# Investigating the Practices in Teacher Education that Promote and Inhibit Technology Integration in Early Career Teachers

Aimee Michelle Brenner

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Jennifer M. Brill (Chair)

John K. Burton

Patricia P. Kelly

Barbara B. Lockee

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**Abstract**

In an attempt to promote the transfer of technology integration knowledge and skills in preservice teachers, studies have attempted to identify effective instructional technology integration practices on the part of the teacher education program, as well as exemplary programs themselves (Hofer, 2005; Mergendoller, Johnston, Rockman, & Willis, 1994; Strudler & Wetzler, 1999). A significant number of studies focus on examining various components of technology integration plans within teacher education programs, but few have extended this examination to determine if transfer is evidenced in the practices of graduates. The purpose of this study, therefore, was to identify instructional technology integration strategies and practices in preservice teacher education that contribute to the transfer of technology integration knowledge and skills to the instructional practices of early career teachers.

This study employed a two-phase, sequential explanatory strategy, where quantitative data were collected via an online survey during the first phase and then interview data were collected during the second phase. The targeted sample population for this research study consisted of male and female early career teachers who had completed a graduate level teacher education program through the School of Education (SOE) at a large, research university located in the Southeast. Overall, these early career teachers assessed themselves as being proficient users of instructional technologies and feeling comfortable with their level of technology integration in the classroom. Out of nine qualities demonstrated in literature to promote learning transfer of technology integration knowledge and skills, the early career teachers reported the top

three factors found in the study institution to be: the modeling of effective uses of technology integration by faculty in content-specific areas; opportunities to reflect upon technology integration practices in the classroom; and opportunities to practice and experiment with instructional technologies.

The early career teachers reported the three top barriers inhibiting technology integration in their classrooms as being: too much content to cover; lack of time to design and implement technology-enhanced lessons; and a lack of software resources. Although a majority of the early career teachers reported that the teacher education program overall prepared them to integrate technology into the classroom, they also reported that opportunities to practice technology integration and having access to expert guidance during their field experiences were lacking. Several suggestions were made by study respondents and these included: providing more opportunities to experiment and play with instructional technologies like SmartBoards; faculty support with regards to implementing and practicing with technology integration in field experiences; and technology courses that focus on up-to-date instructional technology tools within each of the content areas.

Findings from this study might be useful to teacher educators and researchers because it provides naturalistic recommendations (Stake, 1995) on how to improve their programs that are corroborated by the literature, and it offers an adapted survey that can be utilized to investigate technology integration transfer from the teacher education period to the early classroom practice period of new teachers.

## Dedication

This dissertation is dedicated to my parents, Randy and Darlene Ratliff, my daughter Kameryn Alexis Brenner, and to the memory of my late grandparents, Harold and Marion Ratliff.  I am who I have become because of these special individuals.  I love them each profoundly.

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There are many individuals who have contributed to the successful completion of my Ph.D. journey. It has been an arduous, yet richly rewarding journey.

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*In Memoriam:* I dedicated this dissertation to my late grandparents, Harold and Marion Ratliff. These two special individuals were so important to me growing up and I really feel that I lost them way too early. Although it's been over 20 years since I've been able to visit with them, I still think about them daily. They made me feel important and special at a young age. I think that the way they treated me instilled an attitude that I could accomplish anything I set my mind. I know they are proud of me and I can't wait to see them again someday.

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## Chapter One: Introduction and Need for the Study

In the early 1990's, personal computers and the introduction of the Internet changed the face of how instructional technology could be utilized in K-12 classrooms (Stallard & Cocker, 2001). As part of a response to this, the federal government introduced the Preparing Tomorrow's Teachers to Use Technology (PT3) initiative in 1993 (Preparing Tomorrow's Teachers to Use Technology, n.d.). PT3 dedicated grant monies to innovative projects occurring in teacher education programs, where efforts were made to revamp existing programs in order to infuse technology, with the hope that preservice teachers might gain the needed knowledge and skills to integrate technology into their classrooms upon graduation (Preparing Tomorrow's Teachers to Use Technology, n.d). Subsequently, a significant number of colleges and universities with teacher education programs set about developing projects to more comprehensively integrate technology into their programs.

Teacher education programs were further encouraged to rethink their technology integration plans because of the International Society for Technology in Education's (ISTE) release of the National Educational Technology Standards for Students (NETS*S) in 1998 and the National Educational Technology Standards for Teachers (NETS*T) in 2000 (ISTE, n.d.). Since then, both sets of standards have been revised and re-released to meet the rapidly progressing landscape of digital technologies in our society (ISTE, n.d.). Niederhauser, Lindstrom and Strobel (2007) stated the NETS has "provided a vision of technology integration that promoted active student learning and engagement in higher-order thinking as they used technology to increase productivity, solve problems, conduct research, and communicate with others" (p. 485).

According to Dias and Shoffner (2003), another significant influence that has affected the manner in which teacher education programs think about and implement technology integration into their programs has been the national focus on standards-based education, which began at the state level, but then materialized into the No Child Left Behind Act of 2001 (NCLB). NCLB calls for increased accountability in school districts, as well as increased funding to those districts that demonstrate a need for support in meeting these goals (Dias & Shoffner, 2003). Because research supports the idea that technology can support student learning and improve achievement, utilizing instructional technologies in the K-12 classroom has become even more of a focus (Wenglinsky, 2005).

The primary goal of the technology infusion projects born out of these initiatives was, and still is, to produce methodology within the teacher education program structure and practice that promotes the transfer of technology integration knowledge and skills to the K-12 classroom, where technology is utilized to support student learning and achievement (Lei, 2009). From a review of relevant literature, it can be deemed that a respectable amount of research over the past five to ten years has focused on evaluating the sometimes dramatic changes brought to teacher education with regards to technology infusion, methodology and effective instructional practice. Studies have focused on measuring preservice teachers' perceptions of technology, usage of technology, comfort level with technology, efficacy with and knowledge of technology (Atkins & Vasu, 2000; Grable, Osborne, & Corbell, 2006; Nierderhauser & Perkman, 2008; Swain, 2006). From these types of studies, researchers have tried to extrapolate whether they think transfer with regards to technology skills and knowledge will likely take place once preservice teachers have their own classrooms (Brown & Warschauer, 2006; Howard, 2002; Sexton, Gordon, & Guimond, 2009; West & Graham, 2007; Williams, Foulger, & Wetzel, 2009).

Perkins and Saloman (1988, 1994) defined transfer of learning as a process that takes place when learning in one situation and with one set of resources affects the learning outcomes in another situation with similar or related resources. Promoting positive transfer involves the "flexible use of knowledge and skills" and is "the fundamental goal of teaching, because contexts and purposes change, and people are severely handicapped if they do not adapt their past learning to new circumstances and intentions" (Butterfield & Nelson 1989, p. 5). Negative transfer takes place when learning in one situation does not aid or even inhibits the learning success in another context (Perkins & Saloman, 1994)

Bruner (1966) contended, one of the main goals of any type of learning is to master new knowledge or skills in such a manner that when similar, subsequent tasks or situations are encountered by the learner, the learner is not required to relearn the material completely in order to master the new task or situation. Educators want the knowledge and skills that students acquire within the classroom setting to be applicable and transfer to settings outside of the classroom to the workplace and beyond (Greeno, Collins, & Resnick, 1996). So, for example, if one goal of a preservice program is for students to master the integration of SmartBoard technologies in the classroom, graduates should feel confident independently using these technologies in their own teaching spaces without retraining.

Further, Butterfield and Nelson (1989) stated that a major task of the educational system is to employ the development of "experiences to evoke representations of critical elements so that selected knowledge and skills will be relevant to current problems" (p. 17). That is, teachers retain the responsibility of not only teaching content-related knowledge and skills, but to scaffold the learning process for students in such a way, that they can apply previous knowledge to new problems or situations, even though they may not be similar. Unfortunately, research on transfer has demonstrated that this process often fails, establishing it as a major educational issue that exists still today (Saloman & Perkins, 1988).

**Need for the Study**

In an attempt to promote transfer of technology integration knowledge and skills in preservice teachers, studies have attempted to identify effective instructional technology integration practices on the part of the teacher education program, as well as exemplary programs themselves (Hofer, 2005; Mergendoller et al., 1994; Strudler & Wetzler, 1999). Features common to many of the "best practice" programs showcased included: technology training for preservice teachers that began in the content-specific methods and instructional technology courses, and included technology skills training and models of technology integration by faculty; opportunities for students to develop their own technology projects to support learning and teaching; and time for the students to reflect upon technology integration processes in order to encourage critical thinking skills regarding their choices (Brush, et al., 2003; Brush & Saye, 2009; Keeler, 2008).

A review of the literature for instructional practices or programs that have been successful in producing teachers who utilize technology in their classrooms to support student learning appears to be limited. Many of these programs have not actually followed early career teachers into their second through fourth year of teaching to explore their teaching practices with regards to technology integration in order to provide evidence of positive transfer; indicating a gap within this research realm. Further research could potentially provide teacher educators with valuable information with regards to technology instruction for preservice teachers. Figure 1 illustrates, in summary fashion, the forces influencing technology integration in preservice education and the need for more research to describe the current state of knowledge and skill transfer in the practices of teacher education graduates

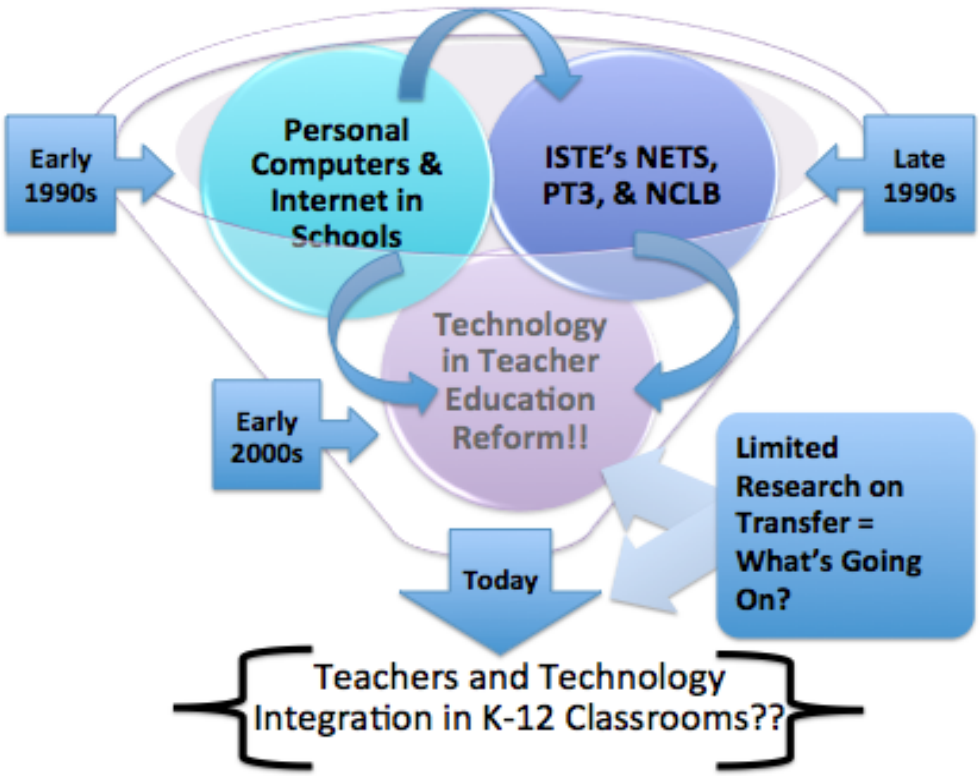


*Figure 1.* Factors that contributed to the need for the present study

**Purpose Statement of the Study**

The purpose of this study was to identify instructional technology integration strategies and practices in preservice teacher education that contribute to the transfer of technology integration knowledge and skills to the instructional practices of early career teachers. The rationale for the study can be summarized as follows. First, technology integration at the teacher education program level, as well as the K-12 level, has become vitally important with the rapid growth of digital technologies in society. New teachers need the knowledge and skill set to utilize technology in their classrooms to support student learning and enables K-12 students to become media literate and productive citizens of a technology-infused society. Second, because of the increased focus on standards-based education, as evidenced through ISTE's NETS and NCLB, a significant amount of money has been spent through government initiatives like PT3, federal and state grants, as well as private foundations and business partnerships to fund the development of technology infused teacher education programs. Finally, a review of the literature with regards to instructional practices within teacher education programs that promote positive transfer of technology knowledge and skills to K-12 classrooms by their graduates appears to be limited. A significant number of studies focus on examining various components of technology integration plans within programs, but few have extended this examination to determine if transfer is evidenced in the practices of graduates.

**Research Questions**

In support of this study's stated purpose, the following research questions focus on identifying instructional technology integration strategies and practices in preservice teacher education that promote or hinder the transfer of technology integration knowledge and skills to the K-12 classrooms of early career teachers:

- How do early career teachers assess themselves with regards to technology integration knowledge, skills, and practices?
- What technology integration barriers do early career teachers manifest or experience? What are the identified sources of these barriers?
- What practices in their preservice teacher education do early career teachers identify as supportive or prohibitive of technology integration in the classroom?

**Benefits of this Study**

The study would benefit teacher education programs in three ways. First, the study would provide scholars with empirical findings regarding technology integration strategies in teacher education that support or hinder the transfer of new knowledge and skills to the classroom practices of early career teachers. Second, the study would provide preservice teacher education faculty with recommendations on how to improve their programs. Third, the study would offer an adapted survey that can be utilized by other researchers to investigate technology integration transfer from the teacher education program level to the classroom practices of early career teachers.

**Organization of the Study**

Chapter One provides background information for the study and introduces the major issues related to the study; the need for the study; the purpose statement; research questions; potential benefits; and organization of this document.

Chapter Two draws on the literature to detail the major issues informing the study and is divided into three sections. The first section focuses on the history of instructional technology in K-12 education. This section traces the evolution of instructional technology from about World War II to the present time. The second section of this chapter chronicles best practices with regards to technology integration training within teacher education programs over the past two decades. The third section of this chapter more fully explores the notion of learning transfer: its origins, conditions and theoretical perspectives. Following a more generalized exploration of transfer, the chapter explores transfer in dealing with preservice technology training and the promotion of positive transfer to real classrooms.

Chapter Three provides a descriptive account of the methodology that was employed to execute the study. The purpose statement and research questions are reiterated first. Next, the study design, site selection, research participants, and selection criteria are explained. Following these topics, the pilot study is discussed, as well as the instrumentation, and data collection procedures.  The chapter concludes with an examination of the data analysis techniques utilized for this research study.

Chapter Four accounts for the findings revealed through the survey and interview data. The survey data are presented first and organized by each of the three research questions.  The first research question deals with how the early career teachers rated themselves.  The second deals with identified barriers to technology integration, and the third deals with practices that support and inhibit technology integration.  The interview data is presented next and is also organized by each research question.  The interview data phase also includes a discussion of useful and less useful technology applications.  Chapter Four concludes with recommendations made to the SOE by the interviewees.

Chapter Five presents a brief review of the study, as well as an exploration of conclusions and interpretations with regards to early career teachers' perceptions of the technology integration knowledge and skills developed during their preservice teacher education; the barriers to technology integration once teaching in their classrooms; the preservice teacher education practices supportive and inhibitive of technology integration transfer; and the value of instructional technology as a useful tool to support learning.  The chapter concludes with detailing the limitations of the study, as well as recommendations for future research and practice.

## Chapter Two: Review of Literature

The purpose of this study is to identify instructional technology integration strategies and practices in preservice teacher education that contribute to the transfer of technology integration knowledge and skills to the instructional practices of early career teachers. Chapter Two examines the literature related to this research study, and is divided into three sections. The first section focuses on the history of instructional technology in K-12 education. This section traces the evolution of instructional technology from about World War II to the present time. Specifically, this section highlights instructional film and the visual education movement; the audiovisual movement and instructional radio; instructional television; programmed instruction; instructional systems design; computers in the classroom; and concludes with the digital age and its influence on the current state of education. The section ends with a discussion of what has been learned by examining the historically significant events within the evolution of instructional technology.

The second section of this chapter chronicles best practices and exemplary models with regards to technology integration training within teacher education programs over the past two decades. Specifically, this section takes a closer look at barriers that affect technology integration in teacher education programs; conditions that foster acceptance of technology in teacher education programs; best practices for technology integration training for professional development and for preservice teachers; and concludes with a discussion of the most prominent characteristics of exemplary teacher education programs.

The third section of this chapter provides an exploration of knowledge and skill transfer in the process of learning. The section commences with a discussion of the origins of transfer; conditions for positive and negative transfer; and the varying theoretical perspectives of transfer.

Following this discussion, learning transfer is then examined through the lens of technology integration knowledge and skills from preservice teacher education training to the classrooms of teacher education graduates. Specifically, barriers that inhibit the transfer of technology integration knowledge and skills, as well as practices that promote the transfer of these knowledge and skills, are examined. The conclusion of this section includes a survey of technology integration studies that have focused on learning transfer. The chapter concludes with an overall summary of these three sections. A history of instruction technology in K-12 education follows in the next section.

**History of Instructional Technology in K-12 Education**

The development and integration of instructional technology into the American educational system and its transformation into what it has become today, dates back to the early part of the twentieth century and has been described as a "post-Second World War phenomenon" (Ely, 2008, p. 245). Literature reveals that the term instructional technology has transitioned through many different definitions; however, Seels and Richey (1994) defined instructional technology as "the theory and practice of design, development, utilization, management and evaluation of processes and resources for learning" (p. 1). This definition is also endorsed by the Association for Educational Communications and Technology (AECT) and is often utilized in industry, business and education (Ely, 2008).

The early roots of instructional technology progressed out of what was termed the audiovisual movement, which included film, and continued to advance through instructional radio, television, computer-assisted instruction, microcomputers, the Internet and of course, the digital technologies that saturate our society and surround students today (Ely, 2008; Reiser 2001a; Saettler, 1968, 1990). In examining the advancement of these instructional technologies, Saettler (1968) contended, "the aim of each age or society is to find the basic skills or subject matter which offer promise of transfer to learner behavior" (p. 12). Mishra, Koehler, and Kereluik (2009) stated that although our current status of rapidly changing digital technologies may in fact seem exclusive to this generation, "the trends and issues are similar in many respects to those of earlier generations" (p. 50).

The idea that the cyclical nature of instructional technology integration encompasses similarities to the challenges faced by educators nearly a century ago provides a rationale for examining the history of instructional technology. As Saettler (1990) reported, "it is clear that educational technology is essentially the product of a great historical stream consisting of trial and error, long practice and imitation, and sporadic manifestations of unusual individual creativity and persuasion" (p. 4). The purpose of this section of the literature review is to provide a brief synopsis of the instructional technologies that have been utilized over the past century, as well as detailing the influences that affected their integration during each era. These influences primarily manifested themselves as political factors, economic issues, and the development of psychology in teaching and learning. Finally, the section will conclude with a discussion on what has been learned from examining the history of instructional technology. Understanding and appreciating past successes and challenges, can aid current practitioners, researchers, and teacher educators in determining a more successful future in utilizing instructional technology in the classroom (Mishra et al., 2009).

**Instructional film and the visual education movement.** Literature reveals that most of the instructional media being utilized in schools in the early part of the twentieth-century dealt with visual media (Saettler, 1968). These influences became known as the visual instruction movement and it was about this time that instructional film made an entrance into the world of education (Saettler, 1968). The film projector was the first form of media to introduce itself to the American classroom (Reiser, 2001a). In 1913, Thomas Edison stated, “Books will soon be obsolete in the schools…It is possible to touch every branch of human knowledge with the motion picture. Our school system will be completely changed in the next ten years.” (as cited in Saettler, 1968, p. 98). This enthusiasm for the use of film in instruction motivated many individuals, whether in business or education, to enter the visual education movement in order to explore its exciting possibilities (Barbousas, 2009; Saettler, 1968).

Theoretically, one of the most prominent features of visual education was that conceptually, visual aids could be classified according to their concreteness or abstractness (Barbousas, 2009). Edgar Dale created his own version of this concrete-abstract continuum, called the ‘Cone of Experience,’ which became popular after World War II (Saettler, 1990). Dale’s continuum ranged from concrete to abstract stimuli and was to be utilized as a guide to aid in selecting the media most effective for specific learning situations (Dale, 1969). Visual instruction may also have been welcomed by educators, because men like Comenius, Rousseau, Pestalozza, Froebel, Herbart and Dewey had been arguing against the formalism found in schools at the time, coupled with the fact that most formal instruction only focused on the verbal learning style (Saettler, 1968).

The first classroom use of film occurred in the public school system of Rochester, New York where the school board adopted the use of instructional films to be utilized on a regular basis (Reiser, 2001a; Saettler, 1968, 1990). Although, the movement did not progress quite as strongly as Edison had predicted, the movement did grow (Reiser, 2001a). Additionally, quite a few national organizations and journals were developed that focused on visual education; teacher training was impacted as well (Johnson, 2008; Saettler, 1990).

During the late 1920s, films with sound became available and educators had mixed feelings about introducing them to the classroom; at this same time, educational film companies began failing (Saettler, 1968). Some attributed this tension to the economic depression that characterized the country at that time (Saettler, 1968). Others however, attributed it to the dissonance between educators and business leaders with competing agendas (Hobs & Jensen, 2009). Hobbs and Jensen (2009) observed:

> The overall incoherence of the field was another significant problem, with fragmentation among educators interested in creating educational films, those interested in using existing commercial films as teaching tools…not to mention the business community's interests in selling projectors, screens, films, support materials and ancillary equipment to schools. (p. 2)

The movement peaked during World War II, as a plethora of visual materials were utilized by the military to train massive amounts of individuals for war, but then declined by the late 1940s as communications research became more prevalent and visual instruction was replaced with audiovisual instruction (Pett & Grabinger, 1995; Reiser, 2001a; Saettler, 1990).

**Audiovisual movement and instructional radio.** The audiovisual instruction movement overlapped some with the visual instruction movement during the 1920s and 1930s as sound recording, radio broadcasting, and motion pictures with sound became more prevalent (Reiser, 2001a). The visual instruction movement slowly transitioned into the audiovisual instruction movement and garnered even more interest in instructional media (Reiser, 2001a). After World War II, the audiovisual instruction movement expanded and this was evidenced at the state level, where teacher education requirements and the budgets that were developed to purchase audiovisual materials for schools, both expanded (Saettler, 1968). The National

Education Association (NEA) first offered support to the audiovisual instruction movement by developing the Department of Visual Instruction in 1932, which was later changed to the Department of Audiovisual Instruction (DAVI) in 1947 (Saettler, 1968). Once World World II commenced, the NEA offered more support by enlisting the DAVI with an executive secretary and staff (Saettler, 1968).

With the advent of sound, radio became a popular medium during this era and instructional media enthusiasts of the day thought it would be the medium to drastically change education for the better (Reiser 2001a). The most documented utilization of instructional radio began in roughly 1929 when the Schools of Air (SOA) movement began (Bianchi, 2009). According to Bianchi (2009), Schools of Air were reminiscent of brick and mortar schools with regards to their organization and operations. They included courses that paralleled existing school curricula, as well as the development of specific programs of study for individual grade levels during time periods that coincided with the regular school year (Bianchi, 2009). Schools of Air existed until roughly 1975 and reached, according to Bianchi (2009), approximately 2.5 million students during its existence. The movement was pioneered by Ben Darrow, who had a vision of radio unifying schools across the country when he launched "The Ohio School of the Air," which aired a daily hour of talks, plays and readings for classroom reception in January of 1929 (Leach, 1983). Shortly thereafter, over 10,000 students from 22 states were tuning in (Leach, 1983).

Following 1945, enthusiasm for television began to increase and publications and research dealing with instructional radio began to wane, as well as course offerings via radio and school broadcasts (Saettler, 1968). Saettler (1968) stated, "intentional or not, radio instruction by the sixties had become the stepchild of instructional technology" (p. 228). In defense of radio's influence upon instruction, Bianchi (2008), who wrote a book about the Schools of Air, contended that with select audiences, education by radio was successful and for many more decades than was usually presented in research. Additionally, Jamison & McAnany (1978), who reviewed three surveys during the late 1960s dealing with the effectiveness of instructional radio, including one by Chu and Schramm from 1967, found that "radio, particularly when appropriately supplemented by visual material, can teach effectively and, for many purposes, as well as other media" (p. 30). Although radio quickly lost its fervor in the classroom, the previous literature supports its impact upon learning if aforementioned criteria are met.

