopping	40	0.409	0.575	157	1.321	2.157	.009	.668
School Work	40	5.450	5.969	157	8.229	6.575	.016	.443
Social Network	40	5.525	5.139	157	8.425	6.207	.007	.511
Hobby Websites	40	2.425	2.393	157	1.423	2.463	.021	.413
Online Gaming	40	1.850	4.353	157	0.568	1.636	.003	.428
Word Processing	40	3.525	2.428	154	6.886	5.587	.000	.839

In comparing email use between males and females, female preservice teachers reported to spend significantly more hours per week on writing emails (M = 4.184, SD = 4.056) than males did (M = 2.590, SD = 2.399), F(1,195) = 5.658, p = .018. Females were also more frequent online shoppers (M = 1.321, SD = 2.157) than males (M = .409, SD = .575), F(1,195) = 6.996, p = .009. Additionally, females reported spending more time online doing school work (M = 8.229, SD = 6.575) than their male peers (M = 5.450, SD = 5.969), F(1,195) = 5.90, p = .016, and females reported significantly more (M = 6.886, SD = 5.587) use of word processing software (e.g., Microsoft Word) than males (M = 3.525, SD = 2.428), F(1,192) = 13.80, p = .000. The difference in male (M = 5.525, SD = 5.139) and female use of social networking use (M = 8.425, SD = 6.207) was statistically significant, F(1,195) = 7.428, p = .007, with females being more frequent users. In these cases, the results align with literature that states females use technology more often than males for communication purposes.

Game-related technologies were an area in which the literature said males were higher users. This data showed that male Internet use for the purposes of online gaming (M = 1.850, SD = 4.353) was significantly greater than female use for this purpose (M = .568, SD = 1.636), F(1,195) = 8.828, p = .003. Reading hobby-related websites was another area in which males reported more hours spent (M = 2.425, SD = 2.393) in comparison with females (M = 1.423, SD = 2.447), F(1,195) = 5.391, p = .021.

Neither focus group discussed gender very much, even when asked directly. However, two of the female preservice teachers in one focus group felt that their male friends used more “techie” technology than their female friends did. When asked to elaborate, one of them explained that a male friend of hers likes to “mess with it, like taking apart their PS3." There were two male participants in this same group, and one of them said the girls he knew spent a lot of time "chatting or whatever, like Facebook."

Null hypothesis 6. Male preservice teachers do not have better attitudes about technology than female preservice teachers.

Measuring the technology knowledge total by gender indicated that males reported better technology attitudes (M = 20.08, SD = 3.292) than females (M = 16.55, SD = 4.287), $F(1,195) = 23.425$, $p = .000$. To determine whether this was due to their answers on a specific item of the Technology Knowledge, Interest, and Skills subscale, each of the subscale items was measured separately with gender as the dependent variable. There was a significant difference between male and female preservice teachers for every item in the subscale (see Table 17). The null hypothesis is rejected here; the alternative hypothesis received support.

Table 17.

Technology Attitude by Gender

	Male			Female				
Measure	*n*	*M*	*SD*	*n*	*M*	*SD*	*p*	*d*
Overall	40	20.08	3.292	157	16.55	4.287	.000	.932
Solve Problems	40	2.90	.591	157	2.32	.877	.000	.790
Learn Easily	40	3.15	.533	157	2.80	.755	.007	.543
Keep Up	39	2.82	.790	157	2.27	.837	.000	.688
Play/Explore	40	2.68	.829	156	2.07	.910	.000	.702
Know Variety	39	2.62	.815	157	2.01	.895	.000	.748
Adequate Skills	40	3.03	.480	157	2.66	.797	.007	.579
Enough Opportunity	40	3.02	.577	157	2.43	.879	.000	.810

These results were further explored in the focus groups, and those preservice teachers did not have a consensus as to whether males or females had better technology attitudes. The majority of the focus group participants were female, and while a few did report their male friends being more “techie,” a couple of them also had female friends who they thought were “pretty good with it.” According to one female participant: “Guys like [technology]. It’s like a new car, something they can play with…their toys.” A male in the same focus group said “I don’t think [gender] has to do with it. The girls have the phones, their computers and stuff, too.”

So, the females seem to think the males might have better attitudes about technology, or they are at least more drawn to it. One focus group did not contain any male participants, but the male participant quoted above was defensive of females he knew, referencing the technology they enjoy using. While one male participant’s comments cannot represent the sample of male preservice teachers, his comments did indicate that perhaps he thought females were more equal in terms of technology; the female participant who contacted about males’ “toys,” was not so sure.

Question 2: How do instructors and preservice teachers differ in terms of technology use characteristics and attitudes toward technology?

Like Question 1, Question 2 explored the constructs of technology use types, technology use frequency, and technology attitudes. To look for differences in these technology characteristics, univariate ANOVA tests were calculated. Fisher's LSD test was used to examine the any specific differences within groups.

Null hypothesis 7. There is not a significant difference in the frequency of technology use by instructors compared with that of preservice teachers.

This hypothesis was explored by looking at the difference between instructors and preservice teachers by their technology use totals and their technology access totals. The difference between instructor and preservice teacher total technology use was statistically significant, $F(1, 215) = 14.347$, $p = .000$. Instructors ($M = 65.000$, $SD = 43.529$) were more frequent technology users than preservice teachers ($M = 42.117$, $SD = 23.852$). The null hypothesis was rejected; the alternative hypothesis received support.

Since Technology access was not a subscale in which the items related to each other, a technology access total ‘score’ was not calculated. Still, both preservice teachers were asked what types of technology devices they have access to, and whether they use these devices to access the Internet. They were asked about personal computers, public labs, cell phones, mobile devices such as *iPad* or *Kindle*, and video game consoles. Table 18 presents the differences between the Internet access methods of preservice teachers and instructors.

Table 18.

Preservice Teacher and Instructor Technology Access

DEVICE TYPE	*n*		USE FOR INTERNET		HAVE ACCESS; DO NOT USE FOR INTERNET	
	PreT.*	Inst.	PreT.	Inst.	PreT.	Inst.
Personal Computer	198	21	99%	100%	0%	0%
Computer Lab	198	19	74.4%	23.8%	17.7%	28.6%
Smart Phone	198	20	59.1%	23.8%	9.1%	38.1%
Mobile ‘Pad’	198	20	18.7%	9.5%	4.5%	14.3%
Game Console	198	19	27.8%	38.1%	9.6%	42.9%

*PreT. denotes preservice teacher. Inst. denotes instructor.

In interviews, instructors were asked about what they did on the internet, versus what they thought preservice teachers did. Instructors thought preservice teachers would use the Internet more for social- or hobby-related reasons. The results from Question 1 did show that students used the Internet for social and hobby-related reasons. Two of the instructors mentioned the “tactile” aspect of receiving a newspaper—“the real paper”: they thought preservice teachers’ news consumption would differ from their own in this way. One instructor said he used the Internet for work purposes, class preparations, and as a research tool. Another reported: “I’m on the Internet all day. I don’t like to get on it on the weekends if I don’t have to.”

On the contrary, in the focus groups, a preservice teacher asserted: “I have to have [access]. I have my laptop, I have my iPhone. I can check it wherever.” Preservice teachers in the focus groups were surprised to learn that instructors used technology more frequently than they did. One of them assumed that “they’re probably on *Blackboard*.” Another said he had an instructor who had written a book: “They probably do stuff like that, or looking at class stuff. It takes a long time.”

The focus group participants and the interviewees made a lot of assumptions about each other’s use of technology, but many of them seemed to be correct. Interviewees had admitted to using technology primarily for productivity and professional reasons; focus group participants were focused on entertainment and communication primarily, with some concern for academic work. (*Blackboard* was specifically mentioned a great deal by focus group participants, and this was not surprising since the survey data showed it was a very popular tool for both instructors and students to use.) The research showed that young people who use technology tend to use it for personal purposes, and the surveys reflected that social networking, communication (email), hobby websites, online videos/TV, and video games were popular technology tools that preservice teachers spent several hours a week using. So, the focus on entertainment and communication in the focus groups was expected. The instructor surveys also reflected what was discussed in the interviews: instructors use technology primarily for work and productivity reasons.

Null hypothesis 8. There is no significant difference in the technology-related attitudes of instructors compared with those of preservice teachers.

The survey responses of instructors and preservice teachers were compared for the technology knowledge total, which was used to quantitatively measure the construct of technology attitude. There was a significant difference between instructor technology attitudes and preservice teacher technology attitudes, $F(1, 217) = 3.946$, $p = .048$. Recalling that each response level was assigned a number, a neutral technology knowledge total was represented by the number 14 (this number is the total of the responses for 7 items in the Technology Knowledge, Interest, and Skills subscale, for which each neutral response was assigned the number 2). Likewise, if a participant answered "Agree" for all of the items in this subscale, that participant would receive a technology knowledge total score of 21. With this in mind: preservice teachers had neutral-to-positive attitudes about technology ($M = 17.26$, $SD = 4.326$), and instructor responses were closer to neutral ($M = 15.29$, $SD = 4.440$). The null hypothesis was rejected and the alternative hypothesis received support. (See Table 19.)

Table 19.

Instructor and Preservice Teacher Technology Attitudes

	Instructors			Preservice Teachers				
Measure	*n*	*M*	*SD*	*n*	*M*	*SD*	*p*	*d*
Overall	21	15.29	4.440	198	17.26	4.326	.048	.449
Adequate Skills	21	2.24	.831	198	2.74	.755	.005	.631

Since the research showed that younger people may have more positive attitudes about technology, the individual items in the subscale were studied further. One significant difference was found, for the technology skills item in the subscale. This item asked whether they thought they had enough skills to use technology, the result was statistically significant, $F(1, 217) = 8.141$, $p = .005$. Preservice teachers ($M = 2.74$, $SD = .755$) "agreed" with this statement. Instructors answers were closer to neutral on this subject ($M = 2.24$, $SD = .831$), indicating that they were less confident about their technology skills than the preservice teachers were. To determine whether the skills item had contributed to the significance of the overall item, a new technology knowledge total was calculated, omitting the technology skills item. When an ANOVA was calculated to compare instructors and preservice teachers on this total—without the skills item—there was no longer a significant difference between instructors and preservice teachers on total technology knowledge. This indicates that skills were a significant difference between instructors and preservice teachers (with preservice teachers having more confidence in their skills). Although the overall result was not significant when skills were removed, the null hypothesis was still rejected because the literature showed that technology skills (or a lack of them) contribute to attitudes about technology, and so a difference in skills would be significant in regard to attitude.

The possibility that there were differences in attitude by the frequency of technology use was also explored. This was done by calculating a variable in SPSS to differentiate preservice teachers and instructors whose technology use was one standard deviation above or below the mean hours of total technology use. The attitudes of these participants were then compared by calculating an ANOVA. The difference in attitude between high users, low users, and average users was not significant for preservice teachers ($F(2, 193) = .642$, $p = .357$) or for instructors ($F(2, 18) = .2.162$, $p = .237$). The means are given in Table 20.

Table 20.

Instructor and Preservice Teacher Technology Attitudes by Use Frequency

Total Weekly Tech Use	Instructors			Preservice Teachers		
	n	*M*	*SD*	*n*	*M*	*SD*
Low use (<17.2 hrs/wk)	2	11.00	3.908	155	18.05	4.936
Average use	12	15.00	.000	20	17.03	4.254
High use (>71.4 hrs/wk)	7	17.00	4.440	21	18.19	4.226

In the interviews, instructors were not surprised that preservice teachers had slightly better attitudes than themselves and their colleagues, but they were surprised that preservice teacher attitudes were still somewhat low. Each instructor believed that students would be positive or very positive about technology. (On a scale of 1-5, each interviewee guessed that preservice teachers would average a rating of 4.) One instructor referenced the digital native generation, saying: “They’ve had enough time with everything… I know that’s a stereotype, but I think they’re a part of that generation.” Another instructor said “Some of them are really good at [technology]. For the most part, there’s more that are, than those who aren’t.” Further conversations about preservice teachers' technology skills would reveal that while instructors did think their students were technology-savvy, they did not believe that those skills would automatically transfer to the classroom. Questions 5 and 6 address these issues in more detail.

When the preservice teachers were asked, they did not feel that instructors had unrealistic expectations of their technology skills or attitudes. One said, "I like to use it, but I sometimes need a little help and they do give us that." In response to this, another preservice teacher said he thought they might help a bit too much sometimes. Another student retaliated: "but I think it's good. If I need help I can get it, we don't have to already know [the technology]." It seemed that students were mostly satisfied by the amount of technology assistance they received in their classes. But what did they think of instructors? The Preservice teachers seemed surprised that instructors rated themselves neutral. All four of the participants in one focus group agreed that they had not noticed anything that would indicate that their instructors are poor technology users, or that they are not confident with technology. In the other focus group, one participant noted: "Well, maybe it's harder for them to figure out; my dad has problems [with his phone]." But others said: "it seems like [my instructors] know a lot," and "They seem pretty good about [the technology]."

Question 3: How often do preservice teachers observe their instructors using instructional technology tools in class, and how often do they use it themselves?

Question 3 related to the constructs of classroom technology use by instructors, and classroom technology by preservice teachers. To answer the question, frequency calculations were run in SPSS to determine how often preservice teachers said they saw technology used in by their instructors and how often they used it for assignments or class work. The instructor classroom technology total and student classroom technology total variables were used for these calculations.

Null hypothesis 9. Preservice teachers see their instructors use technology in the classroom on a daily basis.

Preservice teachers reported seeing technology used in class "sometimes," which was the neutral response on the scale (M = 13.46). (An exact total rating of "sometimes" would have been 14.) The alternative hypothesis received support and the null hypothesis was rejected.

Of the specific instructional technologies listed, preservice teachers saw *Blackboard* use "most days," (M = 3.07), followed closely by presentation software (M = 2.60). (A "4" would represent daily use; a "3" meant the tool was used most days, a "2" was an answer of "sometimes," and so on.) Figure 15 shows the frequency of observation reported by preservice teachers for each technology tool.

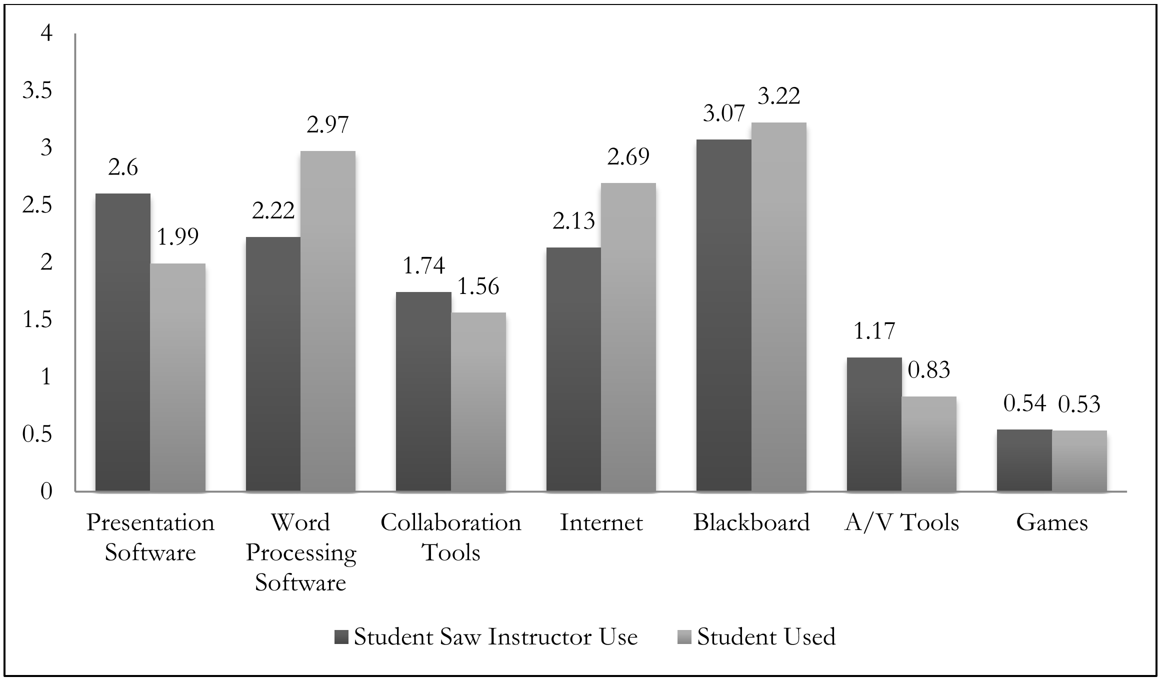


Figure 15. Preservice teacher instructional technology exposure.

While the survey did not offer opportunity for either sample to describe how these tools were used, it is notable that the technology tools preservice teachers observed most often can all be considered to be delivery methods (Presentation software, word-processing software, *Blackboard*). That is to say, it could be assumed that instructors were using these tools to deliver information to their students—not to engage students in integrated lessons.

In the focus groups, preservice teachers were asked qualitatively about their instructors' classroom technology use, and they reported positive experiences. While a couple of the preservice teachers did not like an instructor's "no laptop" policy during a class, they mostly thought the instructors did a decent job of using technology when it was necessary. Still, they were largely unable to describe technology-use situations that sounded similar to integration. Some focus was placed on fluency or literacy development—two focus group participants referenced situations where their instructor had helped the class learn how to use a tool.

Null hypothesis 10. Preservice teachers use technology for class assignments on a daily basis.

Preservice teachers reported using technology for class "sometimes," which was the neutral point on the total scale (M = 13.76). Of the technology tools listed, preservice teachers reported that *Blackboard* was their most frequently used tool, stating that they used *Blackboard* "most days" or for "every class," (M = 3.22). Word-processing (M = 2.97) and the Internet (M = 2.69) were the next most popular technology tools, used "most days" by students when completing assignments. Figure 15 (above) shows how often students said they used each of the technology tools. Preservice teachers' overall use of technology tools for class was neutral, so the null hypothesis was rejected. The alternative hypothesis received support, but cautiously, since students did report using some specific types of technology on a nearly daily basis to do class-related activities.

In the focus groups, preservice teachers were asked about their technology use for class. "I use [*Blackboard*] every day…I mean I check it," said one preservice teacher. She said she does this because there might be some change, or she is waiting for the instructor to post a grade. Another agreed: he checks *Blackboard* frequently because he is waiting to receive a grade or feedback. "Some instructors [post grades] right away… some of them take forever or they don't at all." They also said word-processing software use was "pretty much required" to pass their classes. "You aren't going to be turning in a paper, and it's handwritten. It's typed and a lot of times they don't want it printed. They want it emailed." Another chimed in: "Or you put it on *Blackboard*." Students felt that other technology tools—like presentation software or audio/video tools—were for special projects or finals. "I would do PowerPoint for a presentation—like I'll do one for my final in [class name], but it's not for every day stuff." In each of these situations, these preservice teachers were describing uses of technology for receiving information from their instructor, or delivering information to their instructor. So, they were not using technology every day, but there were certain technology tools they knew they needed to use frequently. This supports the alternative hypothesis.

Instructor interviewees said they had many considerations when assigning projects that include technology. A couple of the interviewees had biases against using certain tools. Although the surveys showed presentation software to be one of the most frequently used technology tools by instructors, one interviewee said: "They can't use PowerPoint. I say, 'that's not technology.'" Instructors did not mention word-processing software or *Blackboard* as types of technology that would be assigned, possibly because these types of technology are required to be used in most classes. (Preservice teachers in the focus groups suggested that this was the case.)

If *Blackboard*, word-processing software, and presentation software are not considered by instructors to be technology, it becomes clearer why technology is not used in every class, or for every lesson. "I want it to be genuine," said an interviewee when describing technology in her assignments, which often include the development of lesson plans: "I don't want them to teach a technology lesson instead of a subject lesson." Another described the importance of what she considered to be genuine use: "They have to create lesson plans implementing a technology of their choice." She clarified that the technology use must be part of the lesson—not them showing technology use to their students. These descriptions could be interpreted as integrated teaching practices: both of these instructors described lessons that would teach technology literacy skills to K-12 students, and then stated that these were not appropriate lessons for preservice teachers to be designing. Integrated teaching methods should include technology as a learning tool, but not focus on it, and this type of lesson sounds closer to what these instructors described.

In the focus groups, one of the preservice teachers described a learning situation that sounded like integration. According to one preservice teacher: "[The instructor] doesn't just say 'here, use this,' but he uses it himself and tells us to get our kids to use it." The key here was that this student understood that the K-12 students should be using the technology—not only the teacher. Another added to the same discussion: "It's in a lot of assignments. Sometimes it's…just to find a source or lesson or whatever, but other times it's that we teach with something. Like a YouTube [video] or a site we found, we would be using that to teach." A third added: "It's definitely important. They [the instructors] obviously see that." These additions to the original student's comments seemed to refer more to fluency (on the part of the teacher) than integrated methods (that foster fluency in K-12 students); the focus group participants were unable to articulate what they meant more clearly.

Question 4: Are there differences in the perceptions of how often tools are used by instructors or assigned for use by preservice teachers?

Null hypothesis 11. There is a significant difference between the amounts of instructor technology use reported by the instructors versus what was observed by the preservice teachers.

Preservice teacher and instructor responses to the subscale for Instructor Classroom Technology Use was compared to see if differences existed between the amount of technology preservice teachers said they saw their instructors using, and the amount of technology instructors reported using. There was a significant difference between the preservice teacher responses (M = 13.460, SD = 3.718) and the instructor responses (M = 15.550, SD = 3.832), with instructors estimating their use higher than preservice teachers estimated the instructors to use the tools, $F(1, 216) = 5.683$, $p = .018$. In other words, students said they saw instructors using the tools less than instructors reported using the tools. The null hypothesis was retained.

To follow up on these results, interviewees and focus group participants were asked to describe what they thought of as technology. It was thought that perhaps generational differences could account for differences in what types of tools were considered to be technology. In most cases, technology descriptions given by preservice teachers revolved around computers, smart phones, and other devices. Computers were mentioned by name by all three interviewees and seven out of nine focus group participants. Although six focus group participants referenced the Internet, their focus was on the devices and the ways these devices could be used. All three of the instructors interviewed mentioned the Internet, one mentioned her smartphone and her digital camera, and one talked about a calculator as a type of technology. One instructor also talked about large technological equipment, such as machinery used in industrial contexts. All instructors focused more on the Internet and software applications than on devices used to access them. One instructor stated directly: “The computer is not the technology, it is the device, the things on it, like Blackboard or software, are technology.”

Conclusions related to the hypothesis cannot be drawn from these conversations, but it was interesting to note that preservice teachers focused more on devices, while instructors focused more on what could be done with the devices (e.g., access to Internet). The discussion of Null Hypothesis 10, in which the question arose of whether word-processing software and other tools were considered to be technology for the purposes of teaching a lesson, raises concern here as well. Uses of computer programs including word-processing and presentation software are effective and necessary for children in K-12 (e.g., Lowther & Morrison, 2009), but they could be skipped over entirely if preservice teachers take their value for granted.

Null hypothesis 12. There is a significant difference between the amounts of technology use assigned by the instructors versus that which is reported by the preservice teachers.

The Student Classroom Technology Use subscale on the surveys measured how often students were given assignments involving technology. Students reported how much technology they were assigned, while instructors reported how much technology they assigned. When the responses were compared, there was not a significant difference between preservice teacher responses and instructor responses. The null hypothesis was rejected; the alternative hypothesis received support.

This result was not further explored by qualitative measures. However, the difference between this result and the result for null hypothesis 11 was interesting to note. Null hypothesis 11 was retained, yet 12 was rejected. In both instances, the samples were asked to report about their own use of specific classroom technology tools, as well as the use of the other sample. Yet, while there was a discrepancy in how much technology each sample thought instructors used (remind us here who said more of what); there was not a discrepancy in how much technology each sample thought students used (remind us here what they both thought). This could be because the surveys required self-reporting, or the issue could be deeper, related to the memories of preservice teachers concerning technology they have used, versus technology they have observed. It is also possible that preservice teachers fail to notice some technology because it is invisible to them. That is, perhaps new devices (such as an e-reader) are technology to them, while the Internet is taken for granted because it has been a part of their lives indefinitely. Implications of this are discussed in *Chapter 5*.

Question 5: What do instructors believe about the importance of the use of technology tools by themselves and by preservice teachers?

Null hypothesis 13. Instructors do not believe it is important for them to use technology when teaching.

This result was measured using the results from the first item in the Technology Importance subscale. The results of a frequency calculation showed that instructors "agreed' or "strongly agreed" that it was important for students to see technology use in their education classes (M = 3.57, SD = .507). ("Agree" was recorded as a 3; "Strongly Agree" was a 4.) The null hypothesis was rejected and the alternative hypothesis received support.

All of the instructor interviewees stressed the importance of technology use, both in preservice education and in the K-12 classrooms. One stated: “We do need to model the technologies. And model the technologies in a way that works for children, then…they need to have some practice, with support.” He went on to explain that through this modeling, preservice teachers could learn how use technology in their own classrooms.

The results for null hypothesis 10 referenced that two of the instructors did describe the importance of what they called “genuine” technology use. All three of the interviewees indicated that they did not believe preservice teachers should teach technology literacy skills to K-12 students. (One instructor called these “skills,” another used the term “typing class,” while another referenced “teaching kids how to use a computer.”) In other instances, however, instructors referenced situations where the preservice teachers were in need of literacy or fluency skills—not education about technology integrated methods. All three of the interviewees referred to a technology class in the program that exists specifically to teach preservice teachers how to use technology in their future classrooms. It would seem that instructors believe technology is important for education, and those in this sample agreed that the use had to be “meaningful” or “genuine.” These adjectives were attached to descriptions of technology use that enabled learning, engaged students, and was purposeful. Integrated methods were not specifically mentioned, but technology integration is not the only method for teaching with technology. It is meaningless use (use for the sake of use) that is most important to avoid, and with this in mind, interviewees’ ideas of how technology should be used were positive.

Null hypothesis 14. Instructors do not believe it is important for preservice teachers to use technology when completing assignments.

The responses to the second item in the Technology Importance subscale was used to measure this hypothesis. Frequency was calculated to determine instructor beliefs on this matter. They "agreed" or "strongly agreed" that it was important for preservice teachers to use technology in their education classes (M = 3.35, SD = .587). (Like the first item in the subscale, a 3 equates to “Agree,” and a 4 is “Strongly Agree.”) The null hypothesis was rejected; the alternative hypothesis received support.

In the interviews, an instructor felt that “classroom and field-based experience” were both important. He asserted the importance of preservice teachers experiencing how K-12 students learn with the assistance of technology. “They need to see what the [K-12] students are capable of, first hand. I hear it over and over again: ‘I didn’t realize that 2nd graders could...or I didn’t realize that 8th graders could…’ That’s what they should take away.” He described technology as a way to stimulate the learning of K-12 students, and the teaching potential of preservice (and eventually inservice) teachers. All three instructor interviewees placed stress on the importance of preservice teachers learning to teach with technology using methods through which the K-12 students are the users of the technology. One said: “I don’t want the [preservice] teacher doing it all. I want the [K-12] kids doing it. Not just [observing].” This sounds very similar to the goals of technology integration. The involvement of K-12 students with technology was mentioned by two of the three interviewees, though no one directly mentioned outcomes or objectives (such as 21st century skills or fluency development). This is further discussed in *Chapter 5*.

Question 6: What do instructors and preservice teachers believe about the students' career readiness in regard to technology?

Null hypothesis 15. The majority of preservice teachers believe that they are being prepared for their careers.

The career readiness item was used to measure whether preservice teachers thought they were ready for their careers as inservice teachers. The majority of preservice teacher respondents (63.1%; n = 125) answered that they were learning the technology skills they would need. Meanwhile, 12.1% of preservice teachers (n = 24) said they did not know if they were learning enough technology skills for their future careers, 11.6% of preservice teachers (n = 23) said they were not learning adequate skills, and another 11.6% (n = 23) said they already possessed the technology skills they would need for their career. If we set aside those respondents who said they already possess the skills, over a quarter (27.3%) of preservice teachers surveyed either did not know, or did not think they were receiving adequate preservice education. None of the preservice teachers surveyed believed they would not need technology skills in their careers. (See Figure 14). The null hypothesis was retained.

The preservice teachers were asked about their perceived readiness in the focus groups. One said: "I feel like I know a lot, but some stuff like video, not so much." Said another, "I am taking [technology for teachers] class, so I think I will [be prepared]." A third included "I don't really know [what will be used] but I think our [instructors] are trying." None of the focus group participants had begun field or student teaching experiences, but they thought those experiences would help them determine whether they were prepared for teaching—they were unsure. "I'm doing that [field experience] in the spring, and I think it'll go well," remarked one preservice teacher. Smart boards were a point of concern for several of the focus group participants. One preservice teacher with a major in early childhood said “I’d like to know more about *SMARTboards*,” and three others agreed. “We haven’t learned about them at all, but I know they’re in the schools.” One participant chimed in “I think [the department] has them now too, but we didn’t learn it yet.” The student focused a great deal on the tools—specifically their literacy or fluency with certain technologies—that they thought would prepare them. Although the question asked them if they felt prepared to teach with technology, the students did not mention pedagogical aspects of teaching.

Null hypothesis 16. The majority of instructors do not believe that preservice teachers are prepared for their careers.

More than half of instructors (52.4%, n = 11) were concerned about whether students were prepared. Still, nearly half (47.6%; n = 10) did feel that preservice teachers were learning the technology skills they will need. The null hypothesis was retained. Figure 16 compares the opinions of preservice teachers and instructors on whether each group thinks the preservice teachers are being prepared to teach with technology.