**Instructional television.** After World War II, there existed a national surge of attention focused on making advances in the sciences and technology (King, 2008). In order to accommodate this push, schools began utilizing the new technology of television for instructional purposes and teachers began receiving better training (King, 2008). Instructional television overshadowed the decline of instructional radio (Reiser, 2001a). Television's use for educational purposes was strengthened in 1952, when the Federal Communications Commission (FCC) reserved 242 channels, several for each state, exclusively for instructional purposes (Reiser, 2001a; Saettler, 1968).

Another important landmark in the progression of instructional television was the fact that the Ford Foundation and its Fund for the Advancement of Education received millions of dollars in funding for educational television (Reiser, 2001a; Saettler, 1968). An additional reason that motivated the spending of federal funds on education in America was the Russian launch of the satellite Sputnik (Bitter & Pierson, 2005; Molenda, 2008; Reiser, 2001b). In 1958, the National Defense Education Act was created, which subsequently led to funding for the educational television movement (Molenda, 2008; Saettler, 1968).

The Ford Foundation tested a variety of instructional television scenarios at various educational levels (King, 2008). The cities of St. Louis, Pittsburgh, Chicago and the state of Alabama retain the status for being pioneers with regards to experiments involving instructional television on educational stations (Saettler, 1968). In each of these situations, lessons were presented to students via television, but in most cases, evaluations revealed that the instruction required face-to-face follow-up (Saettler, 1968). Another well-known project that was funded by a grant from the Ford Foundation involved complex closed-circuit facilities in Washington County, Maryland in 1956 (King, 2008; Reiser, 2001a; Saettler, 1968). Twenty-five instructional telecasts were created and distributed each day to schools all over the county on a variety of subjects, until a total of 50 courses were included in the program (King, 2008; Reiser, 2001a; Saettler, 1968).

These are just a few examples of how instructional television was utilized in classrooms at the time. Ultimately, instructional television was advocated as a device to advance effective teaching in the late 1950s and early 1960s (Cambre, 1995). This was referred to as the "master teacher" idea and resulted in broadcast classrooms where effective teachers taught classes that were telecasted in a broad manner (Cambre, 1995, p. 299). Cambre (1995) also stated that television was vastly utilized at the time to help conquer the shortage of qualified teachers, and to aid in reducing classroom overcrowding caused by increased enrollments.

By the mid-1960s, interest in instructional television diminished because of the mediocre to low quality of the productions (Reiser, 2001a), and because many of the talented teachers chosen for the telecasts lacked on-air talent, which bored students (Cambre, 1995). At this same time, the Ford Foundation began phasing out its funding and began focusing on providing support for public television in general (King, 2008). Many school districts phased out their broadcast projects once the funding ceased (Reiser, 2001a). Research that examined the difference between the effectiveness of instruction utilizing television and traditional teacher-led instruction demonstrated that no significant difference existed between the two, as evidenced by Kumata (1977), who compiled an inventory of research studies on the use of instructional television in education in 1956. Findings dealing with subject-matter tests, short-term retention tests on subject matter, and increasing class sizes with proctors for talk-back sessions all revealed the same results (Kumata, 1977).

Diamond (1964), who saw instructional television as a positive addition to the classroom if utilized under the right conditions, asserted:

> in reality the effectiveness of television depends upon what is televised and how it is applied, for the medium is simply a means of transmission, nothing more…Television is beginning to assume its proper place in instruction as only one part of the answer in effective teaching (p. 194).

Despite the results of these early studies and opinions of media researchers, televisions are still present in classrooms today, although their use is different from when they were first introduced and in most cases, probably on a smaller scale, because of the prominence of other instructional technologies (Cambre, 1995).

**Programmed instruction.** Until this point, this section of the literature review has predominately focused on the discussion of various types of media being introduced into the classroom to present information, and little has been said about the psychology of learning theory that should necessitate the selection of the media. It is appropriate here to discuss the development of programmed instruction and the principles of behaviorism upon which it was based. In the 1920s, Ohio State University psychology professor, Sydney Pressey, developed a device that could help with information drill and skill type practice, and could teach, as well as test (Molenda, 2008). Based upon Thorndike's Law of Effect, which focused on learning in relation to associations that transpire because of actions (Driscoll, 2005), the teaching machines had little effect upon education at the time (Molenda, 2008).

Unfortunately, Pressey's work was almost forgotten until B. F. Skinner from Harvard University instigated a resurgence of interest in programmed instruction in the 1950s (Saettler, 1968). The approach upon which Skinner based the programming for the teaching machines was born out of the "notion of operant conditioning in which the learner's responses are 'shaped' to pronounce and to write responses correctly and whereby his behavior is brought under various types of stimulus control" (Saettler, 1968, p. 254). The first reported use of programmed instruction in a public school system occurred in Massachusetts when second and third graders were taught spelling during the course of the academic school year in 1957 (Saettler, 1990). Skinner (1968) saw that a technology of teaching:

> could maximize the genetic endowment of each student; it could make him as skillful, competent, and informed as possible; it could build the greatest diversity of interests; it could lead him to make the greatest possible contribution to the survival and development of his culture. (p. 91)

In 1962, Robert Mager's book *Preparing Objectives for Programmed Instruction* was also very influential in forwarding the use of teaching machines (Ely, 2008). This popular book described how to formulate objectives and included three components: learner behaviors, conditions and criteria. This book is currently in its third edition and it still utilized by educators today as a model for writing effective objectives (Reiser, 2001b). Previous to Mager's book, Benjamin Bloom attracted attention to behavioral objectives when he and his co-authors published their *Taxonomy of Educational Objectives* in 1956 (Schrock, 1995). In this work, the authors indicated that within the cognitive domain of learning, there existed various types of learning outcomes, which have been organized in a hierarchical fashion and upon which educators should base their objectives (Bloom & Krathwohl, 1956).

Unfortunately, the 1960s saw a decline of the programmed instruction movement. Some of the problems associated with programmed instruction included the fact that small, incremental steps were not always necessary to the process, neither was a linear sequence; and students were often bored by the process (Molenda, 2008; Saettler 1990). Even though the excitement of programmed instruction waned, the implications for the field of instructional development were substantial. It shifted educators' attention to the outcome behavior of the learner and it also documented the importance of self-pacing, mastery learning and carefully crafting instructional materials (Schrock, 1995). Continuing into the 1960s, more and more attention in the field of instructional technology was placed on the design process of integrating technology into the classroom and shifted gradually away from the selection of media to merely present information (Molenda, 2008).

Lastly, programmed instruction paved the technological path for computer-assisted instruction and the systems approach to instructional technology (Saettler, 1990). The principles involved with programmed instruction influenced Fred Keller's development of the Personalized System of Instruction (PSI) in 1963 (Molenda, 2008). In PSI, course content is organized into sequential modules; the learners work through the modules at their own pace; they take a competency test at the end; and they receive immediate feedback in order to remediate any deficiencies (Molenda, 2008). By the mid-1970s, interest in this type of individualized instruction in schools dissipated, because of poor implementation practices; comparison to conventional instruction demonstrated no significant difference in the effectiveness of instruction (Saettler, 1990).

**Instructional systems design.** Instructional systems development (ISD) can be defined as "a systems approach for the orderly and comprehensive design, development, and management of both instructional materials and instructional systems" (McCombs, 1986, p. 67). Two of the earliest authors to promote instructional systems were Robert Glaser and Robert Gagne. Glaser (1963) coined the term *instructional system* in 1962 and identified, described and diagrammed each of its elements. Gagne (1965) published *The Conditions of Learning* in 1965, which focused on the analysis of learning objectives and how different categories of these relate to various instructional designs. Utilizing the concepts developed by authors like Glaser and Gagne, systematic processes or models were created to guide the design of instructional materials (Reiser, 2001b). Many of these models, and more, can be found in Kent Gustafson and Robert Branch's publication *Survey of Instructional Development Models* (2002), which is now in its fourth edition (Gustafson & Branch, 2002).

The instructional systems notion was also advanced by work the military was doing in the field, as well as by the passage of the Elementary and Secondary Education Act (ESEA) in 1965, which founded 20 federally funded research and development laboratories (Shrock, 1995). In 1970, the Department of Audiovisual Instruction became the Association of Educational Communications and Technology (AECT) (Saettler, 1990). Similarly, terminology such as *educational technology* and *instructional technology* began to replace the term *audiovisual instruction* (Reiser, 2001a).

**Computers in the classroom.** About the same time that instructional television and programmed instruction reached a low point, computer assisted-instruction (CAI) became of interest to educators as millions of dollars were being invested in instructional research and development (Saettler, 1990). Educationally based companies like Harcourt, Brace & World, and Harper & Row, immediately saw an avenue in which to commercialize computer programs that would potentially bring in large profits (Atkinson & Wilson, 1968). Computer assisted-instruction is similar to programmed instruction in that the learner is exposed to instruction that is individualized and often self-paced (Pycior, 1984). Essentially, it is still a drill and skill practice, except that the computer has the advantage of storing learner scores and offering remediation when necessary (Pycior, 1984). CAI can be utilized to provide instructional content in the manner of drill and practice, tutorials, and simulations (Chambers & Sprecher, 1983). The early work for CAI actually began in the 1950s by IBM who developed the first CAI authoring language, as well as one of the first educational programs to be utilized in public schools (Reiser, 2001a).

Many of the CAI projects developed during the 1960s and 1970s were created utilizing behaviorist principles and were basically automated versions of Skinner's teaching machines (Saettler, 1990). One of the first major projects involving CAI occurred at Stanford University under the direction of Patrick Suppes and Richard Atkinson who developed applications for both elementary schools and at the university level (Atkinson & Wilson, 1968; Chambers & Sprecher, 1983; Saettler, 1990). A second example of CAI is the PLATO (Programmed Logic for Automatic Teaching Operation) project, which originated out of the University of Illinois under the direction of Donald Blitzer and his colleagues (Atkinson & Wilson, 1968; Chambers & Sprecher, 1983; Saettler, 1990). A third major project was the ICCIT (Time-Shared, Interactive, Computer-Controlled Information Television Project), which was funded by the National Science Foundation in 1971 and was sponsored jointly by the MITRE Corporation and the

University of Texas (later Brigham Young University) (Atkinson & Wilson, 1968; Chambers & Sprecher, 1983; Saettler, 1990).

Philadelphia's school system was the first to implement CAI without the sponsorship of a university (Atkinson & Wilson, 1968). New York followed closely behind with the implementation of the first phase of a major project in 1967-1968 and full implementation during the following school year (Atkinson & Wilson, 1968). Chambers & Sprecher (1983) recommended utilizing the Keller Plan as a way to integrate CAI into the classroom. Fred Keller was a psychologist who did not advocate traditional, lecture-based instruction, but rather, he supported the idea of allowing students to work independently through teacher-created learning modules installed on a microcomputer until they mastered the content (Keller, 1978). Teachers in this environment were to serve as support by providing some lectures, but also integrating other forms of instruction like demonstrations and interviews (Keller, 1978). The teachers would also provide remediation for those who needed aid in mastering the instructional materials (Keller, 1978).

Even though CAI was still being implemented in the late 1960s and early 1970s, it failed to achieve the potential that it had originally promised (Saettler, 1990). For several reasons including: teacher resistance, low quality of instructional materials, cost, and difficulty with the evaluation of student achievement (Saettler, 1990). By the late 1970s and early 1980s, personal microcomputers began to infiltrate the educational arena and new hope filled educators as they envisioned how these affordable and, now portable, units would be the new tool to aid them for instructional purposes (Harwood & Arsal, 2007; Reiser, 2001a). In 1977, the first computer to be introduced was the Commodore Pet, which was then followed by the TRS-80 and then the Apple (Coburn et al., 1982). During this time, computers were utilized in the schools primarily as “word processors, numerical analysis programs, data processors, instrument monitoring devices, high resolution graphics software, and sound synthesizers” (Coburn et al., 1982, p. 37).

As microcomputers migrated into the schools, educational psychologists concentrated on testing learning theories and applied cognitive science was found to be a practical device for activities in the classroom (Ely, 2008). According to Saettler (1990):

> Recent research in cognition implies that teaching involves the active design of instructional activities that facilitate the learner’s active construction of verbal and mental processes that relates or integrates memories and knowledge with new information and generates a process we call learning. (p. 479)

About the same time, Seymour Papert, who was heavily influenced by Jean Piaget, a Swiss psychologist, devised the LOGO language with others from MIT so that children could learn how to program a computer (Atkinson & Wilson, 1968; Chambers & Sprecher, 1983; Saettler, 1990). Papert (1980) stated:

> In the LOGO work we have invented versions of such machines in which powerful ideas from physics or mathematics or linguistics are embedded in a way that permits the player to learn them in a natural fashion, analogous to how a child learns to speak (p. 27).

Papert’s primary interest was not to equip children to become avid programmers, but rather, to further their intelligence and create confidence utilizing their learning experiences involving the computer (1980).

By 1988, it was estimated approximately three million computers resided in schools around the nation; computer applications like hypertext and hypermedia, as well as the development of more programming languages became popular (Saettler, 1990). Saettler (1990) also pointed out that during this time, not only were educators utilizing computers in their classroom, but other forms of media technology had matured, including: more portable video recorders, cassettes, laser discs, inexpensive television equipment, and cellular communications. Having access to so many forms of media sometimes made it challenging for teachers to know which too to choose in order to create interesting, yet effective instruction. Levie and Dickie (1973) stated, "First it should be noted that most objectives may be attained through instruction presented by any of a variety of different media. A great many studies have shown no significant difference between one medium and another" (p. 859).

Briggs (1982) posited "media are thus vehicles for stimulus presentation" and "the sensory mode to be stimulated, and the detailed characteristics of the needed stimuli, together are considered in order to select the mechanisms or media to be employed to present the stimuli" (p. 121). In his famous argument, Clark (1983) contended "media are mere vehicles that deliver instruction but do not influence student achievement" (p. 445). In response, Kozma (1994), who discussed the "capabilities of media" or its attributes, stated: "Media must be designed to give us powerful new methods, and our methods must take appropriate advantage of a medium's capabilities" (p. 10).

Regardless of the enthusiasm surrounding the growing pervasiveness of computers in the schools, surveys conducted in the mid-1990s revealed that there was only one computer for every nine students on average; that teacher usage of computers was little to none; and that when utilized, computer use was not very creative or interesting to students (Reiser 2001a). Further, the "lab model of integrating technology" that was evident during the 1990s, meant that most computers in schools were placed in a separate room or lab and teachers had to sign up for time in the lab (Stallard & Cocker, 2001, p. 30). Despite these challenges, the introduction of the Internet in the 1990s, which allows users all over the world to connect to each other via networks, initiated great interest from educators; because it enabled them to have access to people and resources worldwide instantly, as opposed to reading about them in a more delayed fashion in textbooks (Stallard & Cocker, 2001).

The World Wide Web (WWW) and HTML began with the work of Tim-Berners Lee in 1989 and came to fruition in 1991 (Willis, 2003). Willis (2003) stated, “He created it for his colleagues around the world, but it has become the foundation for a revolution that may be more influential than the original invention of the personal computer” (p. 13). In addition to the Internet, educators during the 1990s had access to the following types of educational technology systems: standalone personal computers, networked stations, interactive video and multimedia stations, and virtual reality systems (Roblyer, Edwards, & Havriluk, 1997). The applications of these educational technology systems fell into one of three categories: instructional technology applications, productivity applications for teachers, and tools for students (Roblyer et al., 1997).

With the face of educational computing becoming so multi-faceted and providing more opportunities for teachers to integrate it into their instruction, the manner in which instruction was delivered also evolved. Newer technologies provided more instances for students to work together to problem solve and experience more authentic tasks (Roblyer et al., 1997). These types of learning strategies are grounded in constructivist theory, which was derived from ideas promoted by John Dewey, Lev Vygotsky, Jerome Bruner, and Jean Piaget, and attempted “to inspire students to see the relevance of what they learn, to prevent students’ failure to transfer what they already know to the learning of other skills that require the prior knowledge” (Roblyer et al., 1997, p. 65).

Another phenomenon that emerged during the 1990s that greatly affected K-12 education and technology integration was the standards movement. It began with the release of the report, *A Nation at Risk* in 1983, which was produced by a panel created by the Secretary of Education

Terrell Bell, and basically declared that education in America was suffering, was not up to par with other countries, and was producing average citizens (Wenglinsky, 2005). Wenglinsky (2005) further described how this report eventually led policymakers to take action and push Goals 2000 through under the Clinton administration in 1994, which basically set standards and assessments in core content areas (e.g., math, science, history, etc.) By the year 2000, almost every state had their own set of standards and assessments, just in time for the movement to culminate with the passage of the No Child Left Behind (NCLB) package in 2001 (Wenglinsky, 2005).

President W. Bush signed the NCLB Act into law in January of 2002 (Jorgensen & Hoffmann, 2003). NCLB and its subsequent funding put forth efforts to make each state more accountable for student achievement in the classroom by requiring state-mandated assessment testing in the areas of reading and math between third and eighth grade and at least once in high school (Jorgensen & Hoffmann, 2003). It also requires teachers to be highly qualified in their teaching areas. If a specific school cannot meet these objectives, parents can choose to transfer their children to a successful school within the district, and the government would step in to aid the school not making the appropriate progress (Jorgensen & Hoffmann, 2003). With these new pressures being placed upon educators to align their current curricula with state/national standards and subsequently focus much of their time and energy on making sure students could meet these standards, attention was diverted away from utilizing technology in innovative ways, except perhaps to aid in allowing students to practice taking tests similar to those found on state assessments (Hew & Brush, 2006).

**The current digital age and education.** As the millennial year has come and gone, the face of technology has changed drastically from the era of the visual education movement. For example, by 2003, 93% of all schools in the U. S. had Internet connection in instructional classrooms and the ratio of students to instructional computers was one to over four, as compared to only 3% of schools having access to the Internet in instructional rooms in 1994 (National Center for Education Statistics, 2005.). However, by the fall of 2008, the ratio of students to computers was around three to one; 58% of schools had access to laptops on carts; 97% had LCD projectors, 73% had interactive whiteboards; 38% had classroom response systems; and 93% had digital cameras (National Center for Education Statistics, 2010). These statistics demonstrate that today's school is vastly different from one of even 20 years ago, because of the immense growth of digital media and technologies.

Even though digital media and emerging technologies are in essence, saturating our society, and schools today, as reported in the statistics above, have greater access, access for students to these technologies is still rather limited, often sporadic, and usually only focuses on information searches, rather than the social engagement and collaboration opportunities that characterize technologies like Web 2.0 tools. (Harwood & Asal, 2007; Holcomb & Beal, 2010; Kajder, 2010). School-based professionals may not appreciate the changing media literacy that learners are developing outside of school, when participating in activities like social networking, gaming, or creating data mashups, which can lead to a challenge for educators in understanding how to design instruction in varied ways that support multiple literacies engaged by digital technologies (Ito et al., 2008). Other factors that may create barriers for effective technology integration in schools today include: technological resources, knowledge and skills of school personnel, school leadership issues, attitudes and beliefs of school personnel towards technology, pressures of high stakes testing, and the school culture (Hew & Brush, 2006; Lowther, Inan, Strahl, & Ross, 2008). Hew and Brush (2006) suggested several ideas to overcome these barriers, including: “having a shared vision and technology integration plan, overcoming the scarcity of resources, changing attitudes and beliefs, conducting professional development, and reconsidering assessments” (p. 232).

**Lessons learned.** There are many lessons to be learned from examining the history of instructional technology in K-12 education. Reiser (2001a) contended that a predominant theme that has emerged over the course of the past century in relation to instructional media and technology integration, is that whenever a new technology becomes present on the educational horizon, educators, politicians and business leaders often became overzealous and anxiously push it into the schools with the idea that it has the power to transform education and bring it to a new state. Many times this enthusiasm ends in disappointment, because it becomes obvious that the new medium does not possess the anticipated power previously believed (Reiser, 2001a). The first lesson here is that technology should be viewed as an instructional tool to support student learning, not a device that will transform the face of education. This eliminates educators from having unreasonable expectations and the ever-constant search for the next device or gadget that they perceive will bring about educational reform.

Another reason for the limited success of some of the earlier educational technologies like programmed instruction, teaching machines or computer-assisted instruction might be because they were “oriented toward an isolated student, interacting with a quasi-intelligent black box, with the teacher marginalized into a coordination and maintenance role” (Venesky, 2004, pp. 3-4). The instructional media mentioned by Venesky (2004) was integrated into classrooms based almost entirely on behaviorist principles. Today, innovative instruction comes from educators who utilize principles from a variety of learning theories (behavioral, cognitive, constructivist) and base it upon the desired outcome and what is appropriate for their learners

(Venesky, 2004). This idea is further supported by Wenglinsky (2005), who based upon statistics collected from the National Assessment of Educational Progress (NAEP) from 1996 to 2000 in math, science, and reading from fourth to twelfth grade, found that when technology is utilized in relation to constructivist principles, students perform better than when only direct instructional methods are utilized. Thus, a second lesson to be learned here may be that educators must draw from a full complement of learning theories and strategies in order to integrate technologies in meaningful ways.

**Summary of the history of instructional technology.** This section of the literature review served the purpose of highlighting important and significant events pertaining to instructional technologies towards the beginning of the twentieth century and concluding with those that are prevalent today. The following topics were presented and discussed: instructional film and the visual education movement; the audiovisual education movement and instructional radio; instructional television; programmed instruction; instructional systems design; computers in the schools; and the digital age. The section concluded with a brief discussion of two lessons that could be derived from an analysis of the cycles that instructional technology has progressed over the past century. These included: viewing all technology as instructional tools to support student learning and not as vehicles of educational reform; and that technology should be utilized in the classroom employing a variety of instructional strategies founded on the appropriate learning theories, which might include those stemming from behaviorism, cognition or constructivism, the selection of which depends largely on the intended outcome and learner needs. Overall, it is important to analyze the past challenges and successes of instructional technology in order to move forward and realize the potential of the digital era in contributing to teaching and learning in schools.

**Technology Integration within Teacher Education**

An interesting and valid paradigm facing many educators and administrators in K-12 classrooms today is how to effectively incorporate technology into instruction to enhance and support student learning. This does not mean merely automating stale and antiquated instructional strategies that bore students, but actually approaching technology from a pedagogical and development stance. This issue could be targeted from several different avenues, including examining current curricular directives, leadership reform, and inservice training for experienced teachers (Dutt-Doner, Allen, & Corcoran, 2005). Much time and energy has been spent attempting to retrain experienced teachers on how to incorporate instructional technologies into their classes, but many of these attempts have had limited success in significantly improving classroom instruction (Hargreaves & Fullan, 1992).

One method of cultivating change, as promoted by the National Educational Technology Standards (NETS) (ISTE, 2008) is to focus attention on teacher education programs. Teacher educators are encouraged to work with prospective teachers in incorporating technology that supports teaching and learning, and not just the delivery of instruction (ISTE, 2008). Ito et al. (2008), contended that today's "youth could benefit from educators being more open to forms of experimentation and social exploration that are generally not characteristic of educational institutions" (p. 2). Many recent preservice teachers have been raised during this era of rapidly developing digital technologies and thus, should be the perfect candidates to bring exciting, emerging technologies to their future students. Dutt-Doner et al. (2005) quantified that although this should be the case, that "in working with teacher candidates, we have learned that growing up digital is not adequate preparation for understanding how to meaningfully integrate technology to transform learning (p. 65). They advocated that preservice teachers should not just be taught web and technological applications, but rather, these applications should be "modeled, exercised, and assessed as embedded curriculum within the teacher education program," (Dutt-Doner et al., 2005, p. 65).

The research of Lei (2009) also supported the idea that although many preservice teachers have grown up in a digitally saturated environment, they do not necessarily possess the pedagogical understanding and skill to integrate technology effectively into their classroom. Further, Lei (2009) detailed that not much research has been conducted on digital natives as preservice teachers and poses the call that it is time for more research to be pursued. Lei's research findings, which explored preservice teachers' attitudes, experiences, strengths, weaknesses, and preparation needed in the field of technology, included several interesting insights: preservice teachers possessed strong feelings about technology, but did not feel as confident or comfortable in utilizing it; they spent about 80% of their time utilizing social networking activities and only about 10% of their time engaged in learning activities; and they were quite comfortable with basic technologies, but lacked experience with more advanced technologies, like Web 2.0 applications or virtual learning environments, both of which possess strong potential for classroom integration (2009). Lei formulated a similar conclusion as the aforementioned researchers, that "systematic technology preparation is needed to help them learn more advanced technologies, classroom technologies, and assistive technologies, and more importantly, to help them make the connections between technology and teaching and to help them make the transition from digital-native students to digital-native teachers" (2009, p. 1).