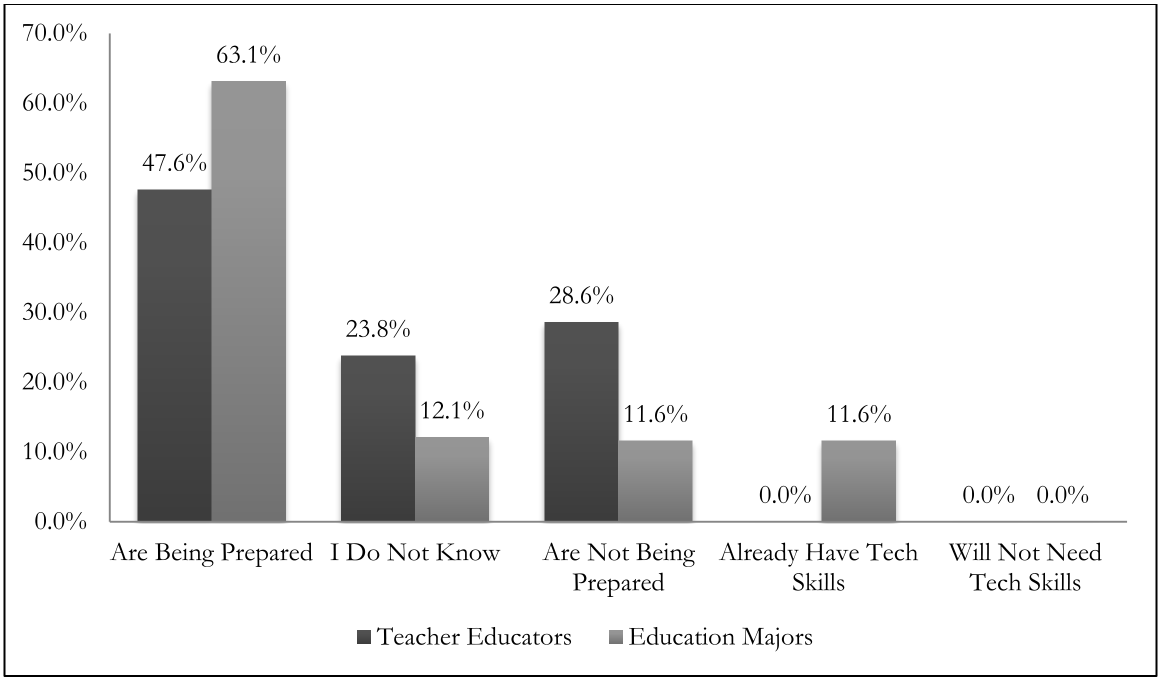


Figure 16. Instructor and preservice teacher perceived career readiness.

In the interviews, instructors spoke positively about preservice teacher preparation. All three were fairly certain that the preservice teachers would use technology in their future jobs. “I think we’re doing an adequate job,” said one interviewee. He felt that the recently-renovated building and accompanying new resources would help inspire more of a focus on technology. “We try to emphasize the impact,” said another interviewee, though she admitted she knew some preservice teachers were not as comfortable as others were with technology.

Interactive white boards—a concern of preservice teachers—were mentioned by instructors as well. “I think we’ve been behind with things like interactive white boards...students have mentioned to me that they wished they had been more prepared—that they had to learn it in the field and wished they’d had a head start.” The interviewees explained that the department recently acquired interactive white boards (as of this semester), but they were not yet hooked up. One instructor said she overcame the previous absence of white boards in the department by holding some class sessions off campus, at a local school where the white boards could be used. "[The *SMARTboards*] are in the schools already. If they have a jump start in that, they'll be ready," she said.

But again, references to white boards and other specific tools are inferences that technology fluency skills of preservice teachers are important. These skills are important, but what about understanding methods of teaching with technology? Instructors did not often reference methods or pedagogy when discussing preservice teacher preparedness.

It is additionally difficult for instructors (or researchers) to determine whether preservice teachers are being prepared to teach with technology because presumptions about digital natives color the effectiveness of existing models or requirements. Do preservice teachers of the 21st century need to learn about physical technology tools? Do they need to develop literacy with technology? Fluency? Or should their education be focused on ideas and information, rather than tools? Existing models cannot define what it what it means to be a digital native, preparing to teach in the 21st century.

CHAPTER V

DISCUSSION

Summary

In *Chapter 2* we saw that technology is in integral part of our society—for business and personal use—and is used by nearly everyone to access information and communicate, among other things (PSRAI, 2007). It is important for individuals to understand the many opportunities, capabilities, and responsibilities associated with technology (U.S. Department of Education, 2001a; 2010). This level of understanding has been defined as a set of 21st century skills—learning and thinking skills related to technology and connectivity that will allow people to be successful in our technology-immersed society (P21, 2009). Through the development of technology fluency—higher order skills that include literacy with technology as well as adaptability and problem solving capabilities—young people are able to also improve their attainment toward these 21st century skills (Lin, 2000; P21, 2009).

A significant amount of research about teacher education focuses on improving the use of technology-inclusive teaching techniques in K-12 schools; these techniques—including technology integration—have been found to promote the development of fluency and 21st century skills (Grabe & Grabe, 2007; ISTE, 2008; Lowther, Ross, & Morrison, 2003). Yet, research has suggested that preservice teachers may face barriers that prevent them from using methods of technology integration in their classes (Ertmer, 1999; Butler & Sellbom, 2002). Some of these barriers are first order barriers: they are related resources, policies, or other factors external to the teacher. Although first order barriers have not necessarily been resolved in all cases, they can be overcome through creativity or other workarounds and as such, researchers have shifted their focus to second order barriers (Ertmer, 2005). Second order barriers are internal to the teacher and include attitudes about technology, teaching philosophy conflicts, and a lack of education about technology use for teaching (Brinkner, 2005; Ertmer, 1999). For inservice teachers, it is best to address second order barriers with professional development such as inservice days or other administrative support (Bryzcki & Dudt, 2005; Carlson & Gooden, 1999). Some also believe that older teachers use less technology than newer teachers (Inan & Lowther, 2008), and as older teachers retire they will take "their" second order barriers with them. Fueling this assumption is the idea that current preservice teachers and recent graduates of teacher education programs are part of a generation of digital natives (Prensky, 2001).

This digital native generation, which is often defined as those born in the mid-1980s or later, is seen as technology-savvy due to a technology-enriched upbringing (Prensky, 2006). We might then assume that this new generation of teachers does not need professional development concerning technology because they are naturally fluent and possess 21st century skills already. But is this really the case?

Researchers have found that there is no commonality in skill level, and little deep understanding of technology use among people of this generation (Oblinger & Oblinger, 2005; Jones & Czerniewicz, 2010). Even if these students are fluent with technology, technology fluency does not automatically equate to use of technology integration methods (Davis, 2011; ISTE 2008). Furthermore, preservice teachers may be low users of technology or have low confidence with it in comparison with their peers in other majors (Lei, 2009; Salentiny, 2010). These findings suggest that preservice teachers may form second order barriers to technology integration before they graduate from college, and thus would need as much professional development as older teachers. They may also need specific types of instruction when they are in their preservice education program. More knowledge about how the technology characteristics of preservice teachers and their instructors was needed. Specifically, conflicting beliefs and negative attitudes were two second order barriers to integration. Knowledge about these areas paves the way for future research to focus on technology integration.

This study sought to explore the technology characteristics of preservice teachers and their instructors. Answers to questions about technology usage, access, and attitudinal characteristics of preservice teachers and instructors allowed identification of how these two groups experience technology now and what they believe about technology in education. Commonalities between preservice characteristics and instructor characteristics were analyzed because the research has shown that instructor methods and attitudes can influence preservice teachers' methods and attitudes when they become inservice teachers (Teo, 2009).

The expectation was that preservice teachers would have positive attitudes about technology, but would differ on use by some demographic characteristics (specifically gender and age). This was expected because the research suggested that this generation does not have uniform technology skills or usage (Kennedy, Judd, Churchward Gray, & Krause, 2008), although most of them are positive about technology in general (Beloit

College, 2011; Tapscott, 2009). Preservice teachers were also expected to have more positive attitudes and use technology more often in comparison to their instructors: they have grown up with technology and are likely more accustomed to it than their instructors, many of whom are from older generations (Oblinger & Oblinger, 2005; Prensky, 2006). Preservice teachers were expected to feel unprepared (technologically) for their careers, while instructors would believe they had been prepared properly. This expectation was based on research that indicated that preservice and inservice teachers did not feel prepared by their preservice education to integrate technology (Lei, 2009; Walden, 2010). Additional information was sought concerning how much technology preservice teachers observed in classrooms and used for assignments or other class purposes; this was because technology use should be integrated to promote the development of 21st century skills and fluency, and this type of use by instructors models integration and other technology-inclusive methods for the preservice teachers as well (Ashburn & Floden, 2006; Lowther & Morrison, 2009).

This study used a sequential mixed-methods approach. In phase one, 198 preservice teachers and 21 instructors of teacher education courses were surveyed. The surveys collected data about their demographics, usage, access, attitudes, perceptions, and opinions. The results of the analyses of this data influenced the development of qualitative inquiries used in phase two. In phase two, nine student participants attended either of two additional focus groups to discuss trends found in the data; three faculty participants offered similar dialogue through individual interviews.

Question 1: Demographic Differences

Question 1 asked: Do preservice teachers differ in technology use and attitudes based on demographic characteristics?

This research question asked whether student technology use and attitudes differed by the demographics of age, class standing (underclassmate, upperclassmate), or gender. The question was designed to explore the constructs of personal and professional technology use types, personal and professional technology use frequency, and technology attitudes. The goal of the question was to find out whether the students had the characteristics described by the research: younger students using more technology and having more positive technology attitudes than older students, and male students using more technology, and having more positive technology attitudes than female students. The results indicated that yes, there are differences among preservice teachers by demographics.

Age

Hypotheses were that younger students would use more technology and have better attitudes about technology than older students have, and that underclassmates would use more technology and have better technology attitudes than upperclassmates. The vast majority of the participants (91.4%) were under age 24; three quarters were under 21 (74%). It was not expected that technology use would differ greatly between participants of ages 18 between 23 years old because all of these students could be identified as digital natives by their birth years (Prensky, 2001). Preservice teachers in the focus groups were between the ages 19 and 21 years old; they did not discuss any differences they thought were related to age or class standing. (One exception: a student hypothesized that instructors might struggle with Internet use because they were older; this comment was related to a different question.) Although some research has shown that younger people may have more technology experiences and own more devices than older people (Pew Internet Research Center, 2011b; Prensky, 2001 & 2006), the results in this study were not surprising due to the distribution of ages in the sample. Additionally, there was scarce research on how preservice teachers' class standings might relate to their technology characteristics, this aspect was studied to see if differences did exist. The only differences found were parallel to those found by age; if differences had existed, further inquiry as to how student coursework or college experiences could be related to their technology characteristics could have been conducted. No overall significant difference was found by age, but technically almost all student participants would be members of this digital native generation.

Technology use types and frequencies. Results from the surveys found that there were only a few specific differences between older and younger students, and between underclassmates and upperclassmates. Additionally, these differences were not overall differences: they were concerning specific types of technology. Students age 22 and older spent significantly more time researching products online, and using the Internet or computers for work than students aged 21 and younger did. The 21-and-younger students spent significantly more time watching online television, movies, and video clips than the older students. Similarly, underclassmates (freshman and sophomore students) watched significantly more online videos than upperclassmates (junior and senior students); this result is related to the ages of the students—the majority of the younger students are also underclassmates.

Gender

Student characteristics by gender were studied because research has shown that females tend to be less technically apt than males. These findings are related to preservice teacher education because the majority of preservice and inservice teachers are female. A majority (80%) of this study's participants were female, which reflects the overall population of teachers (Ingersoll & Merrill, 2010). This fact, along with the research that showed differences in technology characteristics of males and females, indicated a need for the study of gender in relation to preservice teacher technology characteristics. The gender-related hypotheses for Question 1 were that male preservice teachers would use more technology, and would have better technology attitudes than female preservice teachers. There was not a significant difference overall in student technology use by gender, though significant differences by individual types of technology use (such as social networking and video games) were found.

Technology use types and frequencies. Female preservice teachers in this study reported using significantly more email, social networking tools, and Internet for doing school work than males reported. The former two aspects—email and social networking—had also been identified in McEwan's 2001 study as areas female students tended to use more than males; another study by Selwyn (2008) identified females as using more technology for academic purposes as well. The male participants used significantly more online hobby websites, and played more online games; this finding also aligns with the research regarding male student technology use (Smith, Salaway, & Caruso, 2009; Viadaro, 2009). In the focus groups, students were hesitant to agree or disagree on whether males or females were higher users of technology. Some did not think gender mattered, but others thought that their male friends were "techier" than they were. The male participants thought their female friends used social networking and communication tools more often than they did—an observation that, as we have seen, was reflected in the survey results.

Technology attitude. In studying the construct of attitude, it was hypothesized that males would have better attitudes than females about technology. There were significant differences found in attitude by gender, with males being more positive about technology; these differences were also expected. This finding implies that instructors should be aware that their students might not be technically-inclined, especially if the majority of their students are female (as the literature—and this study—both indicate is the case).

The male student attitudes were significantly better concerning technology, and the null hypothesis was rejected while the alternative hypothesis received support. Males answered the attitude-related questions with overall "agree" responses, indicating that they felt comfortable with various aspects of technology use. Females answered with overall "neutral" responses to these questions. Male and female students had significantly different responses to each of the attitude subscale items, which were aspects of technology use such as "solving my own technical problems" and "keeping up with new technologies." Males had significantly more positive answers on all of the items. Again, this was expected based on the research regarding male and female young people: males are more likely to be early adopters, while females have been found to be "technophobes," (Morahan-Martin & Schumacher, 2007, p. 2237).

Implications

Before discussing the implications for age or gender, an overall concern for all preservice teachers is that the majority of their technology use types and frequencies were personal in nature. Females reported that the most frequent technologies they used were personal communication tools, while males reported the most frequent use of entertainment-related technology; all of these uses are personal. This aligns with the research indicating that preservice teachers' technology knowledge is not related—or transferable—to the professional realm (e.g., Davies, 2011).

In the focus groups, students did not name any specific personal skills they had that would directly transfer to teaching, but they did believe that their personal experiences would at least feed in to what they were learning in their preservice education program. For example, three of the nine participants (33.3%) mentioned some type of mobile device (tablet, mp3 player) that they either owned or had experience with, and thought this experience would help them conduct related lessons in schools that had these devices. (While this paragraph does not have a gender-specific focus, it is pertinent to note that two of the three students who mentioned these experiences were male—the only two male focus group participants.) Themes of technology literacy skills emerged through the focus group discussions, because the majority of focus group participants (77.8%) mentioned some type of technology skill they possessed and thought it would serve them well in the classroom. Examples of these skills included keyboarding skills, Internet searching skills, and skills with productivity software such as email and word-processing programs. In these cases, the students did not indicate (even when prompted) how they intended to use these skills for teaching. The implication here is that these preservice teachers will need educational support, from their instructors and from their program overall, to understand which personal skills they have that might transfer to their future careers, and how they can appropriately use these skills.

Most differences found by age were not significant; rest of this section focuses on gender. The personal uses of technology by preservice teachers have already been discussed, but gender and attitude offered some further concern. The survey responses indicated that male students had more technology knowledge and skills, and this was inferred to mean that they have better attitudes. The qualitative research sought to solidify this inference, but it was instead found that more knowledge and better skills did not necessarily equate to more positive attitude about technology. The majority of the focus group participants (77.8%) described themselves as having very positive attitudes about technology, and also made references relating it to education and how it can "help the kids learn," or "make classrooms more fun." (No one was able to elaborate on how technology would do this.)

Gender is concerned here because while female preservice teachers were inferred to have significantly lower technology attitudes due to their responses on the surveys, the females in the focus group did not display this verbally. Six of the seven female focus group participants (85.7%) indicated being very positive about technology (in general, and in education). With more questioning about these positive attitudes, it was determined that almost all of the focus group participants (88.9%)—and 100% of the female participants—believed there would be a specialist or IT support person available in their future workplace to take care of technical things for them "I would be teaching with it. Like, I should know the teaching stuff, how to use [technology] for education.

But, I wouldn't know how to fix it if it broke. They should have [staff/IT people] for that." The implication here is that if these preservice teachers become inservice teachers, and they carry with them the belief that they will not have to have technical knowledge in order to teach with technology, a barrier may develop when they are faced with issues. This could be a first order barrier—such as a technical support barrier—but it could also develop in to a second order attitudinal barrier. This implication is discussed in further detail as a conclusion to this study.

Question 2: Preservice Teacher and Instructor Differences

Question 2 asked: How do instructors and preservice teachers differ in terms of technology use characteristics and attitudes toward technology?

The goal of the question was to find out whether differences exist, and which group uses technology more often and with a more positive attitude. Like Question 1, this question explored the constructs of personal and professional technology use types and frequencies, and technology attitudes. It was developed based on research that found that instructor technology-related characteristics may be emulated by their students as the students become inservice teachers. The findings were that instructors used more technology than preservice teachers did, but different types of technology, and for different purposes. The survey results showed that preservice teachers had slightly higher attitudes than their instructors did, but qualitative exploration indicated that both groups had positive attitudes, more so than the quantitative portion of the study indicated.

Technology Use Types and Frequencies

Instructors used more technology than students did. This was attributed to a large amount of work-related technology use by instructors, versus personal use being prominent over work use for preservice teachers. (Note that while it is known that all of the instructors are employed; preservice teachers may or may not be employed: the survey did not ask.) While the literature did not specifically compare university faculty to university students in terms of technology use, it did assert that young people are higher users of technology than older people (Beloit College, 2011; Deloitte, 2001; Tapscott, 2009). The quantitative data showed that instructors in fact used technology significantly more often than students did. Their use was differently-distributed; many of the instructor usage hours were spent doing research or class-related work, whereas students used social networking, online television and music services, and video games much more frequently than instructors did.

Faculty interviewees and student focus group participants were told about the quantitative result and asked for their reaction. They were all were surprised about faculty use being higher. Instructors attributed the result to differences in the type of Internet activities: they use a great deal of technology for work (class and research), sometimes spending the entire day using the computer. These observations were in line with the quantitative data collected. Students also thought the instructors were probably using the computer for work, while their use was personal and for entertainment. Visiting sports websites, social networking, and watching Hulu (online TV) were some of the things students said they do on the Internet; again, these activities were consistent with quantitative data collected.

Technology Attitudes

It was hypothesized that the preservice teachers would have better attitudes toward technology than their instructors would. Comparison of each group's survey results indicated that this was true (again, if we infer this from their reported technology knowledge and skills). From the surveys, student attitudes about technology were found to be significantly more positive than instructor attitudes. But as was encountered with Question 1, instructors and students portrayed positive attitudes about technology during the interviews and focus groups. The only negative factor mentioned in the instructor interviews was the inability to disconnect: one interviewee said he "dreads opening email" sometimes, because of the expectation that goes along with it. Another said "you can't really shut it off." Still, all three of the interviewees were generally positive about this increased expectation: "you can always keep going with your class." All of the instructor interviewees were positive about the Internet, but for different reasons than the students (as expected, from the quantitative results). One instructor said she loved the Internet because it provided "unlimited research-ability." Another said of the Internet: "I feel so empowered with access to educational materials. I can quickly get information that is reputable."

Students did not speak to any negative aspects of technology, except "when it doesn't work and you can't get to your assignment, that's annoying." Students in the focus groups portrayed positive attitudes toward being constantly connected to the Internet. "I might miss something, or someone sends me an invite and I have to get it," said one student when referring to Facebook use. Other students agreed that being connected constantly to friends is important to them, and the Internet allows this.

Implications

Two implications emerged through the comparison of the qualitative and quantitative data related to this question. Firstly—as with the findings from Question 1—preservice teachers and instructors both referenced uses of technology that serve purposes of entertainment, productivity, and communication and are not directly related to teaching. The implication remains the same: for the students, education about methods that use technology in pedagogical (e.g., technology integration) is key. The absence of instructors' references to pedagogy and technology at this point can be attributed to the design of the questions about this construct: they were asked about their attitudes, and what their favorite or least favorite technologies were. Without this knowledge, we could infer that these instructors have barriers to the use of technology in education, but discussions of other constructs indicated that this is likely not the case. At this point, the fact that instructors referenced their classwork and education when discussing their attitudes about technology use was reassuring.

Secondly, one could infer that instructors—as higher users of technology than students—or students—as young people who seem to enjoy technology use (based on their qualitative response)—would have indicated positive attitudes on the surveys. Instead, both groups answered the surveys with neutral (student) or slightly negative (instructor) attitudes about technology use. Preservice teacher attitudes were slightly more positive toward technology use, and this can possibly be attributed to their technology-enriched upbringings. Neither group's quantitatively-measured attitude about technology was particularly high, but the qualitative discussions indicated that both instructors and preservice teachers had very positive attitudes about technology use. This calls back to Question 1, wherein the focus group participants said that technology skills and knowledge were not indicators of their attitudes about technology. Throughout the interviews and focus groups, themes of “IT Person” or “Staff” responsibilities emerged. We saw in Question 1 that preservice teachers believed a staff person would be available to help them with technology, and thus they had drawn a conclusion that technology skills and knowledge were not of utmost importance for teachers to have. Instructors indicated a similar position on this—two of the three interviewees (66.7%) did not consider themselves to be technically-inclined. “I’m somewhere in the middle. I don’t avoid it, but I need help,” one said. All three interviewees indicated that the availability of technical staff members would either directly or indirectly influence how often they taught lessons that included technology. This implies that instructors may face a first order barrier related to technical support, in line with the similar implication derived in Question 1.

Question 3: Preservice Teachers and Classroom Technology

Question 3 asked: How often do preservice teachers observe their instructors using instructional technology tools in class, and how often do they use it themselves?

The research indicated that technology is not being used pedagogically at a high rate in K-12 classrooms, while also indicating that younger people are more frequent technology users than older people. This generation may also not know how to use technology for purposes of learning or other benefits aside from personal enjoyment. This question explored the constructs of classroom technology use by instructors and by preservice teachers. The result was that both instructors and preservice teachers reported using classroom technology tools sometimes. (Recall: “sometimes” was the neutral point on these subscales in the surveys.) In focus groups, preservice teachers said they did not expect to see technology used every day unless there was a good reason for the use. They valued what was thought of as meaningful technology use, and did not want to see it used unnecessarily. Instructors' comments concerning their own use of technology for education purposes were similar.

Classroom Technology Use by Instructors

In the interviews, instructors said that they did not necessarily use technology in the classroom every day, but they tried to use it "to model the technology and how it is used for teaching." One instructor said "I think students like a mix of technology with talk time." The focus from instructors was on pedagogical use of technology. Each of the interviewed instructors indicated that it was their role to help students see how technology could be used as a method. One of the instructors brought up the program's required course that deals specifically with educational technology. She thought highly of the course, and felt that it gave preservice teachers good experience with several technologies they could use in their future classrooms. However, she still included technology in her lessons "when it is useful," and expected preservice teachers to include it in theirs lesson plans as well. 'It can't be just lecture and a movie," she said of her subject area. The instructors echoed this view: they wanted to encourage technology use by preservice teachers, but not without cause. One instructor used *iPads* as an example: the department had just acquired some. He had not used them in his class yet and nor had his preservice teachers used them, because he had not yet decided how they could be used as a meaningful part of the curriculum.

Classroom Technology Use by Preservice Teachers

In the surveys, the technology types preservice teachers reported using most often were *Blackboard* and word-processing software. In the focus groups, several of the preservice teachers explained that they were "pretty much required" to use these tools. *Blackboard* was used often because it is used to check grades or hand in assignments; word-processing software was used often because the homework assignments are completed using it. According to one preservice teacher: "We have to get handouts on *Blackboard*, so I guess I use that all the time…and then if you have to write something, it's in *Word*."

Preservice teachers said that they were experiencing an acceptable amount of technology use in their classrooms. One preservice teacher lamented "maybe a little too much *PowerPoint*. That gets old fast." When asked if she would use presentation software in her future career, she said she probably would not. "If I had to show a bunch of pictures or something, maybe. But not just to put the words up there and then make people read it. That's pointless." One preservice teacher said she had learned how to make a podcast, and she thought she would definitely do that with her future lessons.

The majority of the focus group participants (66.7%) indicated that they did not see a need to use technology in every lesson. One explained: "I don't have to make a movie, or do a project with the Internet every day. That would be a bit much." Asked to elaborate on this comment, she responded that "it's like anything you do in school…you do different things, it's not always the same kind of project, so we don't always use the different tech things." So preservice teachers did not use every technology every day, and they also did not think this was expected or a good idea—echoing what they said about technology use by instructors. One preservice teacher said "I'll use it when I need it, or when I think it will help—that's what [the instructor] told us to do when we do the lesson."

The literature said that technology integration and other methods that use technology in context cannot be measured by how often people use technology tools, but rather how the tools are used (Davies, 2001; NCES, 2002); the preservice teacher and instructor comments regarding when and why technology should be used in the classroom seem to align with this position. Still, the focus group and interview responses indicated an implication concerning what instructors and preservice teachers consider to be meaningful technology use.

Implications

Prior to describing this implication, it is important to note that the survey asked students and instructors about specific uses of technology tools. It did not ask them to determine whether the tools were used in ways they considered meaningful to education: they simply marked how often the tool was used. Thus, the response of "sometimes," for these tools (more for some, like *Blackboard* and word-processing software) does not indicate how or why the tools were used. The interviews and focus groups were thusly designed to collect further information about the ways these tools were used. Students and faculty both tended to name tools and describe how they (the instructors) or their students (the preservice teachers) used the tools. Instructors and preservice teachers each focused on how the tools were used as delivery methods for materials (e.g., Lowther and Morrison, 2009). All three instructors indicated at least one situation in which they delivered a lesson that encouraged technology fluency in their students (the preservice teachers). The preservice teachers in the focus groups described what they (as future teachers) could do with the tools, which is important because as mentioned earlier, they knew not to use technology in the classroom without having a good reason for it. They indicated that they were experiencing enough technology use by instructors in their classrooms, though only two of the nine focus group participants (22.8%) described a situation that sounded constructivist in nature (e.g., technology integration). The implication here is repeated from Questions 1 and 2: preservice teachers were focused primarily on their own literacy skills, not fostering those skills in their future students. This does not necessarily indicate a barrier, but could lead to one when these teachers become inservice teachers and find that they do not possess a rounded understanding of the ways technology can be used in teaching, including constructivist methods like technology integration.

Question 4: Classroom Technology Perceptions

Question 4 asked: Are there differences in the perceptions of how often tools are used by instructors or assigned for use by preservice teachers?

This question was designed along with Question 3, to study the constructs of classroom technology use by instructors and by preservice teachers. While specific research regarding this phenomenon was not found, it was thought that instructor and preservice teacher definitions of what constitutes "technology" might differ due to their generational differences, and thus perceptions of how often "technology" is used use would differ. This difference in perception would cause concern because instructors might believe they are modeling technology use, but the preservice teachers may not be noticing it. Research could not be found to support issue, so the hypothesis was that there would not be a significant difference between the amounts of instructor technology use reported by the instructors versus what was observed by the preservice teachers (i.e.,, they would see and report the same). Instead, the results of the surveys indicated that preservice teachers observed less instructor technology use than instructors reported. It was also hypothesized that there would not be a significant difference between the amounts of technology use assigned by the instructors versus what was reported by the preservice teachers. This was correct: no significant differences were found.

Classroom Technology Use by Instructors

The quantitative results showed that there was a significant difference between how much technology preservice teachers observed instructors using, and how much technology the instructors reported using; preservice teachers saw technology use less often than instructors reported using technology.

The differences from the survey results were discussed in the qualitative portion of the study. One possible reason for the difference in observed and reported technology use is a difference of opinion—or a misunderstanding—of what technology is. Preservice teachers' definitions of technology varied slightly from instructor definitions: the former group described their smart phones, the Internet, *iPad*s, and computers as technology, whereas the latter focused mostly on their computers and other tools such as a calculator. So, instructors may be using technology that students did not consider to be technology. From another other point of view, perhaps instructors were reporting the use of tools they thought were technology, when in fact they were not (according to preservice teachers). Preservice teachers might not—for example—think of a calculator when asked to define technology. Preservice teachers and instructors each discussed the types of technology they used in teaching and learning processes, and—aside from the exceptions just noted—most of these aligned between the two groups. Popular tools assigned by instructors—and used by preservice teachers—included presentation software, online blogs, wikis, and discussion boards, video or web cameras, and Internet tools.

Another possible reason for the difference in observed and reported technology use is that these survey questions asked students to report frequency of use based on past observations. Likewise, the instructors were asked to self-report regarding their past technology use. This is a limitation in that students and faculty were put on the spot, and asked to self-report about past experiences and to answer a question they might not have considered otherwise.

Classroom Technology Use by Preservice Teachers

There was no significant difference in survey results when comparing how much technology-inclusive work instructors said they assigned, and how much of this type of assignment preservice teachers reported receiving. Differing definitions of technology or poor recollection of past technology usage have possibly affected the results.

When asked about classroom technology in her focus group, one preservice teacher said she “found a podcast for the kids to watch,” but she could not remember if her instructor had showed the class how to do this: “I think so? At least, I think he had iTunes up...or he told us to go there.” Another preservice teacher in the same focus group added that they were taught how to find and make podcasts in their technology-for-educators course, so perhaps this other participant had seen it there. These two preservice teachers struggled with remembering exactly where they had learned to use the tool, but were able to speak about specific ways they used the tool as part of a project. To clarify, preservice teachers seemed more likely to recall and accurately describe technology they have used themselves, than to recall each situation in which they have seen an instructor use technology. The research backs up this position: it has shown that more retention occurs from experience, than from observation (Dewey, 2009; Jonassen, Peck, & Wilson, 1999).

It is reasonable to assume that the instructors who took the survey for this study are not all the same instructors each of the preservice teacher participants have had for their classroom instruction. To further explore this question, observations of classroom technology use would likely provide more definitive answers.

Implications

When considering preservice teacher education—it is important to consider not only whether technology is being taught, but also what the tools are and how they are being used. Clear definitions of what types of technology tools should be integrated in preservice teacher programs might prevent situations where instructors think they are modeling pedagogical use of technology, but the preservice teachers do not experience it (because they do not see recognize the tools as "technology").

It is possible that preservice teachers and instructors agreed on what the assigned tools are because they are listed in syllabi or assignment descriptions. Or perhaps, preservice teachers are more attentive to their own technology use because it directly affects them, whereas their observations of instructor technology use are less pertinent to their educational success. In the qualitative portion of the study, preservice teachers were able to describe what technologies they used, and why, much more thoroughly than they were able to recall the use or describe the purpose of technology they had seen their instructors use. An implication for preservice teacher education programs is that they should include technology application opportunities for preservice teachers—they seemed to retain specific memories of the tools they had used for assignments, including a recall of the why they used technology in the assignment. Research about retention related to experience and practice supports this implication.

Question 5: Technology Importance

Question 5 asked: What do instructors believe about the importance of the use of technology tools by themselves and by preservice teachers?

This question was designed to explore the construct of technology importance. The research indicated heavy support at all levels (government, academic, private, non-profit) for technology use in education. The goal of this question was to see if instructors in preservice teacher education supported this position. It was hypothesized that instructors would believe it is important for them to use technology when teaching, and they would also believe it is important for preservice teachers to use technology when completing assignments. The answer was positive in both cases: instructors thought technology was important for preservice teachers to see used for education, and for these students to use themselves.