As has been demonstrated in the preceding paragraphs, effective technology integration continues to be a concern and goal of teacher education programs today. The journey to accomplish this objective began in earnest over a decade ago when The International Society for

Technology in Education (ISTE) devised the National Educational Technology Standards (NETS) in 1998 to aid in setting benchmarks and guidelines for administrators, teachers and students for improved technology competence for teaching and learning (ISTE, n.d.). Another major influence within the realm of preservice teacher training in technology and assessment has been the 1999 governmental initiative Preparing Tomorrow's Teachers to use Technology (PT3), which advocated and awarded grants for the development of innovative strategies by teacher education programs to arm preservice teachers with tools to infuse technology into their instruction for improved student learning (Preparing Tomorrow's Teachers to use Technology, n.d). By the end of June 2003, the goal of PT3 was to award 441 grants and affect over half a million teachers (Market Data Retrieval, 2004).

During the course of this section, literature focused on barriers that affect technology infusion in teacher education programs will be investigated, as well as conditions that foster success. This will be followed by an exploration of best practices for technology integration training in teacher education; and lastly, characteristics of what are thought to be exemplary teacher education programs will be examined.

**Barriers that affect technology infusion in teacher education.** There are many barriers that affect technology infusion into teacher education programs. Since the funding of the Preparing Tomorrow's Teachers to Use Technology (PT3) initiative in 1999 by the U.S. Department of Education, many colleges and universities have sought to overcome these barriers in order to effectively integrate technology training into their teacher education programs (Aust, Newberry, O'Brien, & Thomas 2005; Brush & Saye 2009; Brzycki & Dudt, 2005; Finley & Hartman, 2004). Before PT3, the National Council for the Accreditation of Teacher Education (NCATE, 1997), conveyed that teacher educators reported some of the following problems in utilizing technology in their respective programs: lack of time, technology and support, as well as a restrained emphasis on faculty training in technology, and lack of incentives for technology innovation. Finley and Hartman (2004) conducted a qualitative case study at Western Michigan University regarding faculty perceptions about the barriers involved in integrating technology in their teacher education courses. One important issue included capturing a vision and encouraging faculty to explore the pedagogical benefits of utilizing technology in their courses; without achieving this, faculty are less likely to adopt technology with a spirit of optimism (Finley & Hartman, 2004).

Brzycki and Dudt (2005) reported on a consortium of satellite institutions from the University of Pennsylvania, and their subsequent completion of a PT3 grant. In describing the process of implementing this grant, they described some of the barriers that the participating faculty had to overcome in order to achieve success. Time was listed as a major constraint for the teacher education faculty, as supervising their student teachers encroached on the time needed to reconfigure their courses, as well as hindered their avenues for technology support (Brzycki & Dudt, 2005). Additionally, support was an important barrier, noting that a system of peer assistance, one-to-one assistance, and help desk support was needed for the successful implementation of technology integration, instead of just a few skill-based technology workshops (Brzycki & Dudt, 2005). Having access to models or examples of successful technology uses organized by content-specific area was also a need, as well as an adequate infrastructure of wired offices and classrooms, so that faculty and students would have access to the appropriate software and hardware (Brzycki & Dudt, 2005). Lastly, the tradition of the stand-alone instructional technology course for preservice teachers needed to transition to a process of full technology integration in all education courses (Brzycki & Dudt, 2005).

In order to foster innovation, Aust et al. (2005) developed a PT3 funded systematic model of technology integration in a teacher education program called Learning Generation. Faculty were surveyed during the inception stages of the grant on the barriers they felt inhibited their use of technology with preservice teachers (Aust et al., 2005). Lack of the appropriate technology equipment received the highest percentage of responses, and this was followed by insufficient time, lack of professional development with regards to technology, apprehension towards the use of technology, and inadequate funding (Aust et al., 2005).

In a more recent article, Brush and Saye (2009) reported on their work with preservice social studies teachers at both Indiana University and Auburn University. The authors, as well as Strudler and Wetzler (1999), contended that a barrier they have experienced has been a lack of access to supervising or mentor teachers who are proficient in technology and model effective ways to integrate technology in real classrooms for their preservice teachers' field experiences. Other related barriers included mentor teachers not having the opportunity to model technology-rich experiences because of time constraints or not having access to the appropriate technology resources (Brush & Saye, 2009; Strudler & Wetzler, 1999).

Most of the barriers detailed in the literature referenced in this section are what Ertmer (1999) described as first-order barriers; that is, impediments that affect educators in extrinsic ways. These obstacles might be described as resources, which would include many of the limitations described above, such as time, support, hardware, software, and training (Ertmer, 1999). Ertmer (1999) contended that before technology can be successfully integrated, second-order barriers must be considered as well; second-order barriers are more difficult to change because they are not tangible and are more challenging to conceptualize. They deal with more intrinsic values, like belief systems about teaching and learning, as well as attitudes about technology. Further, Ertmer (1999) advocated dealing with first- and second-order barriers at the same time when possible, especially those that possess an interactive relationship. In closing, it is important for teacher education leaders to identify barriers that may exist in their institution and devise a plan to address them as they continue to hone the effectiveness of their technology infusion processes. Once barriers have been treated, conditions that foster the acceptance of technology can be focused upon. This topic will be discussed in the next section.

**Conditions that foster acceptance of technology in teacher education.** Dexter, Doering, and Riedel (2006) contended that the mandatory resources that can determine whether the integration of technology into a teacher education is successful or not included: "adequate access to supported resources, faculty members' opportunities and willingness to learn, and factors that facilitated communication and coordination" (p. 340). Brzycki and Dudt (2005) discussed how faculty incentives to revise their course syllabi to detail how their courses would be transformed to include technology were quite popular at the three universities where they conducted a study. Additionally, individual help for faculty during the process of integrating technology in their respective programs was described as important (Brzycki & Dudt, 2005; Finley & Hartman, 2004; Strudler & Wetzel, 1999).

Other types of support for these faculty included mentorship in their classrooms to teach specific content while utilizing technology; faculty showcasing their work by acting as models for other faculty; and teaching circles which allow small groups of faculty to get together to discuss issues of technology in teaching and learning (Sahin & Thompson, 2007). Lastly, a major condition for fostering acceptance in technology integration occurred when faculty were allowed to participate in decisions regarding the infusion of technology into the curriculum and field experiences. (Aust et al., 2005; Brzycki & Dudt, 2005; Strudler & Wetzel, 1999).

Finley and Hartman (2004) advocated opportunities for faculty to collaborate with each other as aiding in the adoption of the technology process. Incentives to encourage collaboration included: "release time, co-taught courses, mini-grants for collaborative projects, and maybe even small department-level accolades" to recognize faculty who had utilized technology in innovative ways (Finley & Hartman, 2004, p. 330). Sahin and Thompson (2007) described the significance of highlighting technology tools that would aid faculty in accomplishing their research interests; demonstrating the importance of staying abreast of the development of emerging technologies that assist faculty professionally, and in their own individual learning.

Ertmer (2003) contended that skills training in technology may instigate change, but that the various forms of support described in the previous paragraphs will increase the likelihood that the change in behavior, in terms of a relationship with technology, is stable and durable. Strudler and Wetzler (1999) chronicled that an important factor in fostering the acceptance of technology integration was having a strong, committed leadership in place and "at the core of informed leadership is a person who has internalized the complexity of effective technology integration and who exercises influence over time to ensure that the various enabling factors are in place or being addressed" (p. 68).

Upon the completion of a three-year PT3 grant, Whittier and Lara (2006) presented the following suggestions to aid in the acceptance of technology integration, especially during the implementation stage: "just in time" aid from trained technology professionals was beneficial for faculty during workshops and throughout the implementation period; training should not just focus on how to utilize specific technologies, but more on how teaching can be supported by the appropriate use of technology; and lastly, formative evaluation should be a priority so that adaptations can be incorporated in areas that show signs of needing improvement (p. 54).

Struder and Wetzel (1999) described several other "enabling factors" for the acceptance of technology integration at the institutional level including grants and initiatives to support work with technology by faculty and access to the appropriate hardware and software, as well as technical support on how to utilize it (pp. 71-72).

Maduakolam and Bell (2003) described several conditions of acceptance that were realized during their work with a product-based approach to professional development with regards to technology and they were comprised of: technology workshops based on a needs analysis survey administered to the faculty; individual work on technology products determined during the needs analysis; peer/support groups in order to collaborate with other faculty in similar content areas; and compensation based upon attendance at designated workshops and completion of their technology products. Brzycki and Dudt (2005) indicated that for the best attendance at technology workshops, they should be scheduled over breaks, right before classes begin or right after they end and that they should be well publicized; interest can be maintained if they are time-appropriate, effectively designed, and taught.

Conclusively, four major conditions can be gleaned from the literature that foster acceptance of technology integration in teacher education: adequate access to hard and soft technologies; technology support for individuals and in classes; models of effective technology uses created by peers; and incentives such as release time, compensation, and recognition for success. More may exist that are specific to individual programs and departments, but these are the major ones represented in the literature base and should be considered before transitioning towards an enhanced, technology-rich teacher education program. Once a program has been infused with technology, it is then time to focus on adopting strategies that will best inform preservice teachers on how to integrate technology into the classroom. Best practices with regards to technology training will be the focus of the next section.

**Best practices for technology integration training in teacher education.** Based upon the literature, best practices in the use of technology in teacher education programs shared two distinguishing features. First, they encompassed effective professional development models that aided faculty in adopting and utilizing technology in their instruction as a representative of good practice in the use of technology to their students, preservice teachers (Dexter et al., 2006; Whittier & Lara, 2006). They also embodied instructional strategies that integrated technology successfully and had demonstrated success through evaluation to aid preservice teachers in learning to utilize technology in their instruction to support student learning and achievement (Brush et al., 2003; Brush & Saye, 2009; Keeler, 2008; Seels, Campbell, & Talsma, 2003; Wilson, Wright, Gordon, & Stallworth, 2002). The following paragraphs will survey some of the best practices discovered in the literature through professional development for faculty and instructional strategies for preservice teachers.

***Models of best practice for the professional development of faculty.*** Whittier and Lara (2006) reported on a three-year PT3 grant received by Boston University in 2001 that focused primarily on faculty development in the area of technology infusion in order to better prepare their preservice teachers to utilize instructional technologies. The professional development model was composed of three components: instruction on how to use a learning management system; "just in time" help from a technology training group composed of four graduate students; and technology skills training and roundtables (Whittier & Lara, 2006, p. 50). An external evaluation revealed these significant findings: faculty were engaged when they were provided with hands-on training with technology that was relevant to their professional practice; faculty were able to contextualize specific technologies appropriate for their content area when they reflected on why those specific technologies were the most appropriate; all of the faculty utilized the learning management system by uploading their revised syllabus, which demonstrated specific instances of where technology had been integrated; and the technology training groups were effective in aiding faculty with specific technological needs (Whittier & Lara, 2006). Whittier and Lara (2006) offered that significant gains were made in the faculty's use and integration of technology into their courses and that these gains had significantly benefitted their preservice teachers; they continue, however, to apply iterative evaluation and remediate when specific needs arise.

Dexter et al. (2006) described a five-year PT3 grant to implement a model of professional development for technologies exclusive to various content areas for the education program located at the University of Minnesota, which was initiated in 1999. Components of the model included: bringing in experienced inservice teachers, referred to as Ed-U-Tech fellows, to mentor education faculty in content-specific areas in utilizing technology in their instruction; creating a technology resource website with access to and organized by specific content areas; technology training for faculty; acquisition of technology equipment; and exposure of faculty to evaluation data in order to further hone their technology integration skills (Dexter et al., 2006). Evaluation data revealed that the Ed-U-Tech fellows were instrumental in aiding faculty in each of the content areas to become more knowledgeable about technology, and also served as support for the faculty as they integrated technology into their respective content areas (Dexter et al., 2006). Further, the instructional technology instructor developed a deeper understanding about the relationship between each of the content-specific areas and technology (Dexter et al., 2006). Lastly, content-specific area technology tools were made available to faculty, and the instructional technology course faculty member created exemplary models of technology projects that integrated content-specific materials, which demonstrated to faculty and preservice teachers, how technology might be successfully integrated at the classroom level (Dexter et al., 2006).

***Models of best practice for the technology training of preservice teachers.*** Wright et al. (2002) reported on the Master Technology Teacher (MTT) program that resides at the University of Alabama. Its purpose served to provide an enduring professional development agenda in order to offer opportunities for supervising teachers, preservice teachers and education faculty to develop contemporary technology skills to support teaching and learning (Wright et al., 2002). Preservice teachers were assigned to an MTT at the beginning of the academic year and then collaborated on technology integration projects, as well as utilized the university's Technology on Wheels (TOW), in order to introduce subsequent forms of hardware and software to the classroom (Wright et al., 2002). Education faculty from the university worked closely with the educational technology faculty member, as well as both the preservice and supervising inservice teachers, to brainstorm potential technology projects to integrate into content-specific classrooms; the educational technologist aided further by utilizing the TOW bundles in the classrooms (Wright et al., 2002). Wright et al. (2002) defined "opportunities through initiatives such as the *Master Technology Teacher* program provide mentoring, professional development, and a climate in which preservice teachers can learn effective technology teaching methods" (p. 85).

Brush et al. (2003) qualified another PT3 grant extended to Arizona State University where:

> Efforts have focused on providing preservice teachers with opportunities to develop, implement, and evaluate their own instructional activities utilizing technology effectively and appropriately in authentic situations, to provide them with a myriad of tools necessary to integrate technology into teaching and learning. (p. 57)

This was accomplished by instituting a field-based model that sought to deliver two outcomes: model successful uses of technology in the classroom to support student learning, and provide immediate feedback for preservice teachers, supervising teachers and education faculty (Brush et al., 2003). Brush et al. (2003) indicated that data collected for the formative evaluation demonstrated that the modeling and collaborative activities had a positive effect on the preservice teachers and their knowledge of integrating technology. The most encouraging aspect to the authors, however, was the enthusiasm preservice teachers expressed regarding integrating technology into their own future classrooms (Brush et al., 2003). No literature could be found that indicated Brush et al. (2003) have conducted any follow up studies to see if these preservice teachers actually integrated technology in their classrooms.

Seels et al. (2003) described another PT3 initiative at the University of Pittsburgh that sought to motivate teacher education faculty, student teachers and mentor teachers to vigilantly integrate technology, as well as offer support for innovative ideas and collaboration by establishing Collaborative Communities of Practice (CCOLs). Evaluation data, which was iterative, demonstrated that these goals were achieved through a number of immersive activities, including: one-on-one support; summer institutes; regular professional development meetings; sharing of successful technology projects; and technology skills training (Seels et al., 2003). Seels et al. (2003) defined other forms of support included for the project consisted of a field-based staff, a collective resources website, mini-grants to support various projects, and the loaning of technology-related equipment.

Keeler (2008) recounted results from a research study conducted at a major university in the Southwest and detailed various strategies incorporated to integrate technology into a methods course for a content specific area. The study also attempted to provide opportunities for preservice teachers to utilize strategies characteristic of the technological pedagogical content knowledge, or TPACK (Keeler, 2008). The TPACK model focuses on developing technology integration skills in a content-specific context in which the technology is utilized to support teaching, learning and pedagogical purposes (Mishra & Koehler, 2006). Keeler (2008) stated that the implementation of the project occurred in a dual integration format, which consisted of administrative productivity and instructional delivery. Administrative productivity included: a course website that was continually outfitted with various resources; communications between instructors and preservice teachers via email, blogs, and cell phones; the creation of audio files for immediate feedback to the instructor; and access to grades via the course content management system (Keeler, 2008).

Keeler (2008) stated that although technology for productivity was important, the real power existed when it was used instructionally to support student learning. Technology for instructional uses included: in-class activities with concept mapping software, video streaming, and online tools, online access to readings, blogging, e-portfolios, and rubric generators. As Keeler (2008) stated, “all faculty members must prepare students for the 21$^{st}$ century, and all methods courses must teach strategies enabling preservice teachers to transparently and ubiquitously integrate technologies into their future content-specific classrooms” (p. 29). In conclusion, this study demonstrated a positive effect on preservice teachers and their technology integration knowledge and skills.

Similarly, Brush and Saye (2009) described a model of technology integration that incorporated content-specific areas with a focus on the pedagogy involved in utilizing technology in the classroom.  They have also analyzed methods to cultivate technological pedagogical content knowledge (TPACK) with preservice teachers at both Indiana University and Auburn University (Brush & Saye, 2009).  The authors utilized a dual approach to their integration efforts, which included the utilization of a collection of web resources that aided preservice and supervising inservice social studies teachers in incorporating problem-based inquiry scenarios in the classroom; and secondly, modeling of the successful integration of technology to support content-specific learning goals (Brush & Saye, 2009).

Additionally, the preservice teachers participated as students and engaged in a technology-rich, content-specific environment where education faculty served as the “teachers” and modeled the use of emerging technologies in activities that the preservice teacher could potentially utilize in their classrooms as powerful resources to support learning (Brush & Saye, 2009).  The second component of the integration process placed the preservice teachers in practicum experiences, where they explored opportunities to integrate emerging technologies into the teaching process (Brush & Saye, 2009).  Finally, student capstone projects included creating electronic portfolios to document their process and celebrate the outcomes (Brush & Saye, 2009).

Every teacher education program will possess its own unique set of characteristics that will both advance and challenge efforts to successfully, effectively and consistently offer opportunities for preservice teachers to learn how to integrate technology into their classrooms.

Examining this array of best practice efforts demonstrates that there exist some commonalities in how to effectively accomplish integration. The challenge lies in analyzing the needs and resources available, and then developing a plan unique to each situation, but with the hopes of the same outcome: a preservice teacher who is well-versed and comfortable with technology in his or her content-specific area and who has the confidence and enthusiasm to integrate it into his or her future classroom.

**Exemplary teacher education programs.** In order to identify exemplary teacher education programs, case studies conducted by Mergendoller, Johnston, Rockman, and Willis (1994), to showcase preservice teacher education programs characterized as having innovative approaches for the integration of technology, were analyzed. The specific programs selected included: Vanderbilt University, University of Virginia, University of Northern Iowa and University of Wyoming. Criteria in the selection of these teacher education programs, which were based upon Office of Technology Assessment (OTA) recommendations, advice from experts, as well as considerations from the researchers, were comprised of: evidence of effectiveness, type of technology use, population sociodemographics, and location. In their analysis of factors that promoted these programs to the status of exemplary, Mergendoller et al. (1994) found that each institution utilized technology in three manners: as an aid in bringing authentic experiences to the university classroom; to grant access to and facilitate channels of communication among individuals, documents or other forms of data; and as a tool for supporting teaching and learning and improving classroom practice.

Almost a decade later, six more teacher education programs were recognized by the International Society of Technology in Education (ISTE) as receiving the ISTE National Educational Technology Standards Distinguished Achievement Awards in 2002 (CITE, 2003).

This award highlighted those institutions considered to be exemplary in their models of technology integration utilizing the National Educational Technology Standards for Teachers (NETS*T) and were comprised of the following institutions: Wake Forest University, The Ohio State University at Mansfield, Arizona State University West, Hope College, University of Virginia, and University of Texas at Austin (CITE, 2003).

The editors of the *Contemporary Issues in Teacher Education (CITE)* journal were interested in discovering how these programs prepared their preservice teachers to utilize technology in their classrooms, and how they honed their technology skills through coursework and field experiences (CITE, 2003). Additionally, the editors sought to determine the underlying principles and foundations used to guide the successes in each of these teacher education programs (CITE, 2003). The following paragraphs will explore how these programs accomplished these goals, as well as highlighting lessons that other teacher education programs could potentially learn from these exemplary models.

***Components of exemplary models of technology integration in 1994.*** In the analysis conducted by Mergendoller et al. (1994), one major component that each of the four institutions being investigated shared was that each had a dean that shared in the vision created to effectively integrate technology. This vision was carried out by the dean in such ways as to acquire the funds necessary to carry out the process; hire technologically knowledgeable personnel who could contribute to the vision; work with senior university administration to attribute cohesiveness towards the process; and garner support from faculty in order to forward the utilization of instructional technology (Mergendoller et al., 1994). Leadership was demonstrated to be a major proponent in setting up the necessary infrastructure for technological integration and committing to the long-range goals for each institution (Mergendoller et al., 2004). These institutions were also able to advance the technology infusion process by empowering faculty who were enthusiastic and ready to engage in the steps deemed necessary for success (Mergendoller et al., 1994).

In addition to a strong, committed leadership, the authors also found that these four institutions shared the following elements that could be attributed to their success: they pursued technology integration utilizing a process composed of small, successive steps to achieve their goals; they included one-on-one support and focused on continued mentoring for faculty; they obtained outside expertise and funding to aid in their technology integration efforts; and they recognized that the process would take an extensive amount of time and resources in order to be successful (Mergendoller et al., 1994). Mergandoller et al. (1994) concluded their analysis by suggesting that the strongest contributing factor for the success of each program was that instructional technology was deemed a central focus for each preservice teachers' professional preparation. This was exhibited through modeling it; providing authentic field-based experiences with it; and integrating it into content-specific methods courses (Mergendoller et al., 1994).

During the 1997-1998 academic year, Strudler and Wetzler (1999) examined the four universities cited in the above study and sought to investigate the major aspects of each institution's teacher education program that contributed to it being exemplary; they commented on and described some of the overarching themes that the institutions had in common with each other. The first component they discussed was that of possessing a strong, committed leadership; characteristics illustrative of the leadership found in each of the institutions to include: knowledgeable, passionate, collaborative, and driven (Strudler & Wetzler, 1999). Strudler and Wetzler (1999) also found that a bottom-up leadership was a major component in the success of each program and stated: "in each of the cases studied, we found active college-level technology committees comprised of teacher educators, instructional technology educators, students, and support personnel within the college university wide" (p. 69). Training and support was provided to faculty though various strategies and included: technology skills workshops; individualized training; assistance from a dedicated technology-staff specialist; technologically-savvy student assistance; grants and initiatives as incentives for faculty development utilizing technology; technical support; access to needed technology hardware and software for both faculty and students; technologically-outfitted teacher education classrooms; an understanding of how technology and content-specific areas fit together pedagogically; and hiring new faculty and staff who are knowledgeable about technology with regards to teaching and learning (Strudler & Wetzler, 1999).

Strudler and Wetzler (1999) also described the major components of student learning opportunities that they found characterized each of the teacher education programs as a whole and these included: educational technology courses that were often coupled with practicum experiences; university emphasis on technology integration in all education courses, especially content-specific methods courses; use of national standards in which to base program curricula, for example ISTE's NETS; gradually increasing expectations of the sophistication of technology projects and subsequent integration in classroom activities; integration of technology into lower level general courses; applications in field experiences; and distance learning opportunities for students located in remote areas. Data collected in this study report positive student outcomes; these include motivation to utilize technology in the classroom; confidence to take on risks with various forms of technology and overcoming obstacles often found with using it; and a willingness to take on leadership roles (Strudler & Wetzler, 1999).

***Components of exemplary models of technology integration in 2002.*** In 2003, the *CITE* journal featured articles about each one of the six teacher education programs recognized as receiving the ISTE National Educational Technology Standards Distinguished Achievement Awards in 2002. The recipients of this award included: Arizona State University West; Hope College; Ohio State University, Mansfield; University of Texas, Austin; University of Virginia; Wake Forest University and Valley City State University (ISTE, n.d.). These profiled teacher education programs shared characteristics with those synthesized from the four case studies discussed by Strudler and Wetzler (1999) above and included: committed leadership and faculty; technology support for faculty and students in a variety of contexts, such as one-on-one help and workshops; access to hardware and software resources; and comprehensive technology integration from lower level courses, content specific methods courses and field experiences (CITE, 2003; Strudler & Wetzler, 1999).

In addition, Hofer (2005) also conducted a study comparing the institutions examined by Mergendoller and his associates in 1994 to those recognized by ISTE in 2002. The first difference, he found, was the continued emphasis of integrating technology comprehensively, particularly in field experiences, throughout the teacher education program, as opposed to the stand-alone technology course. Another difference was that support for technology integration, not only came from the deans, but also the faculty and had shifted to more of a bottoms-up approach; additionally, with federal initiatives like PT3, later programs have had more financial support in their efforts to integrate technology (Hofer, 2005). Lastly, the use of technology, as with the rest of society, has advanced quite rapidly (Hofer, 2005).

Despite these contrasts between the two groups of institutions, Hofer (2005) also discovered quite a few commonalities between 1994 and 2002. Three key issues were identified.