The quantitative questions asked about the importance of technology: do preservice teachers need to see instructors using it, and do preservice teachers need to use it themselves? The results were that instructors thought their own use and the preservice teachers' use were both important. Since use does not equal integration, the qualitative portion of the study was used to expand the question: how did instructors think technology use in education should be portrayed?

All of the instructor interviewees placed emphasis on aspects of technology integration, with each instructor specifically mentioning constructivism. One instructor said preservice educators need to learn to "apply it to academic situations and turn it in to learning opportunities for children." According to another, "We have an opportunity to help them focus [their technology knowledge] and use a critical eye of when to use the technology to maximize learning potential and teaching potential." Another felt it was the responsibility of instructors to help preservice teachers focus technology skills they may already have in order to "incorporate them in to teaching a lesson." "I want to help the [preservice teachers] see that what they already have in their hands has educational value," echoed another interviewee on the same subjects. These descriptions call out certain attributes of integration: namely, using technology as a teaching tool—not teaching technical skills.

In addition to their own use in these ways, they also had an expectation of this type of technology use in any assignment preservice teachers completed. One interviewee described a project in which preservice teachers are to develop a lesson and teach it to children. She said they are permitted to use technology as a part of the lesson, but she does not allow them to turn it in to a "technology lesson where they spend the time in the computer lab in the school and help the kids type or something." (Remember, this type of lesson might help develop children's technology literacy skills, but not deeper knowledge of the subject matter (Lin, 2000).) The instructor who gave this example went on to say that skills such as typing are important, but she “does not value that [type of lesson].” Another interviewee said: “It’s about having them find the resources. It’s the methods aspect of having them pull the content in to the lesson.” Another interviewee expressed his idea of what technology use should entail: “Are the [K-12] kids repeating the ideas of others, or are they creating their own ideas and sharing them in creative ways?” So, each of the instructors demonstrated that they did indeed believe technology was important in preservice teacher education. Additionally, these are descriptions of integrated use that align with the definitions of integration seen in the literature (Hammond, & Manfra, 2009; Pierson, 2001). None of the instructors thought they held unique opinions on these issues. Although they knew of some instructors who were more or less proficient with technology than they were, they all spoke of their colleagues as having similar beliefs about technology for teaching and learning as they did.

Implications

The quantitative and qualitative results both indicated that instructors believe technology is important in education, which was an encouraging finding because they are tasked with teaching preservice teachers about it. Furthermore, each of the interviewees described some technology integrated in constructivist ways, and situations in which it was used as a pedagogical tool or tools to engage and teach learners about domain subjects. The instructors promoted their goals to teach preservice teachers how to teach with technology. Still, while instructors indicated that preservice teachers should use technology responsibility (not without reason), they often went on to describe uses that were related to the development of preservice teachers’ technology literacy, rather than fluency. For example, two of the three interviewees mentioned wanting their preservice teachers to learn how to use an interactive whiteboard. Other skills could be construed as either technology literacy or fluency, such as teaching the preservice teachers to use Internet resources to make lessons more engaging. It depends on how they are taught. Goals of encouraging pedagogical technology use were clear in many instructors' statements, but an implication here could be that instructors of preservice teachers need to fully grasp the outcomes of various technology-inclusive teaching methods including technology integration. Defining the various methods would affect how the technology is taught to preservice teachers (i.e., with a goal of technology literacy, versus fluency).

Question 6: Career Readiness

Question 6 asked: What do instructors and preservice teachers believe about the students' career readiness in regard to technology?

This question explored the construct of career readiness; it was important because a common theme of teacher-education research is that inservice teachers do not use these tools because they have not been prepared to do so (Teo, Chai, Hung, & Lee, 2008; Walden, 2010). Furthermore, if inservice teachers encounter technology and have trouble, they may face second order barriers to future use (Ertmer, 1999). The research in this area showed that many inservice teachers did not feel prepared to teach with technology by their undergraduate teacher preparation programs (Walden, 2010). The hypotheses were that the majority of preservice teachers would not believe that they are being prepared for their careers, while the majority of instructors would believe that preservice teachers are prepared for their careers. The survey results indicated that the preservice teachers were quite positive about their preparedness, while only about half of the instructors surveyed believed the students were prepared.

The focus group participants thought their preparation included a mix of their own skills and the skills they were learning in the program. One preservice teacher said: “I feel like I knew some of it, but I didn’t know, like, how to make a lesson with it. I think I’m learning that.” Another preservice teacher based his preparation on past experience: “my school used the computers, and we had the SMART boards in some of the classrooms…so I figured when I went in to teaching I would need to use [technology].” When asked, he said he thought he was learning what he needed to learn. They also placed a lot of value on their field experience. “I can’t wait to get in to the classroom,” one student said. “My friend did hers, and she said she learned a ton.”

Preservice teachers did not articulate examples of pedagogical technology use, but they believed the tools were being depicted properly by their instructors. When asked to clarify the value of technology in education, one preservice teacher responded that she wanted to learn more about using technology to teach without “feeling like I am doing something wrong, or like I can’t do it.” Another added: “to teach—using it to teach a subject—not just being able to do it;” the original student agreed with this clarification. Another said he already knew how to use a lot of technology for his own use, but the teachers and classes would help him “figure out how to use it to help the kids when they do the lesson.” They also felt there was an expectation for technology methods knowledge when they student-taught: “and in your field teaching, a lot of the classrooms have technology. You’re supposed to be able to use it right.” The students explained that using it “right” helps the kids learn about the subject. “They learn the subject. Like the reading, or the science lesson. I guess they get the computer experience at the same time, but it’s not like a computer class where you’re telling them ‘click here, click there.’” This was the closest anyone came to describing outcomes of 21^{st} century skills or fluency development in K-12 students. The preservice teachers who participated in the focus groups were mostly sophomores and juniors, and as such felt that they had more to learn before they were prepared, but their responses at this point in their educational program still reflected awareness of technology and how they thought it should be used educationally.

In the interviews, instructors referenced a few reasons why they thought preservice teachers might not be ready to for their careers. One of these was a lack of interactive white-board training: all of the instructors were concerned that preservice teachers had not received enough experience designing or teaching lessons that use this tool. The department had recently acquired some white boards, and instructors thought preservice teachers would be more prepared when they were comfortable with using this technology with their students.

When told that most preservice teachers did feel that they were prepared for their careers, instructors referenced their personal use of technology as a possible source of false confidence. "Their perception of what they know and the reality of what they know are two different things," said one instructor. Instructors were cautiously optimistic, however. They did think preservice teachers would probably use technology in their classrooms, and thought the department was doing an "adequate" job of educating them about technology for teaching. They also expressed hope for the future, and especially the impact of their renovated teaching space: "We're on the cusp, and it's coming together with our new resources…we've been energized." (The new teaching space and related resources mentioned by this instructor is discussed as a limitation in a later section.)

Implications

The instructors felt that improvements like interactive whiteboard experience and more experience with technology use for educational purposes (rather than personal purposes) would help students become more prepared. The whiteboard experience might aid in preservice teachers' development of confidence (attitude is a second order barrier), it can be argued that training in use of a specific tool is not an indicator that teachers will be fluent with technology and able to use it in their lessons. These responses from instructors—in conjunction with the heavily tool-specific way in which students described their technology preparedness—indicate that neither group associated career readiness with having knowledge of technology inclusive teaching methods (e.g., technology integration). Both groups were concerned with which tools the preservice teachers needed to develop skills with, but if preservice teachers have developed technology fluency, they should be able to adapt to use whatever tools they will have access to at their future school. The implication of needed education emerges here again: preservice teachers and their instructors may believe the preservice education program is preparing them to teach with technology, but they do not know what type of preparedness is necessary. So, both groups may think these preservice teachers are prepared to teach, leading to a situation where preservice teachers become inservice teachers without being fluent with technology and without understanding the pedagogical side of technology use. Instructors need to understand how to foster technology fluency so that they can ensure that preservice teachers are truly prepared. Otherwise, the preservice teachers are being set up to experience second order barriers related to their beliefs, when they find that their idea of teaching with technology—which they thought they were prepared to do—differs from what they will be expected to do in their future.

Overall Conclusions

First Order Barriers Affect Attitudes

Research Questions 1 and 2 explored the technology characteristics of preservice teachers and instructors, with specific attention paid to their attitudes toward technology. Research had indicated that preservice teacher attitudes toward technology were an important factor in determining whether they would use it in the classroom (O'Hanlon, 2009; Teo, 2009). Poor attitudes were also a second order barrier to technology use, and these could be developed due to inexperience with technology, inadequate technology skills, or other technology-related troubles (Ertmer, 2005). The attitudes experienced during focus groups of preservice teachers—as well as the interviews with instructors—lead to a question as to whether abundant technical skills (or a lack thereof) are an issue in preservice teacher education. In measuring preservice teacher attitudes toward technology through the quantitative data, males were found to be more positive about it than females, and preservice teachers were more positive about it than instructors. However, the preservice teachers and instructors who contributed their comments through qualitative methods described themselves as intermediate users, but with very positive attitudes toward technology. Support and reliable access were much more important to these individuals than their personal possession of top-notch skills. "If a tool is slow, it's bad. If it is hard to access or it is out of date, it's bad. If it is too much of a hassle, it's bad," reported one instructor. Support is important to instructors and preservice teachers. Instructors need support to make sure the tools work and are easily accessible by themselves and the students. Instructors believe that preservice teachers need the support from instructors who will show them how to use these tools in education. Preservice teachers agreed that accessibility of the tools was important. "I don't like it when it's old, or it doesn't work right," one commented. Another articulated the need for technical support for preservice teachers (and other students on campus): "If I need help, if will try it myself first and then if I can't get it, I hope someone else can help me."

Remembering the literature about barriers: access and technical problems are two first order barriers to technology use (Butler & Sellbom, 2002; Maddux & Johnson, 2010). The time required to use technology is another first order barrier, and we have just seen that neither instructors nor preservice teachers have patience for out-of-date technology—it takes too long to use. When considering preservice teacher education, these findings align with the research, implying that technology needs to be up-to-date and easy to access. Furthermore, the instructors and the preservice teachers both expect support staff to be available to help them with technical issues and to answer questions about technology use. Accessibility of knowledgeable staff was identified as an important factor in whether teachers and students will use technology in their programs and in their future classrooms. Remembering that encountering first order barriers contributes to the development of second order barriers (Brush & Hew, 2007), these finds are important to consider.

Throughout the interviews and the focus groups, preservice teachers and instructors each mentioned support staff or IT people; a responsibility-related theme emerged. Both groups indicated that they could do some technology-related things, but that their responsibility or goal was to use the technology for educational purposes. One preservice teacher did believe that technical skills would be helpful, “in case it doesn’t work,” but the majority of the preservice teachers had an expectation that technical support staff would be available at their future job to help them with technology issues. Two of the instructors interviewed also said they required help from technical staff when integrating technology, referencing these people as the experts with the tools. One instructor said that when this help was not available, he was less likely to integrate technology.

The positive attitudes displayed in the focus groups and interviews, then, appeared not to be related to technical abilities. Instead, instructors’ and preservice teachers’ positive attitudes seemed to be driven by an understanding of how technology could be used to enhance teaching and learning. These attitudes were also dependent on the technical skills and knowledge of other individuals. The preservice teachers and instructors had confidence in the availability of help from a technical support staff member or other support resources, and indicated that this affected their attitudes toward technology use more than whether they could—for example—learn new technologies easily.

Since the research had shown that positive attitudes were important, and that common second order barriers to a positive technology attitude is a lack of technology knowledge, confidence, and skills; the majority of the attitude subscale questions asked about technical skills and interests. These included the ability to troubleshoot, understanding a lot of different technology, and the enjoyment of “playing” with technology. As we have seen, instructors and preservice teachers answered these questions with mid-range responses but then displayed positive attitudes toward technology. One possible reason for this discrepancy may be related to the subscale used. The problem was that this subscale was intended to measure attitude by inference: the subscale asked instructors and preservice teachers about their technology knowledge and skills, then inferred that those with less knowledge and skills would have poor attitudes about technology. This approach was initially deemed appropriate because the research identified low knowledge and skills as reasons inservice teachers may face attitudinal barriers to technology. This turned out not to be an accurate indicator of attitude in this study because the preservice teachers and instructors referred to first order barriers as reasons they would be less likely to integrate technology into their lessons. Other reasons for this mismatched finding are also possible, including the culture of the region in which the study was completed: it is possible that respondents wanted to be polite and refrain from displaying ego about their own skills, or discontent with the institution in which they work and go to school. This is discussed below as a limitation.

Accountable Technology Use Is Varied, But Present

Research Questions 3 and 4 were related to the amount of technology use experienced and used by preservice teachers and instructors. The findings indicated that preservice teachers did not see technology used every day, nor did they use it every day. The preservice teachers and instructors each expressed that daily use was not an indicator of proper technology use. The literature about technology integration agrees: integration cannot be measured by looking at how often the resources are used (Davies, 2011; Sivin-Kachala & Bailo, 1998). The instructors who were interviewed each stressed that learning the subject matter was the important part, with the expectation that their students would see and be taught about associated technology use as it happened. Again, the literature agrees with this assessment—technology should be used as a tool in the classroom, not as a separate subject (Lowther & Morrison, 2009).

Research Questions 5 and 6 asked about the importance of technology in education, and whether or not students were being prepared to use technology in their careers. The findings indicated that instructors thought technology was important in education, but they were unsure of whether students were being prepared for technology use in their careers. (Students, meanwhile, thought they were being prepared adequately.) One instructor commented that in order to prepare preservice teachers for their careers, "we need to be able to model what we could call 'appropriate and powerful use of technology'—tools for better teaching." Another echoed this opinion, adding that technology use does affect the courses, and she needs to figure out how to roll things in, or else let something else go. The instructors did not feel that technology should change their entire course or practices: "I don't feel that technology has taken over my courses or students' learning." Another instructor said it was important to learn to make decisions regarding "how to [use technology] to support what you're already doing, rather than adding on something." He felt this was also important for his preservice teachers to understand for their future careers. "It's easy to get attached to the tools," explained another instructor, "But they are not the end. They are the means to get somewhere. We try to keep the perspective that this is a part of better teaching and learning, as opposed to saying 'now, we have *iPad*s.'"

These findings indicated that instructors were opposed to using technology simply because it existed, and that they wanted to teach preservice teachers the appropriate ways to use it. It was not clear whether they understood the method of technology integration, but they did reference constructivist methods (and the practice of integration aligns with this). They described technology use (their own, and that of preservice teachers they taught) as something that needed to have a purpose.

However, they also relied a great deal on the technology literacy skills they and the preservice teachers had or needed to develop. They indicated that they supported technology as part of the subject matter, and as an extension of the classroom resources, but did not discuss ways in which technology should foster the development of 21st century skills in K-12 students. While each instructor described at least one instance that would indicate they teach and support constructivist methods (including technology integration), most of the technology usage described productivity skills and delivery methods.