First, instruction and experiences involving technology must be well planned in order to result in a smooth and successful implementation process (Hofer, 2005). Second, stakeholders need to be unified when developing a plan and should allow themselves to be led by the mission and philosophy of the program (Hofer, 2005). Lastly, a shared vision among the leadership and faculty of the teacher education program is crucial for success (Hofer, 2005). These are some of the general differences and similarities that were found between the two groups of exemplars between 1994 and 2002. What follows is a brief look at some of the specific characteristics found in two of the programs that made them innovative.

Teacher education graduates at Wake Forest University leave the program equipped with an IBM Thinkpad, printer, educational software and are even eligible to receive up to $200 to help with equipping their new classrooms with other forms of technology (Cunninghan, 2003). In addition, it is not uncommon for new graduates to stay in touch with faculty during their first year of teaching in order to continue receiving support during this critical first year (Cunningham, 2003). Some graduates have even remained involved with departmental activities and initiatives (Cunningham, 2003).

Hope College preservice teachers spend time not only investigating how technology can support teaching and learning in regular education, but also how assistive technologies, and the laws that require their use, benefit students with disabilities (Cherub & Synder, 2003). One additional example occured at Ohio State University at Mansfield where the program situates their classroom-based inquiry framework on the constructivist foundations of such researchers as Piaget, Vygotsky, Dewey and Bruner: “The methods and general pedagogy courses use constructivist practices, such as cooperative learning, discovery learning, emergent curriculum development, and using student interests" (Bucci, Copenhaver, Johnson, Lehman, & O'Brien, 2003, p. 41).

**Summary of technology integration and teacher education.** This section of the literature review covered several topics as related to technology integration and teacher education. First, barriers that have inhibited the integration of technology within teacher education were highlighted. NCATE (1997) conveyed that teacher educators reported some of the following problems in utilizing technology in their respective programs: lack of time, technology, and support, as well as a restrained emphasis on faculty training in technology, and lack of incentives for technology innovation. These same barriers were found in much of the literature base on the same topic.

Secondly, conditions that that foster technology integration within teacher education programs were examined. Four major conditions were synthesized from the literature that have been shown to foster acceptance of technology integration in teacher education: adequate access to hardware and software; technology support for individuals and in classes; peer models of effective technology uses; and incentives such as release time, compensation, and recognition for success. More may exist that are specific to individual programs and departments, but these are the major ones represented in the literature base and should be considered before transitioning towards an enhanced, technology-rich teacher education program.

Third, best practices with regards to technology integration training in teacher education for faculty and preservice teachers were analyzed. Several common themes were extracted from literature dealing with best practices with regards to faculty and technology integration. First, successful processes of technology infusion in teacher education begin with effective professional development of the teacher education faculty, not only in adopting base technology skills, but in understanding the pedagogical significance of incorporating technology in their content-specific methods courses in order to model these processes to preservice teachers (Dexter et al., 2006; Whittier & Lara, 2006). Also, instructional technology faculty need to collaborate with teacher education faculty to gain a better understanding of content-specific areas and how technology can support these various areas (Dexter et al., 2006; Wright et al., 2002). Once teacher education and instructional faculty have revised their syllabi and course content to support the integration of technology, attention can then focus on developing experiences that will be provided for the preservice and supervising inservice teachers involved with the program.

Underlying themes common to many of the programs showcased here as models of best practice with regards to preservice teachers and technology integration, included technology training for preservice teachers that began in the content-specific methods and instructional technology courses, where not only were students provided with technology skills training, but they were also presented with models of technology integration by faculty (Brush et al., 2003; Brush & Saye, 2009; Keeler, 2008). Further, students were afforded the opportunity to develop their own technology projects to support learning and teaching, as well as time to reflect upon these processes in order to encourage critical thinking skills regarding their choices (Brush et al., 2003; Brush & Saye, 2009; Keeler, 2008). Another common thread that served as a best practice with regards to the training of preservice teachers in the area of technology integration was the use of a technological pedagogical content knowledge (TPACK) approach, which advocated a focus on the pedagogy of technology integration within content-specific areas (Brush & Saye, 2009; Keeler, 2008). The last underlying principle realized through analyzing these best practices was the fact that preservice teachers need to be provided with technology-rich environments both in the classroom and in their field-based experiences; this involves the collaboration of teacher education faculty, instructional technology faculty, preservice teachers and the supervising inservice teachers to develop such valuable opportunities (Brush et al., 2003; Brush & Saye, 2009; Seels et al., 2003; Wright et al., 2002).

The final component of this section dealt with examining exemplary teacher education programs in order to compile a shared list of characteristics that have contributed to the effectiveness of each institution's technology integration practices. Interestingly, Hofer (2005), as previously discussed, conducted a study comparing the institutions examined by Mergendoller and his associates in 1994 to those recognized by ISTE in 2002. Three key, unifying issues were identified. First, instruction and experiences involving technology must be well planned in order to result in a smooth and successful implementation process (Hofer, 2005). Second, stakeholders need to be unified when developing a plan and should allow themselves to be led by the mission and philosophy of the program (Hofer, 2005). Lastly, a shared vision among the leadership and faculty of the teacher education program is crucial for success (Hofer, 2005).

Kay (2006) reviewed the literature detailing various strategies utilized to incorporate technology in preservice teacher education following the implementation of many PT3 grants. It was found that many programs claimed an integrated approach was the most successful, but Kay (2006) discovered a lack of evaluation efforts to corroborate these claims. It was found that regardless of the strategy utilized to integrate the technology, modeling effective uses of technology and providing authentic instructional activities for preservice teachers was very significant in order for transfer to occur from the university setting to the K-12 classroom (Kay, 2006).

Brown and Warschauer (2006) also summarized findings surrounding research related to PT3 projects:

> These findings include the need for university faculty to upgrade their technological expertise, to model technology infusion into curricula, and to provide a comfortable learning environment for technology application. These studies also pointed to the importance of placing student teachers in technologically rich and supportive environments. (p. 601)

In conclusion, teacher education programs can learn important lessons by paying attention to some of the best practices discussed in this section, as well as the major characteristics shared by the programs identified as being exemplary. Elements of learning transfer and practices demonstrated to support the transfer of technology integration knowledge and skills will be discussed in the next section.

**Transfer of Technology Knowledge and Skills to the Classroom**

The previous section of this chapter discussed a variety of best practices found in teacher education programs considered to utilize effective technology integration training. Additionally, it has been articulated several times that literature focusing on research examining the technology practices of early career teachers has been limited with respects to their preservice training. This section will investigate the literature that is available. However, before that is done, the notion of transfer will be investigated. The following topics will be explored in this chapter: origins of transfer; definition of transfer; conditions of transfer; theoretical perspectives of transfer; situated cognition; cognitive apprenticeship; transfer as related to technology integration and teaching; barriers to learning transfer; promoting positive transfer; and the section will conclude with studies that focus on transfer of technology knowledge and skills to the classroom.

**Origins of learning transfer.** The notion of transfer is a key issue in the world of education. Successful outcomes in learning depend upon whether teaching and instruction in one context can successfully relate to other similar situations (Halpern, 2003; Perkins & Saloman, 1994). Unfortunately, a plethora of research demonstrates that positive transfer does not often occur, and thus, "the prospects and conditions of transfer are crucial educational issues" (Perkins & Saloman, 1994, p. 6452). Transfer is not just a recent concern, however. Thorndike and Woodworth (1901) compared the mind to a "dynamic machine" that specifically adapts itself to specific occurrences and "works in great detail, adapting itself to the special data of which it has experience" (pp. 249-250). Thorndike and Woodworth (1901) argued that learning transfer occurred more successfully in situations where the learning task and the transfer task shared similar characteristics; this approach was respectively coined the identical elements theory.

Brown (1990) noted that Thorndike's contemporaries took a different perspective and focused on transfer as a process that will not occur if the information that is learned is not meaningful and relevant to the learner first. Further, "when learning can be organized around a guiding principle…transfer is determined by the extent to which the learner understands the principle" (Brown 1990, p. 109). For example, Judd (1939) negated Thorndike's identical elements theory of transfer and instead, proposed that transfer was more dependent upon understanding principles that are general in nature and possess a high degree of generalizability. Principles therefore, learned for one task can be broadly transferred to another similar task (Judd, 1939).

**Defining learning transfer.** The terms learning and transfer are often defined as separate entities. Greeno et al. (1996) summarized learning as a procedure by which knowledge and skills are expanded or adapted, and transfer is the action of implementing knowledge in new contexts. Gick and Holyoak (1987) specified that the only difference between transfer and learning is that in transfer, the tasks involved are not the same. However, in learning, the tasks are repeated, but the tasks are never identical (Gick & Holyoak, 1987). Perkins and Saloman (1994) defined transfer of learning as a process that “occurs when learning in one context or with one set of materials impacts performance in another context or with other related materials” (p. 6452).

Educators want the knowledge and skills that students develop in school to be applicable in a general sense to students’ lives outside of school, as opposed to being restricted to contexts within the classroom, where it is amassed (Halpern, 2003; Greeno et al., 1996). Research has demonstrated that in order for learning transfer to be considered effective, a significant amount of “original learning” must occur first (Bransford & Schwartz, 1999, p. 63). Positive transfer takes place when learning in one situation, or context, contributes to learning success in another situation (Perkins & Saloman, 1994). On the contrary, negative transfer takes place when learning in one situation does not aid or even inhibits the learning success in another context (Perkins & Saloman, 1994).

A prominent condition of positive transfer includes an individual’s ability to accept the viewpoints and opinions of others, because this enhances their ability for future learning as well (Bransford & Schwartz, 1999). Gick and Holyoak (1987) stated, “the magnitude and direction of transfer reflects the similarity relationship between the structure of the two tasks (p. 10). Halpern (2003) suggested that the most important factor in supporting transfer and “long-term retention" is the practice of "generating responses, with minimal cues, repeatedly over time with varied application so that recall becomes fluent and is more likely to occur across different contexts and content domains" (p. 38). Now that elements of both learning and transfer have been defined, conditions for transfer will be discussed in the next section.

**Conditions of learning transfer.** Perkins & Saloman (1988) claimed empirical studies have demonstrated transfer does not often occur and that this failure may be attributed to a number of factors. A more prominent claim, however, has been that much of the learning that occurred has been too specific or "local" for transfer to be successful (Perkins & Saloman, 1988, p. 25). Bransford and Schwartz (1999) noted that allowing individuals to encounter knowledge and skills at varying levels of abstraction could rectify these issues. Further, "appropriate problem representations increase positive transfer and decrease the probability of negative transfer" (Bransford & Schwartz, 1999, pp. 64-65). Halpern (2003) advocated "varying the conditions under which learning takes place," which she admitted makes learning more difficult for students, "but results in better learning," (p. 39).

Bransford and Schwartz (1999) sought to broaden the traditional views on transfer, by offering an alternative that expanded ideas that had already been considered. They contended that emphasis also needs to be placed on an individual's "preparation for future learning (PFL)," which not only considers a person's ability to learn, but their ability to utilize available resources in a knowledge-elaborate situation (Bransford & Schwartz, 1999, p. 68). With regards to PFL, Leberman, McDonald, and Doyle (2006) stated that it is "another theory of transfer, which complements rather than displaces other theories, which they [Bransford and Schwartz] see as being useful in some contexts and for some reasons" (p. 28).

Gick and Holyoak (1987) devised a model based upon four factors that could affect the performance of transfer, which included: the structure of the concept or task to be learned and its association with the concept or task to be transferred; assessing whether the conditions of encoding authenticate the learning materials and are relevant for the identified transfer task; conditions for retrieval that affect the connection and application of relevant knowledge; and lastly, what knowledge the individual already possesses in relation to the task.

Subsequently, how transfer occurs is just as important as what transfers and therefore, it is necessary to differentiate between two different mechanisms by which transfer operates: low road transfer and high road transfer (Perkins & Saloman, 1988; Saloman & Perkins, 1989). Low road transfer occurs when situations arise that activate processes in an individual that have been repeated and practiced so many times, that it almost happens without much thought (Perkins & Saloman, 1988; Saloman & Perkins, 1989). The example of driving a car and then having to drive a truck was described in reference to how an individual could likely make the transition smoothly and effectively, because driving a vehicle becomes second nature through recurrent experience (Perkins & Saloman, 1988; Saloman & Perkins, 1989). High road transfer is different in that it involves an individual purposefully and consciously extracting knowledge and skills from one context in order to apply them in another (Perkins & Saloman, 1988; Saloman & Perkins, 1989). An example of high road transfer would include recalling data analysis techniques for specific research designs in order to identify the correct one to utilize in a new research design.

Two techniques that also promote transfer are “hugging” and “bridging” (Perkins & Salmon, 1988, 1994). Hugging takes advantage of reflexive transfer and includes involving learners in instructional activities that are similar to situations where they can apply what they have learned; examples include role-playing, teaching a lesson for practice, or taking practice tests (Perkins & Saloman, 1988, 1994; Harris, Lowery-Moore, & Farrow, 2008). Bridging, however, means setting the stage for high road transfer to occur (Perkins & Saloman, 1988, 1994). This type of instruction includes strategies that involve abstract thinking; ones that create opportunities to identify connections between topics; and ones that allow for an examination of one's own metacognitive characteristics (Perkins & Saloman, 1988, 1994; Harris et al., 2008). In conclusion, Perkins and Saloman (1988) described that in the process of teaching for transfer, a teacher must first determine what type of transfer is appropriate and then create instruction that aligns with the transfer desired.

Haskell (2001) went further in his classification on the levels of transfer and identified a taxonomy of various stages of transfer that build upon each other. First, there is nonspecific transfer, because Haskell (2001) stated, all learning is based upon some sort of connection to knowledge that was acquired in the past, and any learning that occurs requires some sort of transfer of learning. Secondly, Haskell (2001) identified application transfer, which means applying what you've learned about a specific task to a specific application. Third, is context transfer, which refers to applying what one has learned to a slightly different scenario (Haskell, 2001).

Fourth in this taxonomy of transfer stages, is near transfer, which is similar to Perkins and Saloman's low road transfer, but accounts for learning that has occurred in the past and is then applied to a slightly dissimilar situation (Haskell, 2001). The fifth level is far transfer and is similar to high road transfer, where learning must be applied to dissimilar situations than what was originally learned; this has sometimes been termed learning by analogy (Gick & Holyoak, 1987; Haskell, 2001; Leberman et al., 2006). Last in the taxonomy, is displacement or creative transfer, which refers to transferring knowledge in a way in which a totally new concept is born (Haskell, 2001). These levels share similar characteristics to those offered by Perkins and Saloman; however Haskell creates additional levels that contain more specific variables within each level. This section identified various conditions of transfer identified in the literature. The following paragraphs will describe varying perspectives on transfer based on an array of learning theories.

**Varying perspectives on learning transfer.** Several different views on transfer exist and they are each founded on applicable theories of learning (Greeno et al., 1996; Haskell, 2001). This section will highlight several of the more popular perspectives and will include: behaviorist/empiricist, cognitive/rationalist, and situative/pragmatist-sociohistoric. In the behaviorist/empiricist view, obtaining knowledge creates associations and the process of learning within a new context is dependent upon the level of associations that have already been encountered in previous contexts (Greeno et al., 1996). A reaction acquired as an association to one stimulant generalizes more firmly to other stimulants that share the same characteristics as the initial stimulant, and less to those that don't share a similar likeness in one or more realms (Greeno et al., 1996). Haskell (2001) termed this "stimulus generalization" and defined it as the drawing out of a response that has not been reinforced by a stimulus that is closely related to the original conditioned stimulus. Leberman et al. (2006) termed this "associationism," and stated: "unobservable internal states were not considered important in this learning" (p. 11). The internal stage was, however, considered in the cognitive perspective, which will be discussed next.

In the cognitive/rationalist perspective, transfer is dependent upon obtaining an "abstract mental representation" in what is referred to as schema, which is a generalized structure of knowledge (Greeno, 1996). The structure is general therefore, a solution or skill needed for one task will be transferred to the solution or skill needed for the execution of another task (Greeno, et al., 1996, p. 23). Haskell (2001) stated: "New information is assimilated, learned, and interpreted in terms of relevant pre-existing schemata (p. 82). Anderson, Reder, and Simon (1996) contended that theories in cognitive psychology advocate that learning occurs more effectively when abstract instruction is integrated with concrete examples with regards to the information being presented. Further, this method is quite powerful when the knowledge must be applicable to a multitude of future tasks (Anderson et al., 1996).

The situative/pragmatist-sociohistoric view focuses on the participatory nature of education where students are actively involved in learning communities that are characterized by working together to develop questions, solve problems and formulate conclusions with regards to issues or arguments (Greeno et al., 1996; Lave, 1993). Thinking includes a plethora of cognitive skills, and the situative view recognizes that each one of these skills is independently obtained in activities that are socially adapted, and always connected to a specific context where they originated (Guberman & Greenfield, 1991). Haskell (2001) described this model as one that focuses not on the individual, but rather on the individual's participation in a social activity and "that includes the very structures that form, facilitate, and cue transfer" (p. 85). Further, "learning and knowing are processes of participation and apprenticeship in communities of practice. The master-novice relationship is considered important when learning about these interactions and transferring them to new situations" (Konkola, Tuomi-Gröhn, Lambert, & Ludvigsen, 2007, p. 213).

In conclusion, this section has presented four different perspectives on transfer. It highlighted the behaviorist/empiricist view, which dictates that numbers and levels of associations with stimuli affect whether transfer takes place (Greeno et al., 1996). The cognitive/rationalist view deems that knowledge obtained while performing one task should transfer to the ability to perform another, similar task (Greeno et al., 1996). Lastly, the situative/pragmatist-sociohistoric view is characterized by communities of practice, as well as meaningful learning activities (Greeno et al., 1996; Lave, 1993). The next section will more closely examine situated cognition, which combines aspects of the cognitive/rationalist view and the situative/pragmatist sociohistoric view.

***Situated cognition.*** One reason that situated cognition is being explored here is because it is considered relevant to many of the best practice methods mentioned in the second component of this review of literature. Many of the best practice methods, advocated that preservice teachers observe, experience and practice technology integration within their field experiences, which maintains that learning would be situated in order to promote transfer to real classrooms. Field experiences seek to bride the gap between classroom learning and a new teacher's actual classroom; therefore, field experiences offer meaningful and authentic contexts in teacher education.

As mentioned in the introduction of this third section, there are many reasons that transfer of knowledge is challenging and often fails. Collins (1991) argued that when learning occurs in multiple situations, one learns a variety of ways in which knowledge can be utilized and this allows learners to generalize about these different avenues. Unfortunately, this is quite the opposite of how learning occurs in schools today, where abstract concepts are taught, and then often applied in one context, rather than teaching in a multitude of contexts and then determining the generalizability across those contexts (Collins, 1991). Lave and Wenger (1991) commented:

“the generality of any form of knowledge always lies in the power to renegotiate the meaning of the past and future in constructing the meaning of present circumstances (p. 34).

Brown, Collins, and Duguid (1989) also described schools as places where knowledge is broken down into abstract concepts with no relation to a context. They contended however, “the activity in which knowledge is developed and deployed…is not separable from or ancillary to learning and cognition…Learning and cognition, it is now possible to argue, are fundamentally situated” (Brown et al., 1989, p. 32). Brown et al. (1989) proffered that students in today’s classrooms need to be provided with the opportunity to be engaged in authentic activities. Authentic activities are those that are familiar to a certain culture.

In order to develop a better understanding of situated cognition, Brown et al. (1989) compared the role of a student to that of an apprentice, where the individual is fully immersed in the environment in which they are to learn the related processes, routines, problems and solutions of a particular trade. The activities in which the apprentice is engaged are authentic and meaningful because they are similar to those that will be encountered in the real world (Brown et al., 1989). Like an apprentice they are “given the chance to observe and practice in situ behavior of members of a culture, people pick up relevant jargon, imitate behavior, and gradually start to act in accordance with its norms” (Brown et al., 1989, p. 34).

One of the advantages of the situated learning movement has been the heightened focus on the discrepancy between what is taught in today’s schools and what is needed to be productive in today’s workforce (Anderson et al., 1996). Lave (1993) contended that situated learning offers an alternative to current educational practices. Lave and Wenger (1991) described situated cognition or learning in relation to a process they termed *legitimate peripheral participation*, where learners imminently become involved with communities of experts. In order to become experts themselves in a specified domain, as newcomers, they will have to travel toward full participation in the social and cultural practices of this community (Lave & Wenger, 1991). Further, they emphasized that legitimate peripheral participation is not itself an instructional strategy or education method, but rather a viewpoint on learning and understanding how it takes place (Lave & Wenger, 1991).

Collins (1991) summarized that situated learning is the premise that acquiring knowledge and skills should be done within contexts that resemble those that will be encountered and effective in real life situations. Further, Collins (1991) advocated that the advantages of situated learning include first, the fact that students learn in situations where knowledge and skills are applicable. Secondly, situations cultivate innovation in that students learn to utilize their knowledge in an adjustable manner in order to accommodate new situations (Collins, 1991). Third, students observe the practical applications of the knowledge they have acquired and lastly, context can aid in organizing knowledge in the manner in which it is utilized (Collins, 1991).

This is not to say that situated cognition is the only instructional theory that should be applied in today's classroom, but rather it "provides a broad, useful framework that emphasizes the importance of focusing on everyday cognition, authentic tasks, and the value of in-context apprenticeship training" (Cognition and Technology Group at Vanderbilt [CTGV], 1990, p. 9). Cognitive apprenticeship is a situated instructional method that claims many of the same benefits presented previously. The next section will discuss cognitive apprenticeship in more detail as it employs many of the instructional strategies advocated by effective teacher education programs.

***Cognitive apprenticeship.*** Traditional apprenticeship dates back to a time before learning was formally acquired in a schoolhouse (Brown et al., 1989). Traditional apprenticeships exist today, but are not as prevalent. They usually consist of an individual learning a task or job by being immersed in the environment where the task or job is to be performed (Brown et al., 1989). Apprentices observe, help and eventually perform the task, first with close supervision and then gradually, as they gain more experience and confidence, on their own (Brown et al., 1989). Cognitive apprenticeship, like traditional apprenticeship, is a very useful model for learning, which will likely increase the chances of knowledge and skills transferring to real world situations (Collins, Brown, & Hollum, 1991; Collins, Brown, & Newman, 1987; Lave & Wenger, 1991). Collins et al. (1987) stated, "in cognitive apprenticeship, conceptual and factual knowledge is exemplified and situated in the contexts of its use" (p. 5).

There are differences between the traditional and cognitive apprenticeships, however. In cognitive apprenticeship, the following needs to occur: most importantly, thinking involved in the process needs to be clearly identified and made visible or brought into the open with reference to both the student and teacher (Brown et al., 1989; Collins et al., 1987). Second, abstract functions that are centered on the school's curriculum and standards have to be purposefully situated in contexts that are meaningful to the students and are clearly relevant (Brown et al., 1989; Collins et al., 1987). Lastly, skills need to be taught in a manner in which the students can generalize them across a variety of contexts and transfer the skills on their own when they encounter a new situation (Brown et al., 1989; Collins et al., 1987). Leberman et al. (2006) stated, "the cognitive apprenticeship approach is a staged approach in which the 'apprentice' develops from being a dependent observer to becoming an independent practitioner" (p. 16). To demonstrate the applicability of cognitive apprenticeship in education, two examples will be presented.

Palinscar and Brown's (1984) reciprocal teaching method of reading demonstrated many of the beneficial qualities of cognitive apprenticeship. This process was reciprocal because the students and teacher took turns playing the role of the teacher (Palinscar & Brown, 1984). The students and teacher silently read a paragraph and then the "teacher" generated a question, composed a summary, and constructed a prediction or interpretation (Palinscar & Brown, 1984). The teacher modeled the process first, then coached the students in their creation of questions, summaries and predictions, as well as providing constructive feedback, which can be termed scaffolding (Palinscar & Brown, 1984). As the students became more proficient with the process, the teacher was able to fade instructionally, by gradually relinquishing supports (Palinscar & Brown, 1984). Modeling, coaching, scaffolding and fading are all features of cognitive apprenticeship (Brown et al., 1989; Collins et al., 1987).