Like their instructors, preservice teachers were more concerned with how and why technology was used than how often it was used. “I don’t want [the instructor] to just use whatever, for the sake of it. It’s obvious and they usually don’t use it right when they do that.” Another agreed, “Yeah, they’re like ‘look at my skills, I made the words fly in to the screen!’ And I don’t care.” Preservice teachers felt that the best way for them to learn about technology was to see the ways their instructors use it first, and then use it themselves. They were enthusiastic about using it themselves, but wanted to be able to see others do it first, so they could practice. “I don’t think I could just get up there and do it. I’d have watch first, to have an example.” The preservice teachers here were describing modeling—learning by the examples set by their teachers (Harris, Mishra, & Koehler, 2009). New inservice teachers tend to rely on what they have seen in their education classrooms when they start teaching (Jackson, Gum, Jackson, & Helms, 2011). The preservice teachers said that their confidence in being able to use technology in their lessons increased when they saw their instructor or an inservice teacher do it first. The implication for teacher education here is that the research is correct: students require examples in order to use technology correctly. Still, the preservice teachers who participated in this study described technology in ways that align more with having technology literacy skills and personal skills with technology. They wanted to learn how to use tools, but did not indicate how or if these tools or their skills would be used in lessons for their future K-12 students.

Preservice teachers and instructors both voiced positive opinions about the importance of technology in teacher education, but neither felt that it needed to be front and center or used every day. Instructors saw the importance of teaching technology as a pedagogical tool, but only when the technology was appropriate and useful (i.e., not without purpose). Instructors did not consider it their duties to spend a great deal of time teaching intricate technical skills, though they were happy to introduce functionality of tools to their students. Preservice teachers did not want to see technology unless it was being used for a purpose, and were critical of instructors who used unnecessary tools.

These findings indicate that preservice and instructors—at least those who participated in this study—are somewhat educated about technology use in education, but that preservice teachers have more to learn about various teaching methods that include technology, such as technology integration. In the words of one interviewee, they are "half-way there." Both groups understand that technology should be used as part of core subject matter (not on its own, as in literacy lessons), but preservice teachers were unable to paint an accurate picture of how they would use technology in their careers, nor did they mention the outcomes to which it should lead. The research points to low integration rates and negative attitudes or misunderstood ideas of technology integration (Pitler, 2006; Walden, 2010). Negative attitudes were not observed among either sample in this study. Instructors understood more about technology in education than preservice teachers did, but may still be undervaluing (or missing) some of the finer points of how to support preservice teachers as they develop fluency with technology for pedagogical purposes.

Overall Implications

The findings of this study have led to implications for how teacher education programs would benefit from devoting more attention. The implications indicate ways to prevent preservice teachers from developing barriers to teaching with technology.

Technology Support is Important

To foster positive attitudes about technology among instructors and preservice teachers, technology needs to be up-to-date and easy to access. If technology is old or difficult for the instructors or the preservice teachers to access, neither group will be enthusiastic about its use, and may decide to avoid it all together. Consequently, a first order barrier has developed. Instructors and preservice teachers also expect support staff to be available to help them with technical issues and to answer questions about technology integration and curriculum design. Accessibility of these staff members is important if instructors and preservice teachers are to have positive attitudes about technology and integrate it in to their lessons and assignments.

Instructors Need to Foster Technology Fluency through Methods

The findings indicated that instructors thought technology use was important, but they were not entirely clear on the type of technology use (aside from knowing to avoid use without cause). Instructors described some integrated uses, and some uses through direct instruction and other methods, but descriptions were dominated by descriptions of specific uses for technology that—while useful—aligned more with technology literacy development for preservice teachers. Thus, it is important for instructors to make sure that they specify the intended outcomes of their teaching methods, and that they share their intentions with colleagues in their department. If the instructors in a preservice teacher education program agree on what preservice teachers need to know and how it should be taught to their students, the students will have an easier time developing fluency and understanding how to apply technology to pedagogical methods. It will also ensure that preservice teachers are in fact developing technology fluency. This congruency will prevent preservice teachers from forming education-related second order barriers to technology integration.

Preservice Teachers Need to Understand Outcomes of Technology in Pedagogy

In every case where the preservice teachers were asked to describe technology use in education, they described skills that they either had, or wanted to develop. Preservice teachers were very focused on their own skills with specific tools, rather than the development of fluency in their K-12 students. While preservice teachers spoke about their personal technology (literacy) skills, not one of the preservice teachers in the focus groups mentioned technology integration or any other method of teaching with technology. Three of these preservice teachers indicated that they would be learning about technology when they took the technology class that is part of their program. They felt that this class would give them the skills they needed. (Again, they were describing desires to become literate with educational technology tools—such as an *iPad*—rather than becoming versed in methods that can include technology for education.) Research indicated that when technology-inclusive teaching methods such as technology integration are separated from other methods in preservice teacher education, preservice teachers tend to think of technology as separate from the rest of education (e.g., Fleming, Motamedi, & May, 2007). The implication here is that pedagogical technology use needs to be taught and exemplified throughout preservice teacher education programs—not separated in to a separate course. The outcomes of teaching in these ways need to be stressed as well, taking emphasis off of preservice teacher literacy skill development, and placing it on K-12 educational objectives. Otherwise, preservice teachers will encounter second order barriers when they find that their beliefs about technology use in education do not match up with technology-integrated methods.

Preservice Teachers Need To Apply What They Learn

Modeling exemplary use of technology in the preservice teacher education classrooms and during the student teaching process is important: preservice teachers expressed a need to see their instructors and their student-teaching mentors use these tools properly. Instructors should however be aware that while students possess some personal experiences with technology, they may not have a lot of technical skills or interest. Furthermore, assumptions cannot be made about the personal skills students possess, since we have seen how they differ by gender and somewhat by age. However, preservice teachers of different demographic groups seemed to be aware that technology is important in education, and that they require guidance as to how and when to use technology in their lessons. Programs should be sure to include technology application opportunities for preservice teachers, as those who participated in this study retained specific memories of the tools they had used for assignments and why these tools were appropriate in those cases. They were much less accurately able to describe instances where they observed instructors teaching with technology, though they did value seeing examples before being asked to try things on their own. Through experiences with using technology pedagogically, preservice teachers will gain fluency with the technology tools. If they have this fluency as they learn about more methods, such as technology integration, they will not face barriers related to their beliefs, education, or attitudes.

Limitations

Diversity

To get a more accurate portrayal of the technology characteristics of preservice preservice teachers and their instructors, the inclusion of more institutions would be useful as well. Institutions of other sizes, and from other regions, may have faculty who subscribe to different teaching philosophies, and students who come from different backgrounds that have influenced their technology use and attitudes in positive or negative ways.

Culture

Related to diversity of the sample is the culture of the rural Midwestern region in which the study took place. This observation is purely personal, but requires mention due to some of the results of the study. People of this region of the country have an inclination to be humble when discussing their personal traits. Thus, when asked (for example) about their technology skills, they may be inclined to refer to themselves as average when in fact they may be excellent technology users. This could cause them to answer questions on their surveys—or as part of their interviews or focus groups—with responses that are not entirely accurate.

In addition to the trait of modesty, the culture of this region seems to emphasize that people should not cause trouble or raise issues. Many people are polite, but may not share the entire truth of a situation. When asked about troubles they have had, negative experiences, or other subjects that bother them, they may provide a vague or neutral answer.

The combination of these two cultural traits could be a factor when assessing the value of results like those found in Questions 1, 2, and 6. In each of these cases, the quantitative results revealed neutral-to-negative responses for instructors, preservice teachers, or both groups on some subscale of the survey. Yet when asked qualitatively about subjects related to the quantitative results, the preservice teachers and instructors were very positive, a contrast from their survey responses. There is a variety of reasons for this difference and they are described along with each question (as well as in the final conclusions of this chapter). It is important to note, however, that one reason for the discrepancy could be that the participants were modest while answering their surveys, pleasant and polite while being interviewed, or demonstrating a combination of both of these traits.

Environment

This institution renovated its education building during the 2010-2011 academic year. In the pre-renovation building, technology had been added where needed, and equipment varied in age, function, and reliability. The renovated building contains updated equipment and some new tools. Table 21 contains a comparison of the pre- and post-renovation technology capabilities of the building.

Table 21.

Pre- and Post-Renovation Technology Features of the Education Department Building

Feature	Pre-Renovation	Post-Renovation
Classroom without Technology	5	-
Smart 1 Classroom	7	-
Smart 2 Classroom	1	12
Smart 3 Classroom	-	3
IVN Classroom	1	-
Hybrid Classroom	1	6
Projector	3	11
LED/LCD Television Display	-	5
Computer Lab/Computer Classroom	2	1

Note. Types of technology are not mutually exclusive (i.e., a Smart 1 Classroom may also be a hybrid classroom and contain a projector; a computer lab may also be Smart 2).

The Smart 1, Smart 2, and Smart 3 classroom types were defined by campus administrators for use in this and other campus departments. Descriptions of these classroom types are as follows.

- Smart 1 Classroom: keypad, control system, sound system, computer, document camera, DVD/VCR
- Smart 2 Classroom: Smart 1 capabilities plus touch panel, projector, integrated system switcher, microphones, interactive pen display

- Smart 3 Classroom: Smart 1 and 2 capabilities plus dual projectors, video conferencing, dual cameras
- Hybrid Classroom: Smart 2 capabilities plus camera, audio conferencing ability, instructor and student microphones, compatibility with web conferencing applications used on the campus

Pre- and post-renovation, equipment including portable projectors, laptop computer carts, digital video devices, and *Apple iPads* were available for instructors to check out for classroom use.

Preservice teachers and instructors were surveyed in the spring of 2011, when the building was still under construction. During this period, instructor offices were scattered about the campus; some of them were working from home or from public spaces. Classes were held wherever space could be found in other departmental buildings, the university's student union, or non-academic departments' conference rooms. Preservice teacher focus groups and instructor interviews were conducted in the fall of 2011, after the renovations were complete and the new building was open. Faculty interviews took place in the new building.

A question about the building was asked during the focus groups and the interviews. The instructors generally felt that the new building will be positive, but has not yet been impactful. One instructor said it would take a year or so to get settled and that next year will be better. He expressed additional concern about a negative change: the new building has one computer lab rather than the two that were housed in the old building. Additionally, he was concerned that this lab was now locked unless a class was taking place inside; the previous computer labs allowed students to access them throughout the day. Some other concerns were that all the technology tools were not yet set up, and that instructors have not been trained regarding what all of the new technology does. One instructor found value in this situation as a learning opportunity, saying that students will encounter situations where they must improvise in a new classroom, too (so she hopes her struggles are worthwhile teaching moments). Another of the instructors thought the new building—while "nice"—would have less of an impact than the addition of wireless Internet in the building did several years ago—that had been a major positive change.

Of the preservice teachers who participated in the focus groups, two of them had been students at the university prior to the building renovations. These two had each taken at least one class in the building, and described it as "old." They were unable to recall a lot of the technology in the old building, as it had been over a year since those classes had taken place. One of these individuals said he had used the computer labs in the old building, but had not used them in the new building. "I got a new laptop this summer," he explained. Another preservice teacher in the same focus group said she had tried to use the new computer lab a few weeks prior to our conversation: "It was dark and locked up, so I went to the union [computer lab]." The preservice teachers described the new building as "modern," and "really nice." They thought the technology in the rooms was positive, though they had not used much of it themselves. "I heard they got the white boards, so I want to try that," commented one student. "The plugs in some of the desks are great," another pointed out. (Several of the rooms contain power outlets on or near each table or desk.) Other than their sentiments about the comforts of a nice, new building (including comments about the bathrooms, student lounge area, and a rumored coffee kiosk they had yet to see materialize), preservice teachers did not have many comments about how the new building affected their attitudes about technology. One said: “It’s not a majorly tech-filled building or anything, but it’s nice to have the new technology stuff in it so that our computers aren’t going to be old and slow.” Several preservice teachers agreed that the biggest improvement with the new building was: “knowing where the class is going to be…I don’t have to walk all over to find it in some random building.” This was in reference to the semesters during construction; classes related to this preservice education were held wherever space was available on campus.

Comparing the instructors’ and preservice teachers’ comments, it seems as though the new building has been more influential to the instructor attitudes about technology than the preservice teacher attitudes. Neither of the groups was in awe of the building, but preservice teachers seemed to be affected. This could be attributed a few things. First, most of the focus group participants did not attend classes in the old building—it was already closed and under construction when they arrived on campus. Thus, they have no comparison between then and now and to them, the new building is just a building. Additionally, preservice teachers spend a few hours a week in this building. Instructors received new offices in the building, and many of them spend several hours each day in the building. The instructors interviewed had each been working in the department for more than five years, so they had spent some years working from offices in the old building as well. Thus, they were able to compare and contrast the two spaces more accurately than the preservice teachers could.

The new building was considered as a limitation because it was a drastic environmental change for the study sample, and it took place in between the first phase (quantitative) and second phase (qualitative) of data collection. In asking instructors and preservice teachers about the building's influence, it was determined that the change in environment likely did not influence their responses to the survey questions or their comments during interviews or focus groups.

Future Research Opportunities

The limitations of sample diversity and regional culture were identified above: participants of this study may have unintentionally misrepresented their technology traits and attitudes due to their cultural attributes. Additionally, this university's education building underwent a complete renovation during the course of this study, receiving new equipment and technologies in the process; this event could have superficially affected the attitudes of participants in this study as well. Future research would study samples at multiple universities to avoid these possible skews or biases.

Some findings related to preservice teacher and instructor attitudes about technology indicated that perhaps attitudes were not measured in an accurate way. It was assumed that skills and interest would equate to higher attitudes, but the qualitative portion of the study indicated that this was not the case. In a future study, attitudes should be measured differently. Perhaps a different type of quantitative subscale could be used, asking participants more opinion-related questions such as "Do you like technology?" or direct questions such as "Describe your attitude about technology." Participants could also be asked what factors contribute to their attitude. To what extent does—for example—a high level of technology confidence or skill contribute to a preservice teacher's attitude about teaching with technology?

Further inquiry as to how preservice teacher coursework or college experiences could be related to their technology characteristics could also be conducted; research was scarce on this topic. It would be beneficial to see how college experiences alter preservice teachers' technology characteristics: how does their usage change? What about their level of understanding, or their attitudes toward technology? Knowing how class standing affects preservice teachers' technology characteristics as they progress through college, and pinpointing what factors are most important in developing these characteristics (e.g., coursework, peers, available services) could help teacher education programs determine where to place effort in developing technology integration understanding among preservice teachers.

An additional technology should also be included in future research: interactive whiteboards were not included as a technology tool when the survey was designed. Instructors and preservice teachers both mentioned these as important classroom tools, but the researcher was not familiar with popularity of whiteboards or their place as an integrated technology for teaching. Future research could incorporate interactive whiteboards into the study design, either as part of the quantitative technology subscale, or as a point of qualitative discussion. Possible inquiries could be made regarding how preservice teachers will be expected to use these whiteboards: is this an integrated use of technology, or a case of shaping a lesson around technology? Similar inquiries could be made regarding *Apple iPads* and other tools.