In another example that exemplified the qualities of the cognitive apprenticeship model, Scardamalia, Bereiter, and Steinbeck (1984) conducted an instructional study, which involved sixth graders and was aimed at improving their written composition skills. Scardamalia et al. (1984) described that writing is often a one-way communication process and so, they advocated a two-way process included modeling ideas aloud; using cues to aid students with questioning their choices during planning; and direct instruction aimed at supporting students in strategizing on how to synthesize competing ideas. This enabled the researchers to influence the students to generate a similar format of two-way communication with regards to the writing process on their own (Scardamalia et al., 1984). These writing tactics are ones utilized by experts and so, by leading the students through the process and then gradually lessening the supports, students were able to navigate it on their own (Brown et al., 1989; Collins et al., 1987). The cognitive apprenticeship traits of: modeling, coaching, scaffolding and fading were again, all present in the process (Brown et al., 1989; Collins et al., 1987).

The examples provided illustrate how cognitive apprenticeship can be utilized as a framework for learning in the classroom, where students are situated within the learning activity, yet provided guidance from an expert, that lessens as the student gains experience (Brown et al., 1989; Collins et al., 1987). Situated cognition and cognitive apprenticeship correspond with many of the qualities set forth by the best practice methods involving technology integration. Programs that demonstrated effective instructional strategies or exemplary comprehensive programs boasted learning in multiple authentic learning environments and instruction that involved modeling, coaching, fading, evaluating and reflecting. The next section will examine transfer through a different lens, not just in regard to learning in general, but learning and transfer when it deals with technology and integrating it effectively into a classroom environment.

**Transfer related to technology integration.** Even though transfer is the goal of any learning situation, accomplishing it successfully is challenging, especially when it involves technology. Howard (2002) stated that transfer is not as common when: the intellectual skills to be acquired are fact-driven and not related to the widespread body of knowledge; desired skills are obtained in a generic context; and when transfer is estimated to be intuitive or automatic. There are other issues that can hinder the transference of knowledge and skills from the educational context to a real world context. Brown et al. (1989) qualified that when activities intended for transfer are delivered in classroom contexts, they tend to mirror the culture of the classroom, lacking the necessary authenticity that promotes positive transfer.

Alderman (2008) stated that in applying this to teacher education, such a situation could pose a problem for preservice teachers, because, as they attempt to relate integrating instructional technology skills into their own classrooms, they possess relatively little practical experience in the classroom, which can hinder the transfer of these skills. Additionally, today there exists a plethora of instructional strategies and instructional technologies to master. It is also challenging for teacher educators to develop learning activities integrating technology that will be relevant outside the scope of the course, because teaching situations and resources are so diverse (Alderman, 2008).

***Technology integration transfer barriers.*** Royer and Richards (2009) stated the factors that hinder the transfer of technology integration knowledge and skills were varied, but that they included: a lack of technological expertise or confidence on part of the instructor; absence of or diminished technical support and administration; inadequate access to technology equipment or software; and constrained time limits for practice and experimentation. West and Graham (2007) proffered that preservice teachers gain teaching skills by modeling themselves after other teachers, which includes their previous K-12 teachers, education faculty and mentoring teachers from their field-based experiences. Unfortunately, research has demonstrated that many of these teachers do not effectively integrate instruction into their classroom practice, thus providing poor examples for prospective teachers and again, limiting the potential of knowledge transfer of these skills to their own future classrooms (West & Graham, 2007).

***Promoting positive technology integration transfer.*** Transfer, however, is more likely to occur when the "salient qualities of transferable learning experiences occur in an environment that is characterized by meaningful activities, expert guidance, and knowledge-building collaboration (Howard, 2002, p. 347). Additionally, educators should consider the following when making decisions regarding which aspects are the most significant when designing instructional strategies: types of environments the student may encounter in which knowledge transfer would be necessitated and desirable; knowledge required in order to provide successful knowledge transfer; and identification of additional environments where specific knowledge transfer might prove useful (Butterfield & Nelson, 1989). Brown et al. (1989) asserted that the practice of cognitive apprenticeship provides an opportunity that increases the chances of transfer in teaching and learning; "cognitive apprenticeship methods try to enculturate students into authentic practices through activity and social interaction in a way similar to that evident—and evidently successful—in craft apprenticeship" (p. 37).

Additionally, West and Graham (2007) advocated increasing opportunities for all teachers to further their expertise with regards to technological pedagogical content knowledge (TPACK), as has been previously discussed in this chapter. West and Graham (2007) contended:

> In addition to content knowledge, and knowledge about how to teach (pedagogical knowledge), and knowledge about how to teach a particular content (pedagogical content knowledge, that there is a fourth type of knowledge essential for today's teachers. This is the knowledge of how to use educational technologies effectively to teach a particular content area. (p. 132)

Mishra and Koehler (2006) described that viewing these three (technology, pedagogy, and content) in isolation of each other provides a disservice to preservice and inservice teachers because technology in a "context-neutral" environment promotes "generic solutions to the problem of teaching" (p. 1032).

Rather, Mishra and Koehler (2006) advocated a "learning-technology-by-design approach" where the focus is placed on a more hands-on, experimentation environment and further emphasizes a “construction of artifacts (such as online courses, digital videos, and so on)” (p. 1035). Butterfield and Nelson (1989) also affirmed that transfer is strongest when students have “encoded previously all and only critical elements in the relationship structure of a learned mental model and has selected all and only critical elements in the representation of the current problem” (p. 16). In order to further explore these concepts, the next section of this chapter will explore the literature that seeks to promote instructional strategies and models that increase the likelihood that preservice teachers will transfer technology knowledge and skills developed in a teacher education program to their own K-12 classrooms. Following a description of those studies dedicated to measuring the transference qualities of these instructional strategies and examining their recommendations for future study or improvement, a synthesized list of common characteristics will be presented as part of the conclusion.

**Technology integration studies focused on transfer.** Howard (2002) described a project supported by a PT3 initiative at Elon University, that enabled faculty involved with methods courses in the teacher education program to issue significant modifications. The purpose of this project was to boost knowledge transfer, with regards to instructional strategies and activities, from the university setting into K-12 classrooms to eventually support the learning and achievement of younger learners (Howard, 2002). A project-based approach was chosen as the instructional strategy to promote knowledge transference, because the characteristics of project-based activities support conditions that foster the likelihood that transfer will occur (Howard, 2002). These characteristics include students being: engaged in a meaningful activity or process; situated in a context that is applicable to the real world environment for which the transfer is desired; involved in collaborative work with each other and experts; and facilitated and coached by the teacher, where the learner is also encouraged to think independently (Howard, 2002).

Although at the time this article was written, a formal evaluation had not been carried out, the author did note that several of the students from the first two rounds of this process had contacted university faculty and indicated that they were utilizing a technology-enhanced version of the project-based learning process in their own classrooms (Howard, 2002). Thus, this informal data invoked optimism that the dual purposes of transfer were taking place (Howard, 2002). These previous students had confirmed utilizing what they learned in their preservice teacher education courses in their own classrooms and that they were successfully equipped with instructional methods and skills that promote transfer to their own students (Howard, 2002).

West and Graham (2007) implemented a modeling approach to an instructional technology course in the hopes of increasing knowledge transference for preservice teachers. The course itself was designed to expose the preservice teachers to a variety of educational technologies in the context of its application in the classroom; therefore focusing on the pedagogical attributes of each example in content-specific subjects (West & Graham, 2007). The live modeling sessions were composed of three stages and included: example lessons taught by the instructor utilizing a form of technology coupled with the students completing a project correlated with the session; students collaborating to create an outcome that evidenced their comprehension of the technology and content area; students being encouraged to reflect upon the experience; and relating the knowledge obtained to a potential classroom context (West & Graham, 2007).

The live modeling sessions exhibited three benefits for the students: hands-on experiences with various forms of technology, in-class assistance and support while initially working with the technology, and the fact that the learning took place in a context similar to a K-12 classroom (West & Graham, 2007). The authors also discovered five challenges that hindered the potential transfer of the simultaneous technology and pedagogical training, which included differences among: subject matter, intended age of future students, teaching styles, course expectations and technology resources (West & Graham, 2007). This study was considered important because it demonstrated to the researchers and other teacher educators that the number of contextual differences present when preservice teachers are attempting to transfer knowledge affects the success or failure of that transfer (West & Graham, 2007). The number of contextual differences and the potential influence of each challenge identified was dependent upon each individual student, however (West & Graham, 2007).

Williams, Foulger, and Wetzel (2009) detailed a project called *Innovation Mini-Teach* at a large urban university in the Southwest, which "was developed to acquaint preservice teachers with new and evolving technologies in an atmosphere where they could help each other learn their assigned technology, better understand how technology could be integrated, and contribute to their collection of teaching ideas and materials by way of the accumulated wiki" (pp. 396-397). Based upon an inventory measuring prior knowledge of instructional technologies, the educational technology instructors: placed the preservice teachers into small groups; assigned them an emerging technology to explore; had them research its capabilities and possible uses in a classroom; and then present a brief, hands-on workshop to their peers (Williams et al., 2009).

Prior to these presentations, however, the course instructors modeled how the technology should be effectively demonstrated to the rest of the class (Williams et al., 2009). Additionally, the purpose of the presentation was not exclusively to learn about the technology example, but rather, it was more for the preservice teachers to explore the potential for technology integration in their own classrooms (Williams et al., 2009). Williams et al. (2009) stated that data analysis from this study revealed the preservice teachers utilized the following strategies: collaborated with others, located information from an expert source, experimented with a technological program or tool, utilized the Internet for information, and asked the instructor for help. Additionally, three themes emerged indicating evidence of the project's possible effect on the preservice teachers' classrooms in the future: elemental knowledge to reinforce future contexts; a more robust vision for the incorporation of technology into the classroom; and advancements in foundational beliefs about the potential of their teaching (Williams et al., 2009). Because of these revelations, Williams et al. felt that the project was successful in promoting a context in which the confidence of the preservice teachers and their work with instructional technology would transition into their professional teaching lives (2009).

Sexton, Gordon, and Guimond (2009) demonstrated the results of an analysis that was performed on the e-portfolios of their elementary education preservice teachers, who were required to add supporting artifacts and documents to an e-portfolio during each semester of the program. The purpose of the analysis was to evaluate whether and to what extent the preservice teachers were transferring knowledge and skills developed during an instructional technology course, recently aligned with the NETS*T principles, to other methods courses, and eventually to their own classrooms (Sexton et al., 2009). Upon completion of the e-portfolio analysis, Sexton et al. (2009) surmised that additional changes would need to be made to the instructional technology course, even though the instructors were already grounding their instruction with technology in authentic examples and contexts. Specifically, three revisions had to materialize if their preservice teachers were to start indicating more uses for instructional technologies in their future elementary classrooms: content-specific area faculty must also model innovative uses of instructional technology; teaching strategies requiring the use of technology must be utilized in methods courses as much as possible; and field experiences must provide technology-rich environments for the preservice teachers where they could observe the modeling of technology and practice utilizing it themselves. Overall, Sexton et al. (2009) concluded that expectations for technology integration must be much more definitive throughout the entire program and that all faculty in the program must model innovative usage of technology for instruction in order to promote the transfer of knowledge and skills.

Lambert, Gong, and Cuper (2008) presented a study conducted at a Midwestern university where a single instructional technology course, based on ISTE's NETS principles, was revised to account for student differences, in the hopes that it would enable instruction with regards to technology integration to become more effective. The individual differences focused on included: "attitude (e.g., anxiety, confidence, beliefs about the general usefulness of computers and their usefulness in education, and predisposition toward computers, etc.), and preservice teachers' perceived ability to use technology tools effectively" (p. 389). The instructional technology course was differentiated by proficiency level and taught in a computer lab (Lambert et al., 2008). The course also included: brief modeling of educational software, relevant reading exercises about technology use in the classroom, video-based case studies, reflections on learning involved with the assignments, online activities, exposure to content-specific area resources, and collaborative multimedia projects (Lambert et al., 2008).

Results revealed that the preservice teachers involved in this study exhibited no difference in their general computer attitudes based on their year of college or grade they intended to teach (Lambert et al., 2008). However, students who rated themselves as high proficiency with regards to technology also reported feeling less anxious and more confident in working with technology than those who reported themselves at a lower proficiency level (Lambert et al., 2008). Additionally, Lambert et al. (2008) reported that all the students exhibited increasing positive attitudes towards the usefulness of technology in the classroom, but that even at the end of the course, more proficient students expressed stronger attitudes about technology as a teaching tool, than the less proficient students. Lambert et al. (2008) concluded from this study that a single technology course can grant much more than just technology skills, "but it takes a combination of technology integration approaches over an extended period of time to provide these students with real meaning, context, and enough practice to ensure this learning transfers to their future classrooms" (p. 407).

Brown and Warschauer (2006) provided details from a study conducted at a public research university seeking to identify useful and effective instructional strategies that can be utilized to aid in teacher education preparation and promote transfer of these skills to K-12 classrooms. Field-based experiences were to be highlighted in this analysis (Brown & Warschauer, 2006). The researchers collected data from all aspects of the teacher education program though surveys, observations, group and individual interviews and online discussion groups (Brown & Warschauer, 2006). Results revealed: technology was a resource that existed in a secondary role in the program; there was a diminished manifestation of technology integration in the program; a positive exhibition of student beliefs towards the use of technology existed; and field-based experiences were strongly influential in providing preservice teachers with technology integration skills (Brown & Warschauer, 2006).

Based upon these findings, Brown and Warschauer (2006) made the following conclusions with regards to improvements that needed to take place within their teacher education program in order to promote transfer of technology knowledge and skills. First, their instructional technology course needed to include instructional strategies for technology integration, as well as incorporating collaborative projects so that students could examine content-specific uses of technology (Brown & Waschauer, 2006). Second, field-based experiences needed to become technology-rich environments where mentor teachers could model effective uses of technology in the classroom and preservice teachers could hone their technology integration skills (Brown & Warschauer, 2006). Lastly, professional development needed to be developed in order to increase the technological skills of mentor teachers (Brown & Warschauer, 2006).

Espinoza and Pennington (2007) introduced a study conducted on a stand-alone, graduate level instructional technology course, which was populated with preservice teachers from diverse backgrounds. The differences in backgrounds had presented the instructors for the course with the challenge of trying to meet the spectrum of learning needs (Espinoza & Pennington, 2007). In an attempt to meet their needs while teaching and modeling the pedagogical significance of various technology tools, the instructors incorporated activities grounded in three different theories: authentic learning activities, engagement theory, and transfer of learning (Espinoza & Pennington, 2007). Each of these learning theories share characteristics that promote knowledge and skill transfer (Espinoza & Pennington, 2007).

Students in the course participated in a variety of activities such as: exploring search engines and online resources based on learning and instructional theories; creating WebQuests, developing resource guides; and engaging in collaborative projects. Espinoza and Pennington (2007) reported that student comments during and upon completion of the course provided evidence that the theory-based activities promoted transfer of technological knowledge and skill, as many of the students indicated that they were currently utilizing activities introduced in the course in their own classroom or were planning to once they secured a teaching position.

Royer and Richards (2009) conducted a study that involved a small, Maryland school district located in a rural area. They were able to secure a grant to support a graduate level course designed to aid inservice teachers to increase their knowledge and skills with regards to technology integration and literacy skills (Royer & Richards, 2009). The course instructors surveyed a variety of technology tools in the course, including digital storytelling, which was selected because of its adaptability across different content areas with regards to increasing literacy skills (Royer & Richards, 2009). The course was based upon a gradual release model and included a field-based experience (Royer & Richards, 2009). Prior to the digital storytelling assignment, the course instructors modeled how to create a digital story utilizing several educational softwares (Royer & Richards, 2009). The teachers then created their own digital stories independently, shared them with each other, provided feedback to each other, reflected upon the process, and then created digital stories with a sixth and seventh graders enrolled in an after-school enrichment program (Royer & Richards, 2009).

Royer and Richards (2009) detailed findings revealed the following: the field-based experience allowed the teachers to encounter each step of the digital storytelling process with a student, as well as collaborate with peers about the experience; the clinical setting allowed the teachers to be immersed in the project, as well as provided opportunities for practice and engagement; and the field-based experience aided the teachers in learning how to scaffold a technology-enhanced project for a student, as well as provided insight into how a student approaches learning. This section has provided examples of studies that focused on utilizing instructional strategies and models with regards to technology integration in teacher education programs in order to promote the transfer of knowledge and skills to authentic contexts, K-12 classrooms. A summary of the third component of the review of literature follows.

**Summary of the transfer of technology knowledge and skills.** This section began with a discussion on the origins of learning transfer and then proceeded to a definition of knowledge transfer which can be described as taking on knowledge and skills in a manner in which they are flexible so that they can be applied to new or similar situations (Butterfield & Nelson, 1989). If not, learners could potentially spend immense amounts of time in trial and error situations, leading to cognitive overload (Bruner, 1966). The conditions of transfer, according to several noted researchers were presented, as well as three theoretical perspectives. Of these three perspectives, situated cognition and cognitive apprenticeship were more fully defined as they provide a framework similar to those found in the best practice methods for technology integration.

Situations that hinder positive transfer were also discussed. These included: situations where knowledge is acquired in a generic context, where knowledge is assumed to be automatic and is fact-driven, and the intended skills are not related to a larger body of knowledge (Howard, 2002). Alderman (2008) contended that hindrances such as these can affect the transfer of technology integration knowledge and skills for preservice teachers because there is little practical teaching experience to call upon when first adopting technology skills themselves.

Conversely, situations that promote positive transfer were also defined and these included: meaningful activities, expert guidance, and knowledge-building collaboration (Howard, 2002). TabWhen related to technology integration and preservice teachers, situations that influence positive transfer included those opportunities where preservice teachers were encouraged to develop technological pedagogical content knowledge (TPACK) (Mishra &

Koehler, 2006; West & Graham, 2007). Additionally, Brown et al. (1989) advocated the cognitive apprenticeship approach where the learner is situated in an environment much like one that might be encountered when successful transfer is necessary and engaged in authentic, hands-on activities that are facilitated by expert guidance. This is similar to the learning-technology-by-design approach described by Mishra and Koehler (2006), who contended that it is the building or assembling of artifacts that instills lasting knowledge that is capable of transfer. An example of this might include assembling an online course, creating a digital storytelling project or putting together an iMovie tutorial, where a learner physically engages with the process in order to best learn its nuances (Mishra & Koehler, 2006).

After defining transfer, and detailing situations that might potentially hinder or promote transfer, a variety of studies were described that attempted to measure the transference effects of instructional strategies related to technology that had been incorporated in some aspect of a teacher education program. All of these studies occurred following the introduction of the PT3 initiative and some were funded by it. Additionally, all of them were reflections of the call to standards initiated by ISTE's NETS*T. Several characteristics thread themselves through these studies, indicating either success or the need for future incorporation and they included: hands-on, authentic and meaningful activities incorporating technology; meaningful contexts that are similar to future classrooms, such as field-based experiences; modeling of effective uses of technology in content-specific areas; opportunities for collaboration with others; reflection upon learning activities utilizing technology; opportunities for practice and experimentation with technology; and access to expert assistance during the initial stages of adoption. All of these characteristics for promoting positive transfer are similar to those principles set forth in situated learning theory and cognitive apprenticeship. Overall, it is not just any one of these instructional strategies that ensure the successful transfer of technology knowledge and skills, but rather a careful combination of them, delivered over an extended amount of time to meet the specific needs of the students in the teacher education program.

**Summary of Chapter Two**

The first section of this review of literature detailed the progression of instructional technology from about the time of World War II through present day. It explored various forms of technology, like instructional film, radio and television. Many of these mediums excited politicians and educators during their novel phase, because they were new and offered revitalized hope at reforming education (Reiser, 2001a). After being implemented in the classroom, poorly in most cases, many left these stakeholders feeling disappointed and ready to move onto the next new form of technology (Reiser, 2001a). What can be learned from these cycles of various media and movements, like programmed instruction and instructional systems design, is that not any one form of media, technology or instruction is going to suffice and reform the state of education. Rather, instructional technologies must be interpreted as tools to support student learning.

The literature demonstrated that education will always have issues and the answer for meeting the needs and challenges of students today, and even society, is developing well-designed instruction that engages students, meets their needs developmentally, socially, emotionally and academically and then utilizes technology, as well as other tools, to support that instruction. There is no one recipe. Teacher educators need to arm preservice teachers with a variety of learning theories, instructional strategies and instructional technologies and then situate them in contexts where they have to evaluate how best to combine features to meet the needs of their students (Venesky, 2004; Wenglinsky 2005).

The first section, by examining the historical significance of instructional technology, demonstrated the need for preservice teachers to learn how to effectively integrate technology into their classrooms, based on the current digital age we live in and the rapid rate at which technology is advancing. K-12 students are expected to be media literate and technologically savvy when they leave high school and either go to college or enter the work force. With new reforms forcing teaching education programs to revamp their programs a decade ago, much research over the past couple years has focused on examining what progress has been made with respects to technology integration. In the second section of the review of literature, a number of studies were examined, and characteristics emerged identifying best practice methods, as well as exemplary teacher education programs.

A major commonality among these studies was that programs with effective technology integration training tended to integrate their technology training across the entire curriculum of the teacher education program (Strudler & Wetzler, 1999; Hofer, 2005). This means technology was an integral factor in most of the classes that the preservice teacher completed, including any instructional technology courses. Education faculty, who modeled how to utilize technology, especially with respects to content-specific instruction, also characterized these programs (Strudler & Wetzler, 1999; Hofer, 2005). Preservice teachers were also instructed in environments that were technologically rich and immersed in field experiences where, again, technology integration was modeled and coaching was present (Strudler & Wetzler, 1999; Hofer, 2005). In investigating the most common features, it was noticed that these situations were very similar to situated cognition and cognitive apprenticeship, which provide frameworks for instruction in order to foster transfer. This observation led to the last section of the review of literature.

The third and final section of the review of literature dealt with exploring the meaning of learning transfer, first in a generalized manner and then more related to technology integration training and preservice teachers. Transfer, of course, is the goal of all learning and instruction and means taking something learned in one situation and transferring it to another situation in order to accomplish a task (Butterfield & Nelson, 1989). Of course, many types of learning and contexts exist. The type of transfer needed should be determined first and then instruction planned accordingly. Situated cognition and cognitive apprenticeship were explored further because they share many characteristics with those methodologies set forth in the teacher education programs boasting best practices (Brown et al., 1989).

With respect to applying transfer principles to technology integration training in teacher education, barriers to transfer and situations that promote positive transfer were investigated. A number of studies were presented and it was noted that very few formally followed their preservice teachers into the early years of their careers in order to determine if the program's instructional strategies for technology integration had transferred to a real world context; thus providing a rationale for this study. Conducting research on the technology integration practices of early career teachers is a necessary step in refining the instruction and goals of teacher education programs. The methodology of the study will be discussed in the next chapter.

## Chapter Three: Research Methodology

This chapter provides a description of the research methodology utilized for this study. The purpose statement and research questions are reiterated first. Next, the study design, site selection, research participants, and selection criteria are explained. Following these topics, the pilot study is discussed, as well as the instrumentation, and data collection procedures. The chapter concludes with an examination of the data analysis techniques utilized for this research study.

### Purpose Statement

The purpose of this study was to identify instructional technology integration strategies and practices in preservice teacher education that contribute to the transfer of technology integration knowledge and skills to the instructional practices of early career teachers. The rationale for the study can be summarized as follows. First, technology integration at the teacher education program level, as well as the K-12 level, has become vitally important with the rapid growth of digital technologies in society. New teachers need the knowledge and skill set to utilize technology in their classrooms to support student learning and enables K-12 students to become media literate and productive citizens of a technology-infused society. Second, because of the increased focus on standards-based education, as evidenced through ISTE's NETS and NCLB, a significant amount of money has been spent through government initiatives like PT3, federal and state grants, as well as private foundations and business partnerships to fund the development of technology infused teacher education programs. Finally, a review of the literature with regards to instructional practices within teacher education programs that promote positive transfer of technology knowledge and skills to K-12 classrooms by their graduates appears to be limited. A significant number of studies focus on examining various components of technology integration plans within programs, but few have extended this examination to determine if transfer is evidenced in the practices of graduates.

**Research Questions**

In support of this study's stated purpose, the following research questions focused on identifying instructional technology integration strategies and practices in preservice teacher education that promote or hinder the transfer of technology integration knowledge and skills to the K-12 classrooms of early career teachers:

- How do early career teachers assess themselves with regards to technology integration knowledge, skills, and practices?
- What technology integration barriers do early career teachers manifest or experience? What are the identified sources of these barriers?
- What practices in their preservice teacher education do early career teachers identify as supportive or prohibitive of technology integration in the classroom?

**Study Design**

This study employed a two-phase, sequential explanatory strategy, utilizing a mixed methods approach in order to obtain data from a sample of early career teachers. Mixed methods research can be defined as "an approach to inquiry that combines or associates both qualitative and quantitative forms" (Creswell, 2009, p. 4). Specifically, the study utilized an explanatory research design where quantitative and a small amount of qualitative data were collected via an online survey during the first phase, and then additional qualitative data were gathered through individual interviews during the second phase. In reference to explanatory research, Creswell (2009) stated that the sequential explanatory strategy "is characterized by the collection and analysis of quantitative data in a first phase of research followed by the collection and analysis of qualitative data in a second phase that builds on the results of the initial quantitative results (p. 211).

**Site Selection**

This study was conducted through the School of Education (SOE) at a large, research university located in the Southeast utilizing the preservice teacher education programs housed at their main campus, and at a satellite location within the same state. In order to protect the identity of this institution, it will only be referred to as the "University" in this document. There are a variety of teacher education programs situated within the School of Education at this university; programs that specialize in masters, specialist, and doctoral degrees in 20 areas of professional education. These degrees represent endorsements for teaching in many different disciplines and grade levels in K-12 education. The University's SOE has been accredited by The National Council for the Accreditation of Teacher Education (NCATE) and has approval by the state's department of education in all professional education programs.

The total enrollment in the University's SOE during the 2009-2010 academic year was in excess of 900 students. Additionally, each program in the School of Education has a different approach to technology training for its preservice teachers. With such a multitude of disciplines, grade levels, and approaches to technology training, it was believed that the study findings could render feedback that was representative of a diverse population and that might be generalizable to other large, research universities with a similar School of Education structure.

**Research Participants and Selection Criteria**

The targeted sample population for this research study consisted of male and female early career teachers who had completed a graduate level teacher education program through the University's SOE between the years of 2008 – 2010; earned licensure; and were teaching in the

K-12 educational system. The study was focused on examining the technology integration practices of teachers in their second through fourth year of teaching. The decision to focus on teachers in their second through fourth year of teaching was made for two reasons. Teachers in their first year of teaching would only have had a couple of months teaching in the classroom when the data collection period took place; and therefore, would probably not have had enough experience in the classroom and instructionally to provide meaningful data. Teachers in their fifth year of teaching and beyond would most likely not clearly remember the technology training they received during their preservice teacher education; and therefore, would not provide meaningful data as well, since preservice teacher education is a focus of this study.

The proposed sampling strategy yielded a pool of 330 potential participants for Phase One of the study, the online survey administration; however, only 24 of these 330 responded, which is a response rate of only 7%. At the completion of the online survey, each respondent was asked to volunteer for a 30-minute follow-up interview. During Phase Two, five early career teachers volunteered for the interview and were subsequently interviewed using a semi-structured, opened-ended protocol (Fraenkel & Wallen, 2006) in order to gain a more comprehensive insight with regards to their technology training during their preservice teacher education. The sampling procedure for Phase One and Phase Two of this study was purposive. Purposive sampling is not a random sample, but rather, includes a particular sample from a population that is known by the researcher to have the knowledge or experiences that are the focus of the research study (Creswell, 2009; Frankel & Wallen, 2006; Rea & Parker, 2005; Russ-Eft & Preskill, 2001).

**Pilot Study**

A pre-pilot test of the survey instrument developed for this study was administered to four experts in the field of technology and instruction, as well as four individuals, who went through a teacher education program at another institution and were similar to the population which the actual study included (Rea & Parker, 2005). The three most significant revisions made to the survey were as follows. A "Neutral" response was added to those Likert items that ranged from "Strongly Agree" to "Strongly Disagree." The response of "I can do some of this" was added to the technology skills section taking the respective response scale from four points to five points. Lastly, the statement "Technology in this survey relates primarily to computer-based hardware, software and other devices that can be used in conjunction with computers" was added to the beginning description of the survey in order to clarify to respondents what exactly was meant by technology in the various survey items.

Once the pre-pilot was completed and revisions were made to the survey, a pilot study was conducted, which included a sample of 19 early career teachers that had graduated from another institution within the same state of the university participating in this research study (Rea & Parker, 2005). These early career teachers participating in the pilot study were mostly female, elementary level teachers within their first three years of teaching. Feedback with regards to the quality and clarity of the items in the survey was collected and additional revisions were made. Items within the technology skills section of the survey were further updated to represent the types of technology utilized in classrooms and that teachers are expected to know today. Specifically, questions were added that focus on the use of SmartBoards, iPod Touches/iPads, Web 2.0 tools and leaning management systems. Additionally, one question was added to the demographics section that asked participants about the level of technology access and resources they have at their respective schools.

Following additional review by the researcher's doctoral advisor and committee, additional suggestions were made. The researcher and doctoral advisor, who was also the principal investigator on the study, worked together so that the survey would meet the expectations of the doctoral committee. First, the "Neutral" response to those Likert items that ranged from "Strongly Agree" to "Strongly Disagree" was once again removed, in order to motivate participants to make a clear cut decision with regards to the survey items. Second, the section dealing with technology skills was further adapted to only include instructional technology examples utilized to support student learning, as opposed to teacher productivity, to better align with the purpose of the study. Third, a section that dealt with beliefs about technology use in the classroom was removed in order to keep the survey at a reasonable number of items, and also because this section was redundant. An additional section on beliefs about technology integration already existed. Fourth, the section on technology integration beliefs was further updated to reflect more current uses of technology in the classroom to support student learning.

The most significant changes made to the survey involved the last section, which dealt with teacher education and technology integration. The questions in this section were refashioned to reflect each of the factors demonstrated to promote the transfer of technology integration knowledge and skills discussed in Chapter Two. Specifically, these questions were rewritten to include the factors: modeling; practicing and experimenting; expert guidance; meaningful activities; hands-on, authentic activities; collaborating with others; practice in real classrooms; reflecting; and scaffolding. Table 1 depicts each of the nine transfer factors, with supporting literature citations, and the aligned survey question that was created.

Table 1

*Factors that Promote Transfer with Aligned Survey Questions*

| **Factors that Promote Transfer** | **Related Survey Question** |
|---|---|
| Meaningful Activities (Brown et al., 1989; Howard, 2002) | The activities I engaged in with regards to learning how to use technology in K-12 instruction during the program were meaningful in a way that helped me to actually use it in my own classroom. |
| Expert Guidance (Brown et al., 1989; Howard, 2002; Williams et al., 2009) | I had access to expert guidance with regards to using technology in K-12 instruction during my coursework and/or field experiences. |
| Knowledge Building Guidance (Howard, 2002; Royer & Richards, 2009; West & Graham, 2007) | Faculty members provided experiences in learning how to integrate technology that increasingly became more challenging in order to gradually build my knowledge about technology integration. |
| Authentic, Hands-on Activities (Brown et al., 1989; West & Graham, 2007) | The activities I engaged in with regards to learning how to use technology in K-12 instruction during the program included authentic, hands-on experiences with technology that helped me to actually use it in my own classroom. |
| Authentic Contexts (Brown & Warschauer, 2006; Brush et al., 2003; Howard, 2002; Royer & Richards, 2009; West & Graham, 2007; Mergendoller, 1994) | I had opportunities to practice integrating technology in my instruction in real K-12 classrooms during my program through field experiences (e.g. internships, student teaching, special projects including students, etc.). |
| Modeling Effective uses of Technology use in Content-Specific Areas (Brown et al., 1989; Brush & Saye, 2009; Hofer, 2005; Keeler, 2008; Mergendoller, 1994; Strudler & Wetzler, 1999; West & Graham, 2007; Williams et al., 2007) | The professor(s) who taught my content-area methods courses (e.g. English, Math, Science, etc.) modeled how to effectively integrate technology into instruction for K-12 students |
| Opportunities for Collaboration with Others (Brush et al., 2003; Brush & Saye, 2009; Seels et al., 2003; Williams et al., 2007; Wright et al., 2002) | I had opportunities to collaborate with others (e.g. peers, faculty, teachers, etc.) in learning how to integrate technology in the classroom during my program. |
| Opportunities for Practice and Experimentation with Technology (Brush et al., 2003; Keeler, 2008; Williams et al., 2009; Wright et al., 2002) | I was required to incorporate technology activities into some of the lessons I designed for my content-area methods courses in order to practice how to integrate technology to support student learning. |
| Reflection upon Learning Activities that Utilize Technology (Brush et al., 2003; Brush & Saye, 2009; Howard, 2002; Keeler, 2008) | I spent time reflecting upon the uses of technology in the classroom during my program in order to improve my instruction when I had my own classroom. |

The reasoning behind these changes included the belief that the responses to these questions would provide a better overview of the teacher education program(s) being examined as far as which factors were strong and which were weak. In order to obtain even more rich and detailed information, each question that dealt with these factors was followed by an open-ended question. The open-ended questions asked the participants who had responded with “Strongly Agree” or “Agree” to any of the factor-related questions to describe at least one memorable situation in which this factor had been present during their preservice experiences.

This section of the survey concluded with two, new open-ended questions that dealt with commenting about aspects that best prepared the early career teachers for utilizing technology in the classroom, and what experiences they felt might be lacking. The readapted survey was piloted again with one early career teacher from the original pilot study institution, who had not participated previously. It was noted by this individual that the survey was written in an articulate and understandable manner and could be completed close to the targeted 20-minute time frame.

**Instrumentation**

This study utilized two instruments, which consisted of a survey and interview protocol. The questions contained in both were either adapted or designed to answer the research questions guiding this study. A matrix containing the research questions and aligned survey and interview questions can be found in Table 2. A thorough description of both of these instruments is contained in the following sections.

Table 2

*Research Questions with Aligned Survey and Interview Questions*

| Research Questions | Survey Questions | Interview Questions |
|---|---|---|
| 1. How do early career teachers assess themselves with regards to technology integration knowledge, skills and practice? | Questions 7-9, 12-38 | |
| 2. What technology integration barriers do early career teachers manifest or experience? What are the identified sources of these barriers? | Questions 39-46 | Question 3 |
| 3. What practices in their preservice teacher education do early career teachers identify as supportive or prohibitive of technology integration in the classroom? | Questions 47-72 | Question 2, 4 |

*Note.* Survey questions 1-6, 10-11 and interview question 1 are demographic-related.

**Survey instrumentation.** The survey instrument that was utilized in this study was a customized survey drawing from three existing surveys. The survey is entitled, "Technology Integration Knowledge and Skills of Early Career Teachers" (see Appendix A). The first section of the survey has 11 items and asked the participants to provide demographic information (e.g., gender, number of years teaching, grade level, etc.), as well as answer a few questions about technology access at the participant's school. The researcher created this section in order to obtain information relevant to this specific study.

The second component of the survey adapted a one-item self-assessment tool called "Stages of Adoption" (Knezek, Christensen, Miyashita, & Ropp, 2000), which aided in identifying the teacher's adoption of technology level. This item asked the respondents to consider six stages related to the adoption of technology and to select the stage which they felt was the most appropriate choice. The stages represented in the question included: awareness; learning the process; understanding and application of the process; familiarity and confidence; adaption to other contexts; and creative application to new contexts. These levels are similar to those found in the work of Everett Rogers that deals with the diffusion of innovations (Rogers, 2003). Because the “Stages of Adoption” instrument is a single-item assessment survey, data gathered utilizing this instrument could not be used to calculate measures related to internal consistency reliability (Hancock, Knepek, & Christensen, 2007). High test-retest reliability estimates (.91-.96) have been obtained from validation studies on “Stages of Adoption,” however (Hancock et al., 2007).

The third component of the survey utilized another one-item self-assessment tool called the “Concerns-Based Adoption Model (CBAM) Levels of Use of an Innovation” (Knezek et al., 2000) and depicted the behaviors of technology users as they progress in usage of various technology tools. This specific measurement was based upon the work of Hall, Loucks, Rutherford and Newlove (1975). Similar to the former question, this question asked the respondents to consider eight levels with regards to adoption of technology and to again, identify the level, which was most appropriate to them. The eight levels of adoption included: non-use, orientation, preparation, mechanical use, routine, refinement, integration, and renewal.

As with the previous one-item self-assessment tool, data gathered utilizing this instrument could not be used to calculate measures related to internal consistency reliability (Hancock et al., 2007). Additionally, test-retest reliability estimates generally have fallen in the range (.84-.87) for elementary and secondary level teachers (Hancock et al., 2007). In addition to reliability, a study that conducted research to perform a cross validation of instruments utilized to measure technology integration, found when used together, the “Stages of Adoption,” the “Concerns-Based Adoption Model (CBAM) Levels of Use of an Innovation,” and “The Apple Classrooms of Tomorrow Teacher Stages” do “form a consistent self-report measure that has stable construct validity” (Hancock et al., 2007, p. 20).

The researcher made no modifications to this survey item or the one described in the previous paragraph. The publication in which these two instruments were found stated that these instruments could be utilized for non-commercial, scholarly research, as long as proper credit was provided and that their organization was notified of the research findings (Knezek et al., 2000). The researcher, however, did also communicate with Dr. Rhonda Christensen via email (see Appendix B) to inform her that two instruments included in the publication (R. Christensen, personal communications, March 18, 2011) would be utilized in this research. Additionally, the researcher followed the guidelines set forth by the publication in which the instruments were located.

The fourth, fifth, and sixth components of the survey for this research study were adapted from another existing instrument, the "Technology Beliefs and Competencies Survey" (Brinkerhoff, Ku, Glazewski, & Brush, 2001). This existing survey is available in a version for practicing teachers and one for preservice teachers. Educational technology faculty analyzed this survey for content validation by analyzing the survey objectives to confirm they had been achieved and that items were presented in a clear and understandable fashion (Brinkerhoff, 2006). The researcher obtained permission via email from Dr. Jonathan Brinkerhoff (see Appendix C) to use and adapt this survey for the purposes of this research study (J. Brinkerhoff, personal communications, March 25, 2011). The fourth component of this survey dealt with technology skills for practicing teachers. Originally this section consisted of 35 items; however, the researcher cut 20 items and modified the remaining ones to be more representative of technologies currently available, and to keep the overall question count of the survey to a reasonable size. These Likert-style items dealt primarily with basic technology skills such as basic operations, productivity software, communications, online activity, and multimedia. The five-point response scale ranges from “1 = I can’t do this” to “5 = I can teach others how to do this.” The Cronbach Alpha reliability for the original 35 item section of the existing survey was 0.96 (Brinkerhoff et al., 2001).

The fifth component of this survey dealt with beliefs about technology integration in the classroom for practicing teachers and consisted of 10 Likert-style items with a four-point response scale ranging from “1 = Strongly Disagree” to “4 = Strongly Agree.” The researcher did not modify this section at all from the original survey. The Cronbach Alpha reliability for this section was 0.94 (Brinkerhoff et al., 2001). The sixth component of the survey dealt with perceptions of barriers to technology integration. This section was taken from the preservice teacher version of the original survey named in the previous paragraph. This section contained 8 Likert-style items with a three-point response scale ranging from “1 = Not a Barrier” to “3 = Major Barrier.” This section contained 8 Likert-style items and had a Cronbach Alpha of 0.78 (Brinkerhoff et al., 2001).

The researcher constructed the final section of this survey in order to help identify the following: specific aspects of the respondents’ teacher education program that affected their use of technology in the classroom; the focus of the technology integration in the program’s coursework and field experiences; the overall focus on technology integration training that helped these early career teachers for using technology in their classrooms; as well as how often they utilized technology in the classroom for student based activities. This section contained 14 Likert-style items with a four-point response scale ranging from “1 = Strongly Disagree” to “4 = Strongly Agree.”

The first 10 items in this section questioned the early career teachers about the presence of instructional practices demonstrated to support the transfer of learning as outlined in Chapter

Two. Each of these learning transfer characteristics were aligned with a specific survey question (see Table 1). These nine learning characteristics were identified across exemplary teacher education programs in the literature that promote technology integration knowledge and skills to the classrooms of their teacher graduates. Following each of these 10 survey items, an open-ended question was included that asked the respondent to describe at least one memorable situation in which the appropriate practice was utilized during their preservice teacher education, if they strongly agreed or agreed with the item.

The final four survey items dealt with the respondents' overall perceptions of their technology integration training in teacher education, as well as how much time they recently spent utilizing technology in the classroom. The survey concluded with two open-ended questions that sought to obtain more information about aspects of the teacher education program that best prepared each respondent for utilizing technology in the classroom, as well as what aspects they felt might have been improved upon, based on their experiences in the classroom.

**Interview instrumentation.** The interview protocol (see Appendix D) was designed by the researcher and principal investigator, Dr. Jennifer M. Brill, following the analysis of the data rendered from the survey to aid in informing these data more fully. This process is characteristic of the sequential explanatory strategy in mixed methods research (Creswell, 2009). The interview protocol consisted of six questions. The first question consisted of a demographic question that asked the interviewees to describe their current teaching situation (e.g., school size, demographics, subject(s) taught, etc.). The subsequent questions included in the protocol probed the early career teachers in how they felt with regards to the factors that promote transfer; the three main barriers to technology integration identified through the survey; field experiences and suggestions to increase opportunities for more technology integration; which instructional technology tools they perceived to be the most and least useful; and lastly, to what degree they perceived instructional technologies to be useful learning tools. Each question constructed by the researcher was based upon data findings rendered through the survey and/or literature discussed in Chapter Two.

**Data Collection Procedures**

Effective October 31, 2011, the Institutional Review Board (IRB) of Virginia Polytechnic Institute and State University, granted approval to conduct this study (see Appendix E). The data collection process for this study occurred in two phases. Figure 2 displays the order of the data collection procedures. Each phase will be described in the following sections.

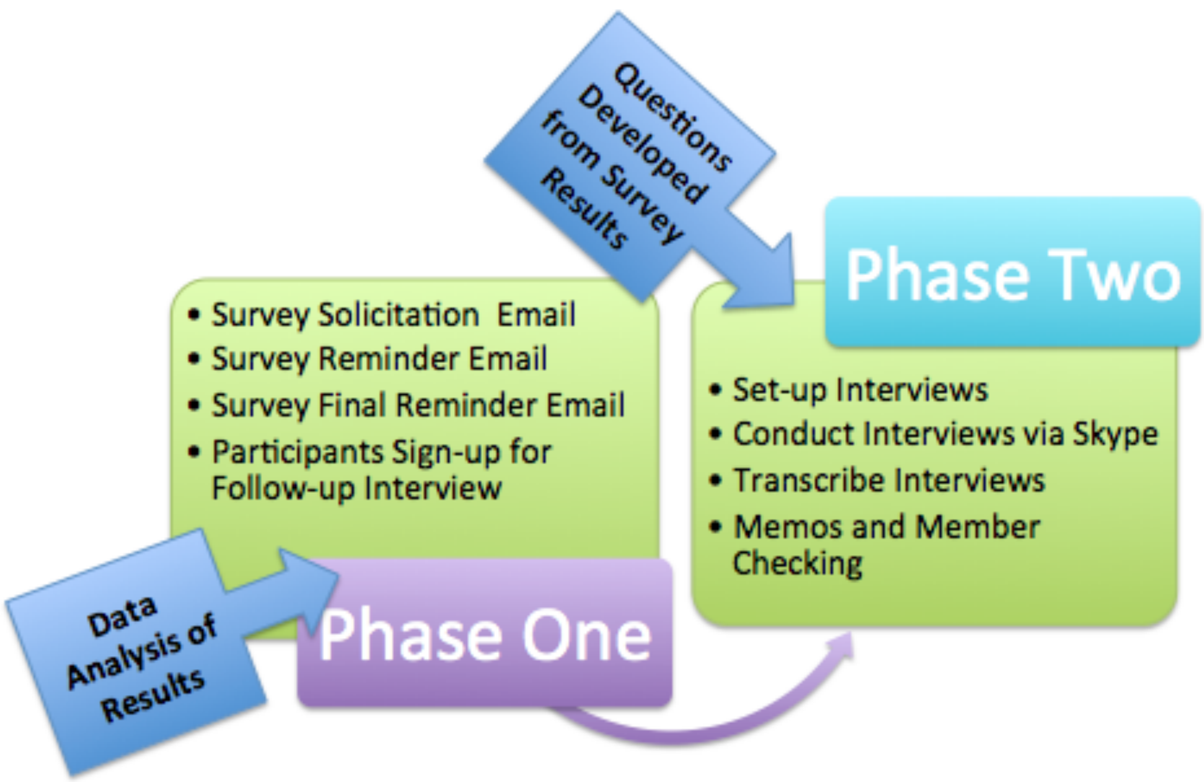


*Figure 2.* Data collection procedures

**Phase one: Survey administration.** The data collection for the online survey began on Monday, November 14, 2011 and ended on Monday, February 13, 2012. The length of time utilized to collect the survey data ran longer than expected due to unexpected challenges in ascertaining current teacher education graduate contact information. The survey instrument for this study was created utilizing the Virginia Tech, web-based tool for creating surveys, which can be found at www.survey.vt.edu. This survey tool is a secure, data collection system where all collected data is housed on Virginia Tech's servers. An invitation email, soliciting voluntary participation in the survey, initiated the data collection process on Monday, November 14, 2011 (see Appendix F). A reminder invitation to participate email was sent on Thursday, December 1, 2011 (see Appendix G), and a final invitation to participate email was sent on Monday, February 6, 2012 (see Appendix H).

Following the dissemination of the initial invitation email, the researcher and principal investigator garnered support from the director and associate director of the SOE to approve an introductory statement encouraging participation in the research study from potential participants. This statement was included in the second and third emails as an attempt to foster a better response rate. In addition to this statement, the purpose and nature of the survey were again reiterated. The emails reminded the subject that in order to voluntarily participate, the survey had to be completed by a certain date. The benefits of participating were also reiterated.

Because this study entailed utilizing a purposeful sample, email contact information for the survey population was first obtained through the University School of Education's administrative office by the principal investigator, Dr. Brill. The contact information of these former graduate students could only be released to the principal investigator as a condition of use. The principal investigator sent out the initial invitation to participate email, as well as the secondary reminder email. The first two emails rendered very low response rates and it was determined that the email addresses supplied through the SOE's administrative office were most likely outdated. Therefore, the principal investigator negotiated the receipt of more updated contact email addresses through the University Alumni Relations office, something the SOE administrative office had tried, but failed to achieve. The final invitation to participate email was sent out to the more updated email addresses, and although the response rate did go up after this last round, it still remained low.

Each invitation to participate email introduced the purpose of the study, the nature of the survey, and explained that participating in the study was voluntary and completely confidential. The web address of the online survey was also included in each email. Additionally, each email informed the participant that if they wished to be considered for a follow-up interview, the survey provided a link that would take them to a separate survey, where they could voluntarily provide their name and contact information (see Appendix I). The survey was designed in this two-part structure as a condition set forth by the SOE administrative office.

Before taking part in the survey, each participant was directed to download and read the informed consent form (see Appendix J). The letter of consent provided the participant with the title of the project; identify of the investigators; purpose and procedures of the research study; risks and benefits of the study; confidential nature of the study; the subject's responsibilities and permission; as well as contact information for the principal investigator and the Virginia Tech IRB representatives. By taking part in the survey, it was assumed that the participant had read and understood the information included with the informed consent.

The online survey began by providing an overview of the research study, as well as informing participants that the term "technology" in the survey related primarily to computer-based hardware, software and other devices that could be used in conjunction with effective pedagogy to support student learning and achievement. Additionally, the participants were also informed that the survey would take approximately 20 minutes of their time and that all responses would be kept confidential. The introduction of the survey concluded by providing the contact information of the principal investigator. The participants were then asked a series of survey items and open-ended questions that related to demographic and background information, technology skills, beliefs about technology integration, barriers to technology integration, and their perceptions of the teacher education experiences with regards to technology integration practices. The survey concluded with asking the participants if they would like to voluntarily participate in a 30-minute follow-up interview. If so, they were prompted to click on a link, which would take them to a separate survey where they could confidentially provide their name and contact information. Once the end date of Monday, February 13, 2011 arrived, the researcher closed the survey, began the data analysis phase, and started setting up interviews for Phase Two of the data collection process. Phase Two will be discussed in the following section.

**Phase two: Interview administration.** Following analysis of the survey data, the researcher and principal investigator developed semi-structured, open-ended interview questions based upon the findings rendered from the survey. The first question asked the participants about their school and teaching situation. Although it was not specifically stated in the interview protocol, the researcher asked each participant to identify the year they graduated from the SOE and from which program (e.g., English, Math, Elementary, etc.). Subsequent questions probed the early career teachers how they felt with regards to the factors that promoted transfer of technology integration knowledge and skills; the three main barriers to technology integration revealed from the survey; field experiences and suggestions to increase opportunities for more technology integration; which instructional technology tools they perceived to be the most and least useful; and lastly, to what degree they perceived instructional technologies to be useful learning tools.  Five individuals supplied their names and contact information and agreed to voluntarily participate in a 30-minute follow-up interview.