Finally, and most importantly, this study did not look to measure integration. Technology use, access, attitudes, and beliefs have been identified as indicators to whether technology will be integrated, but without observation it is impossible to know if integration is actually happening in these classrooms. It was also difficult at times to determine what instructors and preservice teachers meant when describing their technology characteristics and beliefs. Observations would also be helpful in solidifying these statements. Much of what was said about educational technology use sounded positively related to integration, but taking note of what tools are being used and why would be useful. Using the interactive white board as an example: instructors interviewed for this study referenced the need to train their preservice teachers on how to use the whiteboard; these statements bore more resemblance to technology literacy development (skills to use a whiteboard), not integration of a whiteboard into a lesson. Additionally, observations would be useful to supplement or replace self-reporting. Self-reporting is left up to the perceptions of the individuals who filled out the surveys, and other self-reporting studies have found discrepancy in how much technology use and integration teachers reported, versus how much was actually taking place (Painter, 2001). Furthermore, self-reporting put the participants of this study on the spot to recall their previous technology use and classroom experience. Actual observations could take the place of these questions, measuring actual technology exposure and use, rather than observed and reported exposure and use. With an observation tool designed to measure the presence of integration, future research could determine whether integration is actually happening, and possibly correlate these findings with what beliefs, attitudes, and technology usage were measured. In this study, there were no significant differences found in the technology characteristics of underclassmates versus upperclassmates, or pre-major students versus students with declared majors in preservice teaching. These results were found by polling individuals who were at different points in their academic experience. In contrast, a longitudinal study could follow the same group of students for the 4-5 year span of their preservice education program. This type of study would provide a more accurate picture of the changes that occur in preservice teachers' technology characteristics throughout (and perhaps as a result of) their education. It could also indicate whether preservice teachers develop first or second order barriers during the course of their education.

APPENDICES

Appendix A

Preservice Teacher Survey Instrument

Do not include your name on the survey. *(If you did not sign a consent form, please do not complete the survey!)*

Demographic Information

Age: ________ **Gender:** ○ Male ○ Female

Year in college: ○ Freshman ○ Sophomore ○ Junior ○ Senior (*includes* 5th year) ○ Other ________________

Major:

○ *Pre*-Education.

(*Choose the above if you haven't yet been admitted to the teacher ed. program, then choose your intended major below.*)

○ Early Childhood Ed. ○ Elementary Ed. ○ Middle Level Ed. ○ Secondary Ed.

○ Composite Social Science ○ Composite Science ○ Physical Education ○ Art Education

○ Music Education ○ Other Major: ________________________________

If you chose Middle or Secondary Education, please list your concentrations: ________________________

INTERNET USE

If you use the Internet, how many hours per week do you spend…	Estimated Hours:
1. Using e-mail?	
2. Chatting (i.e. MSN Messenger, or in chat rooms)?	
3. Using online banking or financial resources?	
4. Researching products, services, or news?	
5. Shopping online (including online auction sites such as eBay)?	
6. Using the Internet for school, homework, and research?	
7. Using social networking tools (i.e. Twitter, Facebook)?	
8. Watching shows, movies or clips (i.e. YouTube, Hulu)?	
9. Listening to and/or downloading music? (i.e. Pandora, Grooveshark, iTunes)	
10. Reading blogs, sports sites or other personal hobby sites?	
11. Using it for tasks related to your employment?	
12. Playing online or multi-player games?	

TECHNOLOGY USE

On average, how many hours per week do you spend…	Estimated Hours:
1. Using a computer (personal/non-work use)?	
2. Using word-processing software (i.e. MS Word, Apple Pages)?	
3. Using presentation software (i.e. MS PowerPoint, Prezi)?	
4. Using the Internet (including e-mail, chatting, and through mobile devices)?	
5. Using computers and/or the Internet as part of your job?	

TECHNOLOGY ACCESS

Do you access the Internet with…	Yes	No (I do not have this)	No (I have this, but do not use to access the Internet)
1. Your personal computer (i.e. laptop, desktop, netbook)?	○	○	○
2. A computer in a public lab (i.e. union or library computers)?	○	○	○
3. Your cell phone (i.e. Blackberry, iPhone, Droid)?	○	○	○
4. A different mobile device (i.e. iPad, Kindle)?	○	○	○
5. A video game console (i.e. Playstation, xBox, Wii)?	○	○	○

TECHNOLOGY KNOWLEDGE, INTEREST, SKILLS

Regarding technology:	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I know how to solve my own technical problems.	○	○	○	○	○
2. I can learn technology easily.	○	○	○	○	○
3. I keep up with important new technologies.	○	○	○	○	○
4. I frequently play around with technology.	○	○	○	○	○
5. I know about a lot of different technologies.	○	○	○	○	○
6. I have the technical skills I need to use technology.	○	○	○	○	○
7. I have had sufficient opportunities to work with different technologies.	○	○	○	○	○

As you answer the following questions, think about ALL of your classes within Teaching & Learning (not just the class you're in now).

Overall, how often do YOUR INSTRUCTORS use the following technologies in class?	Never	Once	Sometimes	Most Days	Every Class
1. Presentation software (i.e. PowerPoint, Prezi)	○	○	○	○	○
2. Word-processing software (i.e. MS Word, Pages)	○	○	○	○	○
3. Collaboration tools (i.e. blogs, wikis)	○	○	○	○	○
4. Internet sites (e.g. research, finding free tools)	○	○	○	○	○
5. Blackboard (e.g. materials, projects, assignments)	○	○	○	○	○
6. A/V tools (i.e. cameras, podcast tools, camcorders)	○	○	○	○	○
7. Video games (i.e. flashcards, educational games)	○	○	○	○	○

Overall, how often do YOU use the following technologies in class or to complete a class project/assignment?	Never	Once	Sometimes	Most Days	Every Class
1. Presentation software (i.e. PowerPoint, Prezi)	○	○	○	○	○
2. Word-processing software (i.e. MS Word, Pages)	○	○	○	○	○
3. Collaboration tools (i.e. blogs, wikis)	○	○	○	○	○
4. Internet sites (e.g. research, finding free tools)	○	○	○	○	○
5. Blackboard (e.g. materials, projects, assignments)	○	○	○	○	○
6. A/V tools (i.e. cameras, podcast tools, camcorders)	○	○	○	○	○
7. Video games (i.e. flashcards, educational games)	○	○	○	○	○

Do you think you are learning how to work with the technology you will need for your future career?

○ Yes. ○ No. ○ I don't know. ○ I already have the skills I need. ○ I will not need technology skills.

Appendix B

Instructor Survey Instrument

Faculty Survey

Demographic Information

Gender: ◯ Male ◯ Female

Years teaching in this department: _________

Years as a college educator: _____________

Your Area of Expertise:

◯ General; Courses for pre-majors. (e.g. TL 250)
◯ Early Childhood Education ◯ Capstone/Advisory Role
◯ Elementary Education ◯ Middle Level Education ◯ Secondary Education
◯ Composite Social Science ◯ Composite Science ◯ Physical Education
◯ Art Education ◯ Music Education ◯ Other ________________________________

TECHNOLOGY USE OUTSIDE THE CLASSROOM

Please include your personal technology use and technology used for class preparation, grading, and professional purposes, but do not include technology you may use in class. (E.g. Preparing a PowerPoint for class would be included; presenting the PowerPoint in class would be excluded.)

On average, how many hours per week do you spend...	Estimated Hours:
1. Using word-processing software (i.e. MS Word, Apple Pages)?	
2. Using presentation software (i.e. MS PowerPoint, Prezi)?	
3. Using the Internet (including e-mail, chatting, and through mobile devices)?	
4. Using computers and/or the Internet for work-related use?	
5. Using computers and/or the Internet for personal (non-work) use?	

TECHNOLOGY ACCESS

Do you access the Internet with...	Yes	No (I do not have this)	No (I have this, but do not use to access the Internet)
1. Your personal computer (i.e. laptop, desktop, netbook)?	◯	◯	◯
2. A computer in a public lab (i.e. union or library computers)?	◯	◯	◯
3. Your cell phone (i.e. Blackberry, iPhone, Droid)?	◯	◯	◯
4. A different mobile device (i.e. iPad, Kindle)?	◯	◯	◯
5. A video game console (i.e. Playstation, xBox, Wii)?	◯	◯	◯

TECHNOLOGY KNOWLEDGE, INTEREST, SKILLS

Regarding technology:	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I know how to solve my own technical problems.	○	○	○	○	○
2. I can learn technology easily.	○	○	○	○	○
3. I keep up with important new technologies.	○	○	○	○	○
4. I frequently play around with technology.	○	○	○	○	○
5. I know about a lot of different technologies.	○	○	○	○	○
6. I have the technical skills I need to use technology.	○	○	○	○	○
7. I have had sufficient opportunities to work with different technologies.	○	○	○	○	○

As you answer the following questions, think about any undergraduate courses you teach (or have recently taught in this department).

Overall, how often do YOU use the following technologies in class?	Never	Once	Sometimes	Most Classes	Every Class
1. Presentation software (i.e. PowerPoint, Prezi)	○	○	○	○	○
2. Word-processing software (i.e. MS Word, Pages)	○	○	○	○	○
3. Collaboration tools (i.e. blogs, wikis)	○	○	○	○	○
4. Internet sites (e.g. research, finding free tools)	○	○	○	○	○
5. Blackboard (e.g. materials, projects, assignments)	○	○	○	○	○
6. A/V tools (i.e. cameras, podcast tools, camcorders)	○	○	○	○	○
7. Video games (i.e. flashcards, educational games)	○	○	○	○	○

Overall, how often do you assign or expect that STUDENTS use the following technologies in class or to complete a class project/assignment?	Never	Once	Sometimes	Most Days	Every Class
1. Presentation software (i.e. PowerPoint, Prezi)	○	○	○	○	○
2. Word-processing software (i.e. MS Word, Pages)	○	○	○	○	○
3. Collaboration tools (i.e. blogs, wikis)	○	○	○	○	○
4. Internet sites (e.g. research, finding free tools)	○	○	○	○	○
5. Blackboard (e.g. materials, projects, assignments)	○	○	○	○	○
6. A/V tools (i.e. cameras, podcast tools, camcorders)	○	○	○	○	○
7. Video games (i.e. flashcards, educational games)	○	○	○	○	○

TECHNOLOGY IMPORTANCE

How important do you think it is for your students to SEE technology used by instructors in their teacher education classes?

◯Not At All Important ◯Not Very Important ◯Neutral ◯ Somewhat Important ◯Very Important

How important do you think it is for your students to USE technology for assignments or projects in their teacher education classes?

◯Not At All Important ◯Not Very Important ◯Neutral ◯ Somewhat Important ◯Very Important

How important do you think each of these types of technology tools is for teaching and learning in an education classroom?	Not At All	Not Very Important	Neutral	Somewhat Important	Very Important
1. Presentation software (i.e. PowerPoint, Prezi)	◯	◯	◯	◯	◯
2. Word-processing software (i.e. MS Word, Pages)	◯	◯	◯	◯	◯
3. Collaboration tools (i.e. blogs, wikis)	◯	◯	◯	◯	◯
4. Internet sites (e.g. research, finding free tools)	◯	◯	◯	◯	◯
5. Blackboard (e.g. materials, projects, assignments)	◯	◯	◯	◯	◯
6. A/V tools (i.e. cameras, podcast tools, camcorders)	◯	◯	◯	◯	◯
7. Video games (i.e. flashcards, educational games)	◯	◯	◯	◯	◯

Please rate your knowledge of available classroom and teaching technologies in comparison with that of the students you encounter in your teacher education classes.

◯Students are much more knowledgeable than I am.
◯Students are a slightly more knowledgeable than I am.
◯We are equally knowledgeable about educational technology.
◯Students are slightly less knowledgeable than I am.
◯Students are much less knowledgeable than I am.

Do you think your students are learning how to work with the technology they will need when they become educators?

◯Yes. ◯No. ◯I don't know. ◯ They already have the skills they need. ◯ They will not need technology skills.

Appendix C

Consent Form for Preservice Teacher and Instructor Participation

Consent to Participate in Research

Title of Study: *Analysis of Preservice Teacher and Instructor Technology Beliefs and Uses*
Study Investigator: Adrienne Salentiny, M.S.

You are invited to participate in research that will look at students' use of technology in comparison to their choice of college major. The researcher would like your help because your opinions and knowledge may be helpful to her and to the research on this topic. Your participation is voluntary. Students from your class any many others around campus are being asked to participate.

THE PURPOSE OF THIS STUDY
The purpose of this study is to find out if and how students use technology and whether this affects what they study in college. This study is being done as a part of the researcher's doctoral program. The researcher will write about the findings from the study and may also use what she learns from this study to form more studies relating to this subject.

YOUR PARTICIPATION
Everyone in your class will be given a survey. If you did choose to participate, please fill it out. If you did not, please indicate this on the survey or leave the survey blank. After about 10 minutes, everyone will be asked to pass in their surveys, whether they have chosen to complete it or not. You should not write your name or identifying information on the survey. Your answers on the survey will not be matched to you or this consent form, but the researcher may contact you at a later time to request participation in a focus group or a brief interview. If you are willing to participate in a focus group or a brief interview about these topics, please check the box on this consent form.

YOUR PRIVACY
The data collected in this study will be used to support the researcher's doctoral work, and possibly in journal articles. No person's survey answers will be singled out for discussion at any time. You are asked not to provide a name on your survey. The consent forms will be stored separately from the surveys. If you are interviewed or choose to participate in a focus group, your identity will not be tied to any comments you provide. Any audio recordings of your comments will be stored in a secure place, and you will be given a pseudonym if your comments are used in the dissertation or related articles.

THE RISKS
Many steps are made to ensure privacy, but there is a risk of loss of confidentiality if your identity is accidentally revealed. This could cause you to be embarrassed or uncomfortable. If survey questions make you uncomfortable, you can choose not to answer these questions. Counseling information will be available if you have bad feelings, but no money from the study or the researcher is available to pay for these services.

THE BENEFITS
There are no direct benefits to you for participating in the study. But, your participation in the study may help the researcher learn about technology, education and possible good uses for technology within education.

PAYMENT FOR PARTICIPATION
No person in this study will receive payment for participation.

YOUR RIGHTS TO PARTICIPATE (OR NOT)
Your choice to participate in the study is voluntary. You may decide that you do not want to participate. If you decide to be in the study, you are allowed to change your mind at any time. Your decision to participate (or not) in this study will not affect any relationships you may have with others on campus. You will not receive extra credit in your course, nor will you be reprimanded as a result of your choice whether or not to be in the study. You are not required to attend an interview or focus group, even if you check the box consenting to be contacted about it.

QUESTIONS
If you have questions about the study, please contact the researcher, Adrienne Salentiny, at (701) 777-3448 or by E-mail (adriennesalentiny@mail.und.edu). If you have questions about your rights as a research participant, or if you have any concerns or complaints about the research, you may contact the University of North Dakota Institutional Review Board at (701) 777-4279. Please call this number if you cannot reach Adrienne Salentiny, or if you wish to talk with someone else.

Authorization to participate in the research study:

I have read the information in this consent form, had any questions answered, and I voluntarily agree to take part in this study. I have been given a copy of this consent form.

____

Participant's PRINTED Name

__________________________________ __________________

Participant's Signature Date

☐ *Yes, I am willing to be contacted and participate in an interview or focus group.*

__________________________________ __________________

Signature of Investigator Date

Appendix D

Qualitative Questions for Preservice Teacher Focus Groups

1. Can you describe technology? When I say "technology," what do you picture?
2. What kind of influence do you think technology has on your life overall? (A big one? A small one? Positive? Negative?)
3. What's your favorite type of technology?
    a. How often do you use it?
    b. Why do you use it? (For fun, for school, etc.)
    c. How did you learn the skills to use it? Can you think of any ways you could, or have used use those skills to do other things?
4. If you have ever had a job, or if you have one now, can you tell me if you used any technology for work?
    a. What was the purpose of the technology?
    b. How did you learn the skills for it? Can you think of ways you could, or have used those skills to do other things?
5. Do you remember if your teachers used technology tools in high school or elementary school?
6. What—if anything—do you think technology use adds to kids' learning experiences?
7. Do you think it is important for education majors to have good technology skills before they start taking classes in the program? How about after they graduate? Why or why not?