The researcher contacted three participants by email and two participants by telephone, based upon the contact information provided.  The interview data collection period began on Monday, February 27, 2012 and ended on Thursday, March 1, 2012.  All five interviews were conducted during this time frame and none of the interviews lasted longer than 35 minutes. Because none of the participants were local to the researcher, all interviews were conducted via the free, web-based video conferencing software, Skype; however, two participants did not have video capability on their laptops, so an audio-only interview was conducted.  The day before each scheduled interview, each participant was sent a copy of the interview informed consent form (see Appendix K) and the interview protocol via email, so that they would have time to review them both and ask questions before the interview.

On the day of the interview, each participant was informed that the interview would be audio-recorded in order to ensure accuracy during the transcription process (Rossman & Rallis, 2003; Seidman, 2006).  The introduction listed on the interview protocol was read verbatim to each participant and all participant questions were answered before the beginning of the interview.  The interviews were digitally recorded using the Apple software GarageBand, as well as a digital recording application on the researcher's iPhone.  The recorded interviews were transferred and stored on the researcher's computer, which requires a password.  The recorded conversation was transcribed verbatim shortly after each interview.  During the transcription process, the researcher created memos in order to capture initial thoughts and reactions to utilize while analyzing the data.  Additionally, in a process called member checking, a written transcript was provided to each interview participant allowing the opportunity to check the accuracy of the researcher's account (Rossman & Rallis, 2003).

**Data Analysis Techniques**

This section will describe the data analysis techniques employed for both phases of the study. A summary aligning research questions to data sources and data analysis strategies is presented in Table 3.

Table 3

*Data Sources and Plan for Analysis Matrix*

| **Research Questions** | **Data Source(s) to be Used to Answer this Question** | **How These Data will be Analyzed to Answer this Question** |
|---|---|---|
| 1. How do early career teachers assess themselves with regards to technology integration knowledge and skills? | Technology Integration Knowledge and Skills of Early Career Teachers Survey | Descriptive statistical analysis (Creswell, 2009; Fraenkel & Wallen, 2006; Howell, 2010; Rea & Parker, 2005) |
| 2. What technology integration barriers do early career teachers manifest or experience? What are the identified sources of these barriers? | Technology Integration Knowledge and Skills of Early Career Teachers Survey<br><br>Interview of early career teachers with regards to their varying levels of technology practice and the possible influence of their preservice technology training. | Descriptive statistical analysis (Creswell, 2009; Fraenkel & Wallen, 2006; Howell, 2010; Rea & Parker, 2005)<br><br>Transcription, memos, member checking, code, theme/category generation (Corbin & Strauss, 2008; Creswell, 2007, 2009; Fraenkel & Wallen, 2006; Rossman & Rallis, 2003) |
| 3. What practices in their preservice teacher education do early career teachers identify as supportive or prohibitive of technology integration in the classroom? | Technology Integration Knowledge and Skills of Early Career Teachers Survey<br><br>Interview of early career teachers with regards to their varying levels of technology practice and the possible influence of their preservice technology training. | Descriptive statistical analysis (Creswell, 2009; Fraenkel & Wallen, 2006; Howell, 2010; Rea & Parker, 2005)<br><br>Transcription, memos, member checking, code, theme/category generation (Corbin & Strauss, 2008; Creswell, 2007, 2009; Fraenkel & Wallen, 2006; Rossman & Rallis, 2003) |

**Survey data analysis.** The purpose of the survey strand was to explore how the early career teachers assessed themselves with regards to technology skills; adoption level of technology; perceived barriers to technology integration; and the identification of preservice experience practices that support and inhibit technology integration. During Phase One of this study, self-reported quantitative data were collected from the early career teachers with regards to their demographics, their stage of technology adoption, levels of use of an innovation, technology skills, beliefs about technology integration, perceived barriers to technology integration, and perceptions about their teacher education program and it's influence on their ability to integrate technology. This information was collected via the "Technology Integration Knowledge and Skills of Early Career Teachers Survey," which combined three individual surveys with questions designed and/or adapted by the researcher. The data gathered through this survey were analyzed utilizing descriptive statistics and reported both as raw data and percentages, due to the low response rate.

Descriptive statistics are useful when the purpose of analysis is to merely describe a data set (Howell, 2010). Fraenkel and Wallen (2006) reported that one major benefit in utilizing descriptive statistics is that it allows researchers the opportunity to describe phenomenon contained in a plethora of scores in just a few "indices," like mean, median and percentages (p. 189). Percentages were captured through a report generated by the online survey tool, survey.vt.edu and presented in tables to aid with visualizing patterns of responses to survey items.

**Interview data analysis.** The purpose of the interview strand was to more fully explore the early career teachers' perceptions about the degree to which literature-based transfer factors existed in the technology training they received during their preservice education and how their technology training had supported or inhibited their use of technology in their classrooms. Other topics that were investigated during the qualitative data collection phase included: specific uses of instructional technologies and discussion of which ones created the most impact to support student learning, as well as barriers to utilizing instructional technology in the classroom. Qualitative data in this research study were collected from two different sources: the survey in the form of some open-ended questions; and the interview, in the form of six semi-structured, open-ended questions. Open-ended questions allow participants the opportunity to redesign their personal experiences with regards to an observed phenomenon (Seidman, 2006). Because the amount of text generated from transcribing interviews, as well as the text collected from the open-ended segments of the survey, can be quite extensive, the researcher utilized the constant comparative method for the qualitative data analysis, which included coding, memoing, and organizing data in order to identify potential emerging themes (Corbin & Strauss, 2008; Creswell, 2007).

The researcher followed steps set forth by Creswell (2009) in order to analyze the data, which included: organizing and preparing the data; formulating an overall sense of the data by reading it through; coding the data; identifying the data through the use of categories and themes; writing up the findings; and lastly, including a discussion of the interpretation. The researcher began the data analysis by creating memos during the transcription process of each interview. As the interview was transcribed, notes were collected in a separate Word document of the researcher's initial impressions and to also aid in identifying similarities and dissimilarities across the interviews. Additional memos were added as the researcher reread the transcripts before sending them to the participants to check for accuracy.

Once the interviews were fully transcribed verbatim, the written transcript was sent to each participant to ensure accuracy on part of the researcher; this process is know as member checking (Rossman & Rallis, 2003). The participants approved all written transcripts and no changes were made to the manuscripts. Next, the researcher read through the transcripts again and applied open coding to focus on identifying categories of phenomena (Saldena, 2009). The researcher then created a spreadsheet organized by each participant and individual interview question. Summarized responses, basically consisting of main ideas were placed in a cell under each question. Ideas were separated by bullet point. In reviewing the data again, for selective coding, the researcher was able to more easily recognize themes existing across the interview data and for the preparation of reporting findings (Saldena, 2009). Qualitative data from the survey were analyzed in a similar process. The responses were organized in a spreadsheet according to question and then open coding and a more selective coding were applied in order to recognize emerging themes. Themes were then reported in a narrative fashion based upon the research questions in the next chapter.

**Summary of Chapter Three**

This study employed a two-phase, sequential explanatory strategy, utilizing a mixed methods approach in order to obtain data from a sample of early career teachers. Specifically, the study utilized an explanatory research design where quantitative data were collected via an online survey during the first phase and then interview data were collected during the second phase. The study was conducted through the School of Education (SOE) at a large, research university located in the Southeast utilizing the preservice teacher education programs housed at their main campus, and at a satellite location within the same state. The targeted sample population for this research study consisted of male and female early career teachers who had completed a graduate level teacher education program through the University SOE between the years of 2008 – 2010; earned licensure; and were teaching in the K-12 educational system. The study was focused on examining the technology integration practices of teachers in their second through fourth year of teaching.

A pilot study was conducted for the survey instrument utilized in this study, which included a sample of 19 early career teachers that had graduated from another institution within the same state of the university participating in this research study (Rea & Parker, 2005). The early career teachers participating in the pilot study were mostly female, elementary level teachers within their first three years of teaching. Feedback with regards to the quality and clarity of the items in the survey was collected and revisions were made. Items within the technology skills section of the survey were further updated to represent the types of technology utilized in classrooms and that teachers are expected to know today.

The finalized survey instrument that was utilized in this study, “Technology Integration Knowledge and Skills of Early Career Teachers,” was a customized survey drawing from three existing surveys. The survey consisted of 72 items and was developed to explore technology skills; level of adoption of technology; perceptions about technology integration; perceived barriers to technology integration; and identifying factors that support or inhibit technology integration in teacher education training. The interview protocol, developed by the researcher and principal investigator, was based upon the findings rendered from the survey and consisted of six open-ended questions. The protocol sought to more fully investigate the survey findings.

The data collection window for the online survey began on Monday, November 14, 2011 and ended on Monday, February 13, 2012. The length of time utilized to collect the survey data ran longer than expected due to unexpected challenges in ascertaining current teacher education graduate contact information. Following the dissemination of the initial invitation email, the researcher and principal investigator garnered support from the director and associate director of the SOE to approve an introductory statement encouraging participation in the research study from SOE graduates. This statement was included in the second and third emails as an attempt to foster a better response rate.

After the first two rounds of emails yielded a low response rate, the principal investigator was able to obtain more updated contact information from the University Alumni Relations office for the last round of emails. The response rate increased slightly after the last round. Twenty individuals completed the survey out of a pool of 330. Five individuals supplied their names and contact information and agreed to voluntarily participate in a 30-minute follow-up interview. The researcher contacted three participants by email and two participants by telephone, based upon the contact information provided. The interview data collection period began on Monday, February 27, 2012 and ended on Thursday, March 1, 2012. All interviews were conducted via Skype and were digitally recorded. Following the interviews, the recordings were transcribed verbatim.

During Phase One of this study, self-reported quantitative data was collected from the early career teachers. This information was collected via the "Technology Integration Knowledge and Skills of Early Career Teachers Survey," which combined three individual surveys with questions designed and/or adapted by the researcher. The data gathered through this survey were analyzed utilizing descriptive statistics and reported in raw figures and percentages. Percentages were captured through a report generated by the online survey tool, survey.vt.edu and presented in tables to aid with visualizing patterns of responses to survey items.

For the interview strand, the researcher transcribed interviews verbatim while simultaneously creating memos. The researcher then sent the written transcripts to each participant for member checking (Rossman & Rallis, 2003). Next, the researcher read through the transcripts again and applied open coding to focus on identifying categories of phenomena (Saldena, 2009). The researcher then created a spreadsheet organized by each participant and individual interview question. Summarized responses, consisting of main ideas were placed in a cell under each question. Ideas were separated by bullet point. In reviewing the data again, for selective coding, the researcher recognized themes existing across the interview data and for the preparation of reporting findings (Saldena, 2009). Qualitative data from the survey were analyzed in a similar process. The responses were organized in a spreadsheet according to question and then open coding and a more selective coding were applied in order to recognize emerging themes. Themes were then reported in a narrative fashion. Study findings, which are reported in the next chapter, were organized by the research questions guiding this study.

# Chapter Four: Findings

## Overview of Data Collected and Analyzed

This study captured both quantitative and qualitative data in order to identify technology integration instructional strategies in preservice teacher education that contribute to the transfer of technology integration knowledge and skills to the classroom practices of early career teachers. In order to accomplish this purpose, the study employed a two-phase, sequential explanatory strategy, utilizing a mixed methods approach. Creswell (2009) stated that the sequential explanatory strategy "is characterized by the collection and analysis of quantitative data in a first phase of research followed by the collection and analysis of qualitative data in a second phase that builds upon the results of the initial quantitative results" (p. 211).

Quantitative data were collected utilizing a customized survey instrument that was composed by drawing from three existing surveys to aid in answering the research questions guiding the study. After being administered to a sample of early career teachers, data collected from the survey were analyzed utilizing descriptive statistics and are reported in percentages and raw data. Tables containing these data are presented in the following sections where appropriate.

Once the data from the survey were analyzed, interview questions were developed based upon the survey findings, as well as the nine learning transfer factors demonstrated in the literature to promote transfer of technology integration knowledge and skills from teacher education programs to the classrooms of their teacher education graduates. Volunteer interviewees were presented with a semi-structured, open-ended interview protocol (Frankel & Wallen, 2006) of six questions. All qualitative data were examined and coded in order to discover emerging themes (Creswell, 2009). The findings are presented in two separate sections: the survey strand and the interview strand and organized by the research questions that guided this study in order to demonstrate how the survey findings contributed to the development of the interview questions and the rich set of resulting data. Table 2 in Chapter Three displays the three research questions and the specific components of both the survey and interview instruments that were aligned in order to capture data related to each question.

**Phase One: The Survey Strand**

**Participant demographics.** Twenty-four (*n*=24) individuals responded to the survey and all of them indicated that they had completed a master's degree program through the University School of Education. In response to number of years teaching, 42% (10) of the respondents had been teaching for two years; 33% (8) had been teaching for four years; and 21% (5) indicated they had been teaching for three years. One respondent (4%) indicated they had been teaching for only one year. Originally, participants who had only been teaching for a year were not going to be included in this study, but it was decided to include this respondent, since the response rate to the survey was so low, in order to make the data as rich as possible.

Seventy-five percent (18) of the respondents who submitted the survey were female and 25% (6) were male. A majority of the respondents indicated that they taught grades six through twelve with 54% (13) each in tenth, eleventh, and twelfth grade. Forty-six percent taught ninth grade, 42% (10) eighth grade, 25% (6) each in seventh and sixth grade, and 4% (1) each in fifth and second grade. Eight percent (2) selected the Other category. Respondents could check more than one grade in this category, because secondary teachers often teach more than one grade.

In response to subject taught, 42% (10) of the respondents indicated that they taught Mathematics, whereas 17% (4) each indicated that they taught either English, Science, or had no response; and 8% (2) taught Social Studies. For the write-in portion, there were four responses. One respondent indicated they taught Physical Education / Health; one taught Agriculture

Education; one indicated they taught the foreign language, Spanish; and the last one wrote in Math and Physics courses. As far as geographical location of where these teachers were employed, 71% (17) were located in Virginia, primarily the northern Virginia or Richmond areas; 8% (2) were in North Carolina; and, 4% (1) each were located in Washington D.C., Georgia, Colorado, Delaware, and Japan.

**Research question one.** How do early career teachers assess themselves with regards to technology integration knowledge, skills, and practices?

***Types of technology.*** Table 4 represents the types of technology available to the participating teachers and their students.

Table 4

*Types of Technology Access*

| **Technology** | **Access** |
|---|---|
| Internet | 100% |
| Email | 88% |
| Portable Laptop Station | 88% |
| Computer Lab(s) | 79% |
| LCD Projector | 79% |
| SmartBoards | 75% |
| Digital Cameras | 67% |
| Scanners | 50% |
| Document Camera | 46% |
| Digital Video Cameras | 46% |
| iPads | 17% |
| iPod Touches | 13% |
| Learning Management System | 13% |
| Distance Learning Lab | 4% |
| Other(s) | 17% |

On the higher end of access, 100% (24) of the respondents indicated that they had access to the Internet; 88% (21) had access to email and portable laptop stations; 79% (19) selected computer lab(s) and LCD projectors; and 75% (18) selected SmartBoards. In the middle range of access, 67% (16) had access to digital cameras; 50% (12) scanners; and 46% (11) indicated document cameras and digital video cameras. On the lower range of access, 17% (4) had use of iPads; 13% to learning management systems and iPod Touches; 4% (1) distance learning labs; and 17% (4) selected Other. As far as the number of computers present in the classroom, 50% (12) of the early career teachers responded that they had between one and four computers; 17% (4) indicated between five and eight computers; 17% indicated they had no computers in their classroom; 8% (2) indicated that each student had a computer; 4% (1) indicated they had 40 computers; and 4% (1) did not respond. In response to having a technology resource teacher or coordinator available in their school or district, 83% (20) of respondents indicated they did have one available, 13% (3) indicated they did not, and 4% (1) did not respond.

***Stages of adoption.*** The Stages of Adoption survey item asked respondents to indicate at which level they felt they most closely aligned with regards to taking on and utilizing new technologies in their teaching. Fifty-eight percent (14) of the respondents indicated they were at the top level, Stage 6: Creative Application to New Contexts, which defines the use of technology as being able to apply a knowledge of technology, using it as an instructional tool in the classroom and integrating it in instruction. Twenty-nine percent (7) indicated they aligned themselves with Stage 5: Adaption to Other Contexts, which defines the use of technology as providing tools for the teaching context, as well as applications as an instructional aid. Eight percent (2) of respondents indicated they were at Stage 4: Familiarity and Confidence, which defines the adoption of technology as being at a level where a sense of confidence is still being developed with regards to the use of technology for teaching tasks, as well as a sense of feeling comfortable with utilizing it in the classroom. Lastly, 4% aligned themselves with Stage 2: Learning the Process, which defines adoption of technology as still being isolated to learning about the basics, where there is often frustration and a lack of confidence. Thus, a strong majority of the responding teachers felt that they adopted technology use and integrated it in the classroom proficiently with the percentage combination of the highest two levels (Stage 6 and Stage 5) being 87% (21).

***CBAM Levels of Use of an Innovation.*** Similar to the previous survey item, the Concerns-Based Adoption (CBAM) Levels of Use of an Innovation survey item also deals with stages of adoption as well, but it consists of eight levels varying from the bottom level of non-use of technology, to routine use of technology, to the top levels of integration and renewal. Forty-two (10) percent of the respondents indicated they aligned themselves with Level 5: Integration. This level states that the teacher combines their own efforts with related learning activities of other teachers in order to create the most learning impact in the classroom. For the next highest marked item, 38% (9) identified themselves with Level 4B: Refinement, which states that the use of technology is varied in the classroom to maximize its benefits and effects with regards to students and their learning. Eight percent (2) of respondents aligned themselves with the highest stage, Level 6: Renewal. The renewal level denotes that teachers at this level continually reevaluate their use of technology in the classroom and adjust their instructional practice utilizing technology in order to achieve the greatest impact in student learning and achievement. Lastly, 4% (1) of the respondents identified with the Level 4A: Routine, Level 3: Mechanical Use, and Level 1: Orientation use of technology. This survey item also found a strong majority of the respondents identifying with the top three levels (Level 5, 4B, 6) with a combined percentage of 88% (21), thus making it consistent with the previous survey item.

***Instructional technology use to support student learning***. Appendix L references technology skills and the percentage of early career teachers who felt they were able to teach others how to utilize a technology. In this survey section, each technology tool was described in relation to a specific teaching and learning application; for example, "SmartBoards: Use a SmartBoard interactively with students to teach specific concepts in a lesson." Responses ranged from independent use; use with some assistance; some use; or, could not use at all. Considering these five categories, there is a logical break between response choices four and three, in that choices four and five indicate full and independent use; whereas, choices three and below indicate partial, dependent, or non-use of the technology application. Thus, for reporting purposes, the percentages for "I can teach others how to do this" (choice 5) and "I can use this independently" (choice 4) categories are also shown as an aggregate percentage. For example, 87% of respondents are able to guide students in importing digital images into documents.

Participants reported being able to use the following technologies independently with others: 88% (21) utilizing the advanced features of email; 87% (21) importing digital images; 84% (20) capturing digital images; 80% (19) using the advanced features web browsers; 80% (19) using the basic functions of digital spreadsheets; 79% (19) using SmartBoards; and 79% (19) creating digital presentations. Based upon the experiences of the researcher as a teacher and teacher educator, many of these technologies are commonly found in many schools today and so, it is not surprising to find such high percentages of independent use by these early career teachers.

In the middle range for use of these technologies in teaching and learning, desktop publishing received a combined percentage of 75% (18); learning management systems received 63% (15); and iPod touches/iPads, web 2.0 tools, and photo editing tools each received a combined percentage of 58% (14). Technologies that received lower combined percentages included: 55% (13) web design authoring tools, 54% (13) digital video editing, and 46% (11) digital media creation. Many of the technologies found in the middle to low range of independent use, again through the researcher's experiences, are currently not as prevalent in many schools and require more of a learning curve on the part of the teacher, as well as the time to learn. So, this may account for the declining instances of independent use as compared to those listed in the previously.

***Technology integration for learning.*** The next survey section asked participants to characterize how they were integrating technology into their classroom instruction by rating 10 items on a scale of "Strongly Agree" to "Strongly Disagree." Table 5 displays this list of statements pertaining to technology integration and the corresponding percentages.

Table 5

*Technology Integration for Learning*

| Question | 4 = Strongly Agree | 3 = Agree | 2 = Disagree | 1 = Strongly Disagree | No Response |
|---|---|---|---|---|---|
| I integrate technology-based activities into the curriculum. | 42% | 54% | 4% | 0% | 0% |
| **Aggregate** | **96%** | | | | |
| Technology use supports content learning in my class. | 50% | 46% | 0% | 0% | 4% |
| **Aggregate** | **96%** | | | | |
| I use technology and its unique capabilities to design new learning experiences for students. | 29% | 67% | 4% | 0% | 0% |
| **Aggregate** | **96%** | | | | |
| I use technology in my classroom to help support the state/federal curricular standards. | 46% | 46% | 4% | 0% | 4% |
| **Aggregate** | **92%** | | | | |
| I use technology to help me meet the individual needs of a variety of students in my classroom. | 33% | 58% | 4% | 0% | 4% |
| **Aggregate** | **91%** | | | | |
| Students work collaboratively on technology-based activities in my classroom. | 46% | 38% | 17% | 0% | 0% |
| **Aggregate** | **84%** | | | | |
| I use technology to support project- and problem-based learning activities in my classroom. | 25% | 58% | 13% | 0% | 4% |
| **Aggregate** | **83%** | | | | |
| I locate and evaluate educational technologies including software, hardware, and online resources that students use in my classroom. | 25% | 54% | 21% | 0% | 0% |
| **Aggregate** | **79%** | | | | |
| My students use technology to demonstrate their knowledge of content in non-traditional ways (e.g. websites, multimedia products). | 25% | 42% | 29% | 4% | 0% |
| **Aggregate** | **67%** | | | | |
| I require students to use a variety of software tools and digital resources to support learning. | 21% | 38% | 38% | 4% | 0% |
| **Aggregate** | **59%** | | | | |

*Note.* Bolded percentages represent the aggregate percentage between the “4=Strongly Agree” and “3=Agree” categories.

Most of the respondents reported quite high rates of use (combined “Strongly Agree” and “Agree” percentages of 79% or higher) on eight out of ten items related to technology integration into the curriculum and in support of curriculum standards; technology integration to support individual student needs as well as student collaboration; and technology integration to pursue new learning experiences with newly identified hard and soft technologies, and even newer pedagogies, like problem-based learning. However, respondents reported lower percentages for two items: student demonstrations of knowledge (67%) and mandatory student use of technology to support student learning (57%).

***Summary of research question one survey results.*** Research question one asked how early career teachers assess themselves with regards to technology integration? The findings for research question one included a majority of the participating early career teachers, for the Stages of Adoption survey item, identifying with the top two levels (Stage 6 and Stage 5) with a combined percentage of 87% (21); thus, indicating they were proficient adopters of technology and integrated it in the classroom to support student learning. Similarly, for the CBAM Levels of Use of an Innovation survey item, a strong majority of the respondents identified with the top three levels (Level 5, 4B, 6) with a combined percentage of 88% (21). These CBAM levels indicated the early career teachers maximized the benefits of utilizing technology in the classroom by varying its use and collaborating with others to achieve a meaningful impact upon student achievement. These two survey items demonstrated a consistent self-assessment of the early career teachers and their technology skills and comfort level.

Five technologies rose to the top (79% - 88%) as ones that the early career teachers reported that they could teach others how to utilize or they could utilize independently. These top technologies included: utilizing the advanced features of email; importing and capturing digital images; utilizing the advanced features of web browsers; using the basic functions of digital spreadsheets; using SmartBoards; and creating digital presentations. Technologies that fell to the bottom (46% - 55%), included: web design authoring tools, digital video creation, and using digital media. The researcher surmised, from experience as both a teacher and teacher educator, that these instructional technologies were ranked in this order due to the higher-ranked technologies being more prevalent in schools today; and because the lower-ranked technologies possess a higher learning curve, and often require more time to learn and meaningfully integrate into instruction.