8. What expectations did you have—if any—about whether technology would be involved in your major? Was the technology they might use or teach you about a factor in your major choice?
9. What do you think of your own technology skills? Can you describe them? What kinds of things are you comfortable doing with technology?
10. Do you have friends or know people who are in other majors? Anyone that stands out as a really techie person?
    a. What kind of things do you think they can do with technology—and what major are they in?
    b. Do you think the tech use is personal? Or is it because of their major that they use it more?
    c. Do you think people learn more about technology in other majors than they do in yours?
11. How about your guy friends versus your girl friends. Do you think the girls or the guys have more technology skills, or is it more of a mixture?
12. What do you think about the amount of technology being used—and how it is being used—in your program? Would you like to see more/less technology use?
13. Were you in this program last year? If so, what do you think of the new building? Do you think it has changed anything about the way you think about education and technology? Do you think it might change the way your instructors think about technology?
14. What kinds of technology have you seen used, or had to use yourself, as part of your program?

a. Were you already familiar with it?
b. Did you need to get help with it, and if so, was adequate help provided?
c. Did you like using it?
d. Could you see yourself using it as a future teacher?

15. Have you taken the Technology for Educators class—or do you plan to?
    a. If yes, can you describe what you learned? Do you think you'll apply it in the classroom?
    b. If no, what do you hope you'll learn/why are you taking the class?
16. What are some of the reasons you think your instructors have for using technology in the classroom, or for giving assignments that use it?
17. Do you think your instructors are comfortable with technology use? Do they portray any sort of attitudes about technology?
18. Describe a typical class session where your instructor uses technology. (If you are in Technology for Educators, please describe a different class if you can.)
    a. What does the teacher do?
    b. What do students do?
19. Do your instructors have any rules about technology use? (Against or for it)
20. Who do you think uses computers and the Internet more often overall: your instructors, or you and your classmates? [Faculty did, by far.]
    a. What do you think about that? What kinds of things do you think they do with it?
21. Where would you guess that your average classmates stand as far as how tech savvy they are? [They're neutral/disagree…not very savvy].

a. What do you think about that?

b. Are there things you think your program should do to change that? Or things the individuals should do?

22. Do you think your instructors think of you as tech savvy?

When you become a teacher, do you think you'll use any technology in your classroom? Can you describe a situation where you would/wouldn't?

Appendix E

Qualitative Questions for Instructor Interviews

1. Can you describe technology? When I say "technology," what do you picture?
2. What kind of influence do you think technology has on your life overall? (A big one? A small one? Positive? Negative?)
3. What's your favorite type of technology?
    a. How often do you use it?
    b. Why do you use it? (For fun, for work, etc.)
    c. How did you learn the skills to use it? Can you think of any ways you could, or have used use those skills to do other things?
4. Do you think it is important for education majors to have good technology skills before they start taking classes in the program?
    a. How about after they graduate? Why or why not?
    b. Do you think your students meet those expectations?
5. Do you have any rules about technology use in class, by students? (Against or for it)
6. Describe a typical class session where you use technology: what do you do, and what what do students do?
7. What do you think of the new building? Do you think it has changed anything about the way you think about technology? Do you think it might change the way your students think about education and technology?
8. Do you give assignments that involve technology? Why or why not? What are considerations you would have if you were thinking of giving such an assignment?

9. What kinds of technology have you used when teaching?
    a. What were your reasons for using it, versus using non-tech methods?
    b. Were you already familiar with it before using it to teach?
    c. Did you need to get help with it, and if so, was adequate help provided?
    d. Did you like using it, and could you see yourself using it again?
10. Are there certain tools you think are particularly useful for teaching? How about some you think are not as useful?
11. Do you think your students are comfortable with technology use? Do they portray any sort of attitudes about technology?
12. Who do you think uses computers and the Internet more often overall: faculty, or students?
    a. How do you think their use differs from yours?
13. What do you think of your own technology skills? Can you describe them? What kinds of things are you comfortable doing with technology?
    a. How about your fellow instructors—are they a tech-savvy bunch?
14. What kind of opinion do you think your students have about your tech skills?
15. Where would you guess that your average students stand as far as how tech savvy they are?
    a. What do you think about that?
    b. Are there things you think your program should do to change that? Or things the individuals should do on their own?

16. Over time, and thinking of students you've taught in past years, do you think students' attitudes and skills related to technology have changed? If so, how? And what do you think the reasons are?
17. Describe what you think the best environment would be for students to learn about teaching with technology.
18. After they graduate and get jobs, do you think the students will use technology in their classrooms if it is available? Why or why not?
19. What—if anything—do you think technology use adds to kids' learning experiences at the elementary/high school level? Should your students be striving to use it as they become teachers?

Appendix F

Instructor Comments from Survey Instrument

1. They need to learn how to work with interactive whiteboards - these are prevalent in K-12 education now, and there is a learning curve. Also, learning about safe and free blogging sites are also important so students can stay motivated (they contribute to self-esteem when the kids see their own writing being "published"). Finally, children use games much more so than our generation, and there needs to be an openness in teachers' philosophy to embrace the use of these games in educating children; they are motivating and highly engaging, and teachers need to understand how they can be used to the children's learning benefit rather than using them as a reward for finishing worksheets, etc.

2. I think the building renovations related to technology along with faculty development will address the final question in this survey. [*Researcher's note: the final question was "Do you think your students are learning to work with the technology they will need when they become educators?"*]

3. Continue to help faculty become more confident! Thanks!

4. We are not teaching them how to use Smartboards.

5. My "age and stage" factor into my lack of interest in becoming more technologically savvy. Another factor is that a great deal of my time is absorbed in research and writing and helping my doc students in this endeavor. With a personal life filled with obligation as well, I have a difficult time motivating myself to chat on the internet, get a smart phone....to stay connected. I am already TOO connected!

6. I think students are learning some of the technology they will need, but I don't know what is going on in courses besides my own. In my courses I expose students to internet resources for teaching reading and writing, but many times the undergraduates don't have the vision for it until they are in the field.

7. I agree that learning to use available technologies is important. However, educators should be reminded that good teaching and learning practices do not always have to include the use of technology.

Appendix G

Variable Names used in Preservice Teacher Survey Data Analysis

Variable Name	**Variable Description**
Age	Age in years
AgeCollapsed	Age in years, grouped into 4 groups
AgeCollapsedMore	Age in years, grouped in to 2 groups
Gender	Male or Female
Year	Year in college (class standing)
YearCollapsed	Year in college, grouped into 2 groups.
PreMajor	Student is or is not a pre-major
Major	Primary college major of study
MajorCollapsed	Major grouped in to 4 groups by what age of children they will teach, and ‘other’.
MajorEdu	Student is or is not a preservice teacher
NetEmail	Hours per week of email use
NetChat	Hours per week chatting online
NetBank	Hours per week banking online
NetResearch	Hours per week doing product research, reading news, etc. online
NetShop	Hours per week shopping online
NetSchool	Hours per week doing school work online
NetSocial	Hours per week using social networking tools
NetVideo	Hours per week watching online videos or TV

NetMusic	Hours per week listening to music online
NetHobbies	Hours per week looking at hobby websites
NetWork	Hours per week using the Internet for work
NetGames	Hours per week playing online games
NetTotal	Total hours per week using above types of internet use
TechComptr	Hours per week using a computer
TechWord	Hours per week using word-processing software
TechPPT	Hours per week using presentation software
TechWWW	Hours per week using the Internet
TechWork	Hours per week using a computer at work
TechTotal	Total hours per week using the above types of technology
AccessPC	Ownership and Internet access with a personal computer
AccessLab	Ownership and Internet access in a public lab
AccessPhone	Ownership and Internet access with a mobile phone
AccessPad	Ownership and Internet access with a different mobile device
AccessConsole	Ownership and Internet access with a game console
AccessScore	Total of access/ownership 'points'
KnowSolve	Agree with ability to solve technical issues
KnowLearn	Agree with ability to learn new technologies
KnowKeepup	Agree with ability to keep up with new technologies
KnowPlay	Agree with ability to play with technology
KnowVariety	Agree with knowing a variety of different technologies
KnowSkills	Agree with having adequate technical skill level

KnowOpp	Agree with having opportunities to use technology
KnowScore	Total of knowledge-related 'points'
InstrPPT	Have seen instructors use presentation software
InstrWord	Have seen instructors use word-processing software
InstrCollab	Have seen instructors use collaboration tools
InstrWWW	Have seen instructors use the Internet
InstrBB	Have seen instructors use *Blackboard*
InstrAV	Have seen instructors use audio-visual tools
InstrGames	Have seen instructors use video games
InstrScore	Total report of instructor technology use for class 'points'
StuPPT	Have used presentation software in/for class
StuWord	Have used word-processing software in/for class
StuCollab	Have used collaboration tools in/for class
StuWWW	Have used the Internet in/for class
StuBB	Have used *Blackboard* in/for class
StuAV	Have used audio-visual tools in/for class
StuGames	Have used video games in/for class
StuScore	Total student technology use for class 'points'
CareerSkills	Whether students think they are prepared for career

Appendix H

Variable Names used in Instructor Survey Data Analysis

Variable Name	**Variable Description**
Gender	Male or Female
YearsAsEdu	Years as a college educator
YearsAtDept	Years in this department at this university
TechComptr	Hours per week using a computer
TechWord	Hours per week using word-processing software
TechPPT	Hours per week using presentation software
TechWWW	Hours per week using the Internet
TechWork	Hours per week using a computer at work
TechTotal	Total hours per week using the above types of technology
AccessPC	Ownership and Internet access with a personal computer
AccessLab	Ownership and Internet access in a public lab
AccessPhone	Ownership and Internet access with a mobile phone
AccessPad	Ownership and Internet access with a different mobile device
AccessConsole	Ownership and Internet access with a game console
AccessScore	Total of access/ownership ‘points’
KnowSolve	Agree with ability to solve technical issues
KnowLearn	Agree with ability to learn new technologies
KnowKeepup	Agree with ability to keep up with new technologies
KnowPlay	Agree with ability to play with technology
KnowVariety	Agree with knowing a variety of different technologies

KnowSkills	Agree with having adequate technical skill level
KnowOpp	Agree with having opportunities to use technology
KnowScore	Total of knowledge-related ‘points’
InstrPPT	Have seen instructors use presentation software
InstrWord	Have seen instructors use word-processing software
InstrCollab	Have seen instructors use collaboration tools
InstrWWW	Have seen instructors use the Internet
InstrBB	Have seen instructors use *Blackboard*
InstrAV	Have seen instructors use audio-visual tools
InstrGames	Have seen instructors use video games
InstrScore	Total report of instructor technology use for class ‘points’
StuPPT	Have used presentation software in/for class
StuWord	Have used word-processing software in/for class
StuCollab	Have used collaboration tools in/for class
StuWWW	Have used the Internet in/for class
StuBB	Have used *Blackboard* in/for class
StuAV	Have used audio-visual tools in/for class
StuGames	Have used video games in/for class
StuScore	Total student technology use for class ‘points’
ImportantToSee	Importance of students seeing technology use in class
ImportantToUse	Importance of students using technology in class
PPTImportance	Importance of educational tech: presentation software
WordImportance	Importance of educational tech: word-processing software

CollabImportance	Importance of educational tech: collaboration tools
WWWImportance	Importance of educational tech: Internet
BbImportance	Importance of educational tech: *Blackboard* LMS
AVImportance	Importance of educational tech: audio/visual tools
GamesImportance	Importance of educational tech: video games
FacKnowVsStuKnow	Students are more or less tech-savvy than instructors
StuCareerSkills	Whether students think they are prepared for career
QualComment	Text box: faculty encouraged to enter comments

Appendix I

Preserve Teacher Survey Majors and Numerical Representations

Majors in the Sample	**Assigned Number**	**Majors Outside the Sample**	**Assigned Number**
Early Childhood Edu.	1	Undecided	0
Elementary Edu.	2	Marketing	51
Middle School Edu.	3	Liberal Arts	52
Secondary Edu.	4	Comm. Sci. & Disorders	53
Music Edu.	5	Music Therapy	54
Composite Social Sci. Edu.	6	Business	55
Physical Edu.	7	Nursing	56
Instructor	100	Human Dev. & Family Sci.	57
		Criminal Justice	58
		Community Nutrition	59
		Entrepreneurship	60
		Rehab. & Human Services	61
		Speech Pathology	62
		Occupational Therapy	63
		Phys. Exercise Sci. & Wellness	64
		Social Work	65
		Accounting	66
		Psychology	67
		Biology	68
		French	69
		Spanish	70
		Communication	71
		Flight Education	72
		Social Science	73
		Commercial Aviation	74
		Pre-Mortuary Science	75
		History	76
		Math	77
		Chemistry	78
		Air Traffic Control	79

Appendix J

Codes, Categories, and Themes used for Qualitative Data Analysis

Category: Assumptions
*(**Contributes to themes**: Positive Attitude, Meaningful or Integration, Literacy)*
Codes:

- IT Person: references to technical problems someone else's job to understand.
- Support: references to support staff, resources, and avenues
- Prediction: references to future technology and technology use
- Us and Them: references to things one group (e.g., faculty) thinks about another group (e.g., students)

Category: Barriers
*(**Contributes to theme**: Positive Attitude)*
Codes:

- Barrier: references to problems or negative issues with technology
- Money: references to costs, payment or money
- Negative: references to negative aspects of technology

Category: Change
*(**Contributes to themes**: Positive Attitude, Meaningful or Integration)*
Codes:

- Building: references to the newly renovated department building, reopened in fall 2011.
- Changing: references to changes over time, or how technology has changed things.
- Tactile: references to non-technology tools or activities, or points asserting value of non-technology tools or activities

Category: Demographic
*(**Contributes to themes**: Positive Attitude, Meaningful or Integration)*
Codes:

- Digital native: references to students as being techie or 'part of that generation'
- Gender: references to male or female students

Category: Literacy or Fluency
*(**Contributes to themes**: Meaningful or Integration, Literacy)*
Codes:

- Skills: references to technology skills
- Workshop: references to technology-related professional development

Category: Integration
*(**Contributes to theme**: Meaningful or Integration)*
Codes:

- Integration: references to technology use in context
- Transfer: references to preservice teachers practicing technology behaviors they have seen instructors model

Category: Preservice Education
*(**Contributes to themes**: Positive Attitude, Meaningful or Integration)*
Codes:

- Field: references to student-teaching experience
- Modeling: references to instructors exemplifying technology behavior
- Pedagogy: references to teaching or learning
- Philosophy: references to teaching styles
- Value: references to the importance of technology as part of education (either for preservice teachers, or for K-12 students)

Category: Tech Tools
*(**Contributes to themes**: Positive Attitude, Meaningful or Integration, Literacy)*
Codes:

- Blackboard: references to the learning management system used by the department for online access to materials
- Internet: references to the Internet
- Not technology: references to devices, programs, other entities the subject does not think are technology
- Positive: references to positive aspects of technology
- Technology: references to devices, programs, other entities the subject thinks are technology
- Whiteboard: references to interactive whiteboards (or *SMART boards*)

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