Participants indicated quite high rates of use (96%) for situations that included: integrating technology-based activities into the curriculum; using technology to support content learning in the classroom; and using technology and its unique capabilities to design new learning experiences with students. However, they indicated lower rates of use for situations that included: having students use technology to demonstrate their knowledge of content in non-traditional ways (67%) and requiring students to use a variety of software tools and digital resources to support learning (59%). Through experience, the researcher has determined that many teachers feel limited in utilizing alternative forms of assessment with students because of the pressure to achieve acceptable scores on state/federal standardized tests. The focus on performance is often time-consuming, thus making teachers hesitant to experiment with a variety of technology tools and digital resources. Ultimately, the barriers these early career teachers face in the classroom could also influence the manner in which they responded to these situations involving technology integration. A closer look at these barriers follows.

**Research question two.** What technology integration barriers do early career teachers manifest or experience? What are the identified sources of these barriers?

***Technology integration barriers.*** The next survey section dealt with identifying specific barriers to technology integration in the classroom (see Table 6).

Table 6

*Technology Integration Barriers*

| **Potential Barrier** | **3 = Major Barrier** | **2 = Barrier** | **1 = Not a Barrier** | **No Response** |
|---|---|---|---|---|
| Too much content to cover in class. | 33% | 50% | 17% | 0% |
| **Aggregate** | **83%** | | | |
| Lack of time in class to implement technology-based lessons. | 38% | 42% | 21% | 0% |
| **Aggregate** | **80%** | | | |
| Insufficient time to prepare for technology-integrated curriculum projects. | 21% | 58% | 21% | 0% |
| **Aggregate** | **79%** | | | |
| Lack of/or limited access to software available in schools. | 8% | 50% | 42% | 0% |
| **Aggregate** | **58%** | | | |
| Lack of/or limited access to computers and/or hardware in schools. | 4% | 42% | 54% | 0% |
| **Aggregate** | **46%** | | | |
| Lack of mentoring to help me increase my knowledge about technology. | 4% | 25% | 71% | 0% |
| **Aggregate** | **29%** | | | |
| Lack of knowledge about ways to integrate technology into the curriculum. | 0% | 25% | 71% | 4% |
| **Aggregate** | **25%** | | | |
| Lack of knowledge about technology. | 4% | 8% | 83% | 4% |
| **Aggregate** | **12%** | | | |

*Note.* Bolded percentages represent the aggregate percentage between the "3=Major Barrier" and "2=Barrier" categories.

Participants were asked to report whether they felt certain barriers (e.g., time, resources, content, etc.) could be characterized as: Not a Barrier, Barrier, or a Major Barrier. Again, for reporting purposes, the percentages for the categories of a "Major Barrier" and "Barrier" were combined as one percentage. Three areas were recognized as the strongest barriers: 83% (20) too much content to cover; 80% (19) lack of time to implement technology-based lessons; and 79% (19) insufficient time to prepare technology-integrated curriculum projects. Two areas were recognized as somewhat of a barrier: 58% (14) lack of software and 46% (11) lack of computers or hardware. The remaining three areas were not judged as barriers: 29% (7) lack of mentoring; 25% (6) lack of knowledge about ways to integrate technology into the curriculum; and 12% (3) lack of knowledge about technology.

***Summary of research question two survey results.*** Question two asked what technology integration barriers do early career teachers manifest or experience; and what are the identified sources of these barriers? Research question two survey results, dealt primarily with compiling a list of specific barriers that the early career teachers felt prevented them the most from integrating technology. The strongest barriers (58% - 83%) recognized by the early career teachers included: too much content to cover; lack of time to create and integrate technology-based lessons; and a lack of software resources. It's interesting to point out that all of these barriers are external factors and are not related to knowledge/skill acquisition. In contrast, items recognized as the weakest barriers, ranging from 12% - 29%, in preventing technology integration included: lack of mentoring; lack of knowledge about technology integration; and lack of knowledge about technology. These percentages indicate that the early career teachers surveyed, found their school environments to be more prohibitive of technology integration in the classroom than their own knowledge or access to knowledge with regards to instructional technology and integrating it in the classroom. So, perhaps the greater opportunity to increasing technology integration lies in improving school environments rather than knowledge/skill training. To investigate this further, the results from this survey section prompted an interview question that will be reported on in the next section.

**Research question three.** What practices in their preservice teacher education do early career teachers identify as supportive or prohibitive of technology integration in the classroom?

***Teacher education and technology integration.*** Appendix M details respondents' answers to items dealing with their perceptions about the technology integration training and experiences they received during their teacher education program. Again, for reporting purposes, the percentages for the categories of "Strongly Agree" and "Agree" were combined as an aggregate percentage, so that it is more apparent which categories were stronger or weaker. The item to receive the highest combined percentage of 79% (19) in the Strongly Agree and Agree categories dealt with faculty members in content-area methods courses modeling the effective integration of technology into K-12 instruction.

When asked to describe at least one memorable situation in which this occurred, respondents listed examples that included: the Technology for Mathematics course; CBL (calculator-based laboratory)/CBR (calculator-based ranger) to collect data and model graphs; SmartBoards; Probeware in the field, Blackboard, PowerPoint, TI Navigator and "an entire class on different technologies." Additionally, one respondent from the Secondary English program said, "To limit Dr. Smith's influence to just one memorable situation is impossible. We were constantly taught to think about WHY we would use technology and how (to me, the more important of these two would be why)." To ensure the confidentiality to all members of the participating institution, all names have been replaced with pseudonyms. Another respondent from the Foreign Language program added, “My professors and teaching assistants often had us teach small snippets of lessons and then give constructive feedback to our peers. We were encouraged to teach in the target language and to bring in authentic materials from many different sources (music, web articles, news pages, etc.) to show our students.”

After the top scoring item, the next significant item, with a percentage of 76% (18), dealt with being required to reflect upon the use of technology in the classroom during the teacher education program. With regards to the open-ended question, one responded from the Secondary Science program indicated: “We had to reflect in designing our electronic portfolio – I did not feel that was effective, however.” Another responded from the Secondary Science program commented: “We were required to write reflection pieces on all of our lessons and experiences. This included reflecting on specific technology lessons, but technology was also a common aspect of our general reflections because it has become such a large focus for teachers.” Lastly, a respondent from the Secondary Social Studies program replied: “My collaborating teacher kept a reflection journal with me. I didn't fully appreciate it at the time, but it definitely taught me to take the time to reflect on my teaching.”

Three items within this section of the survey were equal in percentage with regards to the combined response rate for Strongly Agree and Agree. The first, at 71% (17), included opportunities in teacher education courses to practice and experiment with creating technology projects. When asked to detail one memorable situation where this practice occurred in their teacher education program, several responses were similar to the first and included: the Technology for Mathematics class, Geometer’s Sketchpad, PowerPoint, Blackboard, TI Navigator, Dreamweaver, iMovie, blogs, websites, as well as a semester-long course where various technologies were learned and utilized. One respondent from the Secondary English program specifically remarked, “We created a digital literacy narrative which not only made us think about our own reading/writing practices, but how it is important to model and value the many modes in which our students are writing/reading, too.” Another respondent from the Secondary Science program added, “We had to experiment with different online applications as part of our student teaching and use one of them in a lesson that we created. I was able to use a website called Glogster to have students develop poster presentations that were interactive and multimedia-based.”

The next item, that was equal to the one detailed above at 71% (17) included having access to expert guidance with regards to learning about the use of technology in K-12 instruction during related coursework. In response to the open-ended question, Dr. Beth Smith, an English professor, and Alice Huff, a Math instructor, were mentioned several times as excellent resources. One respondent from the Secondary English program described: “Dr. Beth Smith, Cindy Jones, and Alan Brown (all English faculty) were very valuable resources. Without their guidance, I wouldn’t have the confidence to integrate technology in my classroom.” With regards to Alice Huff, another respondent from the Secondary Math program commented:

> Alice Huff was the go-to person for technology. Although she could never teach every way to use every technology available, she gave me the knowledge and confidence to play with technology without hesitation. I am not afraid to just try new things, even if I've never used them before.”

Lastly, a respondent from the Secondary Social Studies program said, “My professors and members of my cohort were knowledgeable and a great support in sharing technology based lessons.”

The last item to receive the same combined percentage of 71% (17) in the Strongly Agree and Agree categories included opportunities to collaborate with others in learning how to integrate technology in classroom instruction. With regards to the open-ended question following this item, respondents again mentioned the Technology for Mathematics course. One respondent from the Secondary Math program offered:

> We did a technology project in which you interview host teachers about what technology is available and how they integrate it into their classrooms. I would have liked if we could have gone further and come up with an additional activity that uses the available technology in a new way.

A respondent from the Secondary Science program remarked that "If you didn't take advantage of the millions of collaborative opportunities, that was your own fault." An additional respondent, also from the Secondary Science program, detailed: "It was a free and open environment where we could bounce ideas off each other." Lastly, another respondent from the Secondary Science program detailed, "This was not as much of a focal point as some of the other aspects of technology, but we were required to post things online and provide feedback for our classmates throughout the semester."

Two items fell in the mid-range of combined percentages between the Strongly Agree and Agree categories. The first included being involved with technology integration activities in the teacher education program that were hands-on and authentic with a percentage of 67% (16). The Technology for Mathematics course was mentioned again with regards to the open-ended question, as well as another comment, which revealed that hands-on, authentic activities occurred in every class. One respondent from the Secondary Math program stated, "We did a T1-83 [type of calculator] activity in which we investigated families of functions. I like to use that activity with my algebra students." Whereas, a respondent from the Secondary English program commented, "We had to create all sorts of lessons individually and in partners/groups, and we were always encouraged to include technology." Lastly, another respondent from the Secondary Science program said, "We were required to create videos of ourselves teaching and develop lessons that were based on the use of various technology resources."

The next mid-ranged item dealt with being engaged with meaningful technology integration activities that aided in learning how to integrate the applications in the classroom at a percentage of 62% (15). Responses to the open-ended question regarding one memorable situation where this occurred included: the Technology for Mathematics course, completing projects using technology, blogs, and website creation. One respondent from the Secondary Science program shared:

> To an extent, yes – it was beneficial in using SmartBoards (I have one in my room), as well as getting more comfortable through utilizing additional software and creating websites. I feel it would have been more helpful had we spent more time in our content classes working on designing lessons integrating technology available to us for whole units, not just an individual lesson.

Another respondent from the Secondary Science program detailed:

> Gaining experience with the creation of PowerPoints and the use of a SmartBoard were both very valuable to me. In addition, I have been able to incorporate sites like Glogster into many of the projects I do because they are free to use and provide the students with a new and different media to work with.

Three items in this section fell into a lower range of percentages when the Strongly Agree and Agree category was combined. The first of the lower response items dealt with faculty members providing experiences in learning how to integrate technology that increasingly became more challenging in order to aid in building knowledge about technology integration at a percentage of 59% (14). One respondent from the Secondary Math program commented, “Alice Huff's [Math Instructor] Teaching Mathematics with Technology class included many activities like using SmartBoards, CBLs, and the Internet.” A respondent from the Secondary Science program said the following:

> I was familiar with many of the technologies that we were working with prior to entering the program. I think that they did start at a lower level and progress towards more difficult and complex technologies, but I never felt like they pushed my boundaries. Specifically, I am not very savvy when it comes to video production and editing. Unfortunately, there was only one assignment related to this and I was able to complete it without learning very much about the hardware/software that we used.

Two items received the lowest combined percentages and they each dealt with field experiences. The first item dealt with having opportunities to practice integrating technology in the instruction of a real K-12 classroom during field experiences with a percentage of 58% (14). There were four comments to this open-ended question. One respondent from the Secondary Social Studies program said, “I used a SmartBoard for the first time during my student teaching. I was able to create lessons utilizing the tools on the Promethean software.” Another from the Secondary Math program added, “My host teacher, when student teaching, taught me new ways to use the SmartBoard. I used the infinite cloner button to create counters, used for adding integers and creating array models.” However, a respondent from the Secondary English program commented: “Unfortunately, my cooperating teachers were VERY hesitant to step outside of the comfort zone and let technology enter their classrooms.”

The second item to receive a lower combined percentage of 50% (12) dealt with having access to expert guidance with regards to learning about technology integration in the real K-12 classroom during field experiences. Several of the comments captured in the open-ended survey items were positive with respects to this question. A respondent from the Secondary Social Studies program said, “I had two of the best mentors during my student teaching--both who modeled using technology in the classroom.” Another respondent from the Secondary Science program shared, “There were constant ideas on how to integrate technology in multiple lessons.” One last respondent from the Secondary Science program had a more critical recollection of the experience and commented:

> My student teaching experiences were both excellent, but they did not utilize much technology beyond PowerPoint and videos. This could have been better emphasized, but a lack of resources in the schools themselves made it difficult. However, I was very pleased to have the opportunity to use a SmartBoard in my high school placement because this is a very important tool for educators to become familiar.

***Perceptions of technology integration and teacher education.*** This final section of the survey asked respondents to characterize their overall perceptions of the technology integration training they received during their teacher education program (see Table 7).
The Strongly Agree and Agree categories were again combined on reflect an aggregate percentage.

Table 7

*Overall Perceptions of Technology Integration and Teacher Education*

| **Questions** | **4 = Strongly Agree** | **3 = Agree** | **2 = Disagree** | **1 = Strongly Disagree** | **No Response** |
|---|---|---|---|---|---|
| Overall, the technology integration training I received in my teacher education program, prepared me to utilize technology in the classroom. | 29% | 42% | 21% | 8% | 0% |
| **Aggregate** | **71%** | | | | |
| The focus on technology integration for use in the K-12 classroom was incorporated in much of my coursework. | 21% | 42% | 25% | 8% | 1% |
| **Aggregate** | **63%** | | | | |
| The focus on technology integration for use in the K-12 classroom was incorporated in much of my field experiences. | 29% | 21% | 46% | 4% | 0% |
| **Aggregate** | **54%** | | | | |

*Note.* Bolded percentages represent the aggregate percentage between the "4=Strongly Agree" and "3=Agree" categories.

The first item, at 71% (17), dealt with the level of preparation the respondents felt they received with regards to their preservice technology integration training and being able to utilize it in the classroom. The second item, at 63% (15), dealt with the level of focus placed on technology integration for the K-12 classroom within the program's coursework. The last item had the weakest response, at 50% (12), and dealt with the level of focus placed on technology integration for the K-12 classroom with regards to the program's field experiences (54%). Lastly, respondents were asked how often they integrated technology into student-based activities and 38% (9) indicated once or twice a week; 33% (8) indicated five or more times a week; 21% (5) three or four times a week; and 8% (2) once a month.

The survey concluded with two open-ended questions. The first question asked respondents to describe what aspects of their teacher education had best prepared them for utilizing technology in the classroom. One respondent from the Physical Education/Health program commented:

> Actually, being required to take an entire class on technology and include it in our lessons helped prepare me tremendously. During grad school, I wasn't thrilled about the technology, but now I use it all the time simply because kids respond to it so well.

Another respondent from the Secondary English program iterated, "Faculty members demonstrated how to use various types of new technologies and then had us complete projects using those technologies." A respondent from the Secondary Social Studies program commented, "Tackling such a big project as the digital portfolio helped me to not be intimidated by using new programs. I found out the best way to learn a new technology program is by using it." A respondent from the Secondary Math program took a more somber tone and shared this comment: "I wasn't able to have enough practice with becoming proficient in any specific technology area for mathematics."

The final concluding open-ended question asked the early career teacher respondents to reflect upon what they felt might have been missing with regards to the technology integration training they received in their teacher education program, based upon their experiences as teachers utilizing technology in the classroom. Specific software or hardware that was mentioned in comments included: SmartBoards and SmartBoard clickers, as well as other types of interactive white boards; Geometer's Sketchpad; and more commonly available software, like PowerPoint. SmartBoards were mentioned in four out of the fifteen comments that were written.

One respondent from the Secondary Science program noted:

> I would have liked to have had more use with additional programs (like Microsoft Publisher) for creating various lessons within a unit, especially for differentiating lessons. Using technology as a means to allow my students to have project-based learning geared towards their abilities is a goal of mine, and I do wish that our education program had focused more on those elements.

The early career teachers made several comments with regards to what they felt like they may have needed from their respective programs. Four comments were made in relation to providing preservice teachers with more training and hands-on experience with SmartBoards. One respondent from the Foreign Language program denoted, "Basic instruction on different types of interactive white boards would have been helpful. I would also have liked to manipulate the software in order to create basic lessons with focus on specific curricular standards." A respondent from the Secondary Math program stated, "I wish there was more information about Smartboards - that was never really a focus and yet we can find them in a lot of schools. Another respondent from the Secondary Math program stated, "Everything. A lack of resources and curriculum led to technology classes being outdated and obsolete."

A Secondary Science program graduate added:

> The primary thing that I feel like I missed out on is the creation of multimedia projects. Movies are the focal point here [referring to their school]. I believe that many students know more about the tools and software that is available than I do, which makes it very easy for them, but hard for me to develop creative and appropriate lessons.

Finally, a respondent from the Secondary Science program commented, "I think it would have been nice to have more guest speakers from people who had graduated from our program and were minimal experience teachers - one or two years out."

Several comments were quite positive about the program and the technology integration training provided to the preservice teachers. A respondent from the Secondary English program said, "I feel like I learned way more about technology integration than my colleagues who attended other graduate programs. I can't think of any tech skills that I wasn't exposed." Another Secondary English Education respondent wrote: "Honestly, I can't think of much. Every school and school district will have different technology programs and limits, so anyone will have to adapt to the specific technology at each school. I think I was prepared very well, but I expected more kids to be very skilled with technology, and they really aren't yet."

***Summary of research question three survey results***. Question three asked survey respondents to indicate which practices in preservice teacher education were supportive and inhibitive for the early career teachers with respects to their technology integration in the classroom. The strongest responses (71% - 79%) dealt with the following: faculty members in content-area methods courses modeling the effective integration of technology into the classroom; reflecting upon the use of technology in the classroom; opportunities to practice and experiment with creating technology projects; access to expert guidance in order to learn about the use of technology in the classroom; and collaborating with others to learn how to integrate technology in the classroom. The lowest responses dealt with opportunities to practice with technology integration in field experiences (58%) and having access to expert guidance with regards to learning about technology integration in field experiences (50%). This is not surprising as research from Chapter Two indicated that this area is often a challenge with teacher education programs because of the lack of cooperating teachers in general.

Overall perceptions of the technology training that these early career teachers received were quite positive (71%). Sixty-three percent felt that the focus on technology integration was incorporated throughout much of the teacher education courses; however, not surprising, only 54% felt this focus was representative in their field experiences. Because of this consistent mid-range response to the field experience and lack of technology resources and expert guidance, this issue was also formulated into an interview question in order to ascertain a richer description of the issue and possible ways to help mediate this experience for future preservice teachers.

Two open-ended questions concluded the survey. The first question asked respondents which components of their teacher education program best prepared them for integrating technology in the classroom. Respondents noted that some of the benefits they felt they received included the technology class offered; faculty members demonstrating how to use various technology tools; being required to integrate technology into lesson plans and to course projects; and the electronic portfolio required by all teacher candidates at the end of each program. The second question asked respondents to voice what they felt might have been missing with regards to technology integration training in the teacher education program. Responses to this question included more instruction on how to utilize SmartBoards, SmartBoard clickers, as well as other interactive white board brands, more commonly used software like PowerPoint and Publisher, learning how to use technology to help with differentiating lessons and for creating project-based learning. The results for the interview questions and qualitative data will be presented in the following section.

**Phase Two: The Interview Strand**

In order to provide further insight to the quantitative survey data results, participants were asked if they would like to volunteer for a confidential, 30-minute follow-up interview. Out of the 24 survey respondents, five early career teachers volunteered to participate in the interview. Of these five interviewees, four were female and one was male. The interview questions were derived from the results of the survey findings (see Appendix D). Each research question is discussed below, as well as other emerging themes and recommendations for the teacher education program.

**Participant demographics.** Table 8 displays the demographics of the five interview participants. All of the interviewees were teaching in either a middle (2) or high school (3) setting at the time of the interview. Two individuals graduated from Virginia Tech's English Education program; two from the Math Education program; and one from the Science Education program. Their experience teaching ranged from two to four years.

Table 8

*Demographics of Interview Participants*

| Interviewee/ Pseudonym | Gender | Program | Year Graduated | Grade(s) / Subject(s) Taught | Years Teaching |
|---|---|---|---|---|---|
| Kim | F | English Education | 2009 | $10^{th}$ grade World Literature & $12^{th}$ grade Advanced Placement (AP) Literature | 3 |
| John | M | Math Education | 2008 | $9^{th}$ – $12^{th}$ grade Geometry and Pre-Calculus | 4 |
| Kelly | F | Math Education | 2010 | $9^{th}$ – $12^{th}$ grade Alegbra II & Pre-Calculus Honors | 2 |
| Tracey | F | English Education | 2008 | $6^{th}$ grade Language Arts | 4 |
| Alexis | F | Science Education | 2008 | $7^{th}$ grade Life Science | 4 |

**School demographics.** Table 9 displays the characteristics of the schools where the interviewees taught at the time of the interview. The table demonstrates that the schools varied as far as demographics and size, but that they all shared a high access to technology.

Table 9

*Demographics of Interview Participants' Schools*

| **Interviewee / Pseudonym** | **School Level / Location** | **Student Demographics** | **Approximate Number of Students** | **Technology Access** |
|---|---|---|---|---|
| Kim | High school (grades 9-12) in Buford, Georgia | City school diverse in race, religion, and socioeconomics | 1000 | iPad cart in room; PC and MacBook |
| John | High school (grades 9-12) in Ashburn, Virginia | Affluent school located in suburban area | 1500 | Promethean Boards in every room; multiple laptop carts and computer labs |
| Kelly | High school (grades 9-12) in Fairfax, Virginia | Middle-class to right above poverty level; Caucasian, Asian, African-American and Latino students | 2200 | Laptops for every teacher; SmartBoards; laptop carts |
| Tracey | Middle school (grades 6-8) in Loudon County, Virginia | Mostly middle-class to upper middle-class; transient population | 1200 | Every classroom has Promethean Boards; laptops carts and computers labs |
| Alexis | Middle school (grades 6-8) in Prince William County, Northern Virginia | Title I school; Diverse population: Hispanic, African-American, Middle East, Asia and Caucasian | 1100 | Great ITRT: SmartBoards in almost every classroom; Smart tablets and clickers; mobile laptop carts; ELMO document readers; flip cameras |

**Research question one.** How do early career teachers assess themselves with regards to technology integration knowledge, skills, and practices?

***Stages of adoption and CBAM.*** To further address research question one, survey data for the five interviewees were extracted for analysis. In doing so, it was discovered that the five early career teachers rated themselves as highly proficient users of technology in the classroom. Three of the five interviewees (60%) rated themselves at a Stage 6: Creative Application to New Contexts for the Stages of Adoption survey item. One other rated himself at Stage 5: Adaptation to Other Contexts and another rated himself at Stage 4: Familiarity and Confidence. With regards to the CBAM Levels of Use of an Innovation survey item, three of the five again, rated themselves at a Level 6: Renewal (1) or Level 5: Integration (2). The remaining two, rated themselves at either Level 4A: Routine (1) or Level 4B: Refinement. As a whole, these assessments indicate that the five early career teachers range from routinely comfortable and confident with technology to being able to consistently utilize it in new and engaging ways to support student learning; but, that all of them feel competent about using it in the classroom.

***Technology integration.*** For items in the survey dealing with technology integration, the five early career teachers rated themselves high in five out of the ten items. The interviewees reported a combined percentage of 100% for the "Strongly Agree" and "Agree" categories for statements dealing with: integrating technology-based activities into the curriculum to support student learning; utilizing technology to support state/federal curricular needs, as well as the varying needs of students; and incorporating technology and its unique qualities to design new learning experiences for students. They reported a lower combined percentage of 60% on items dealing with: utilizing technology for collaborative projects; encouraging students to use a variety of software tools and digital media to support learning; and providing opportunities for students to demonstrate mastery of concepts in nontraditional ways (e.g., websites, digital stories, etc.).

***Summary of research question one interview results.*** Overall, these early career teachers rated themselves as skilled technology users who integrate technology in the classroom to support the varying needs of students, as well as to meet state/federal curricular demands and create engaging learning experiences. The items receiving a lower percentage, such as those dealing with collaboration and assessment in nontraditional ways, could be situations impacted by the barriers discussed earlier in this chapter, such as too little time and too much content to cover. How these early career teachers responded to these barriers will be discussed next.

**Research question two.** What technology integration barriers do early career teachers manifest or experience? What are the identified sources of these barriers?

***Barriers to technology integration.*** In this study, survey respondents were asked to identify what they considered to be barriers to integrating technology in their classrooms. The top three barriers that emerged from the data included: having too much content to cover; insufficient time to prepare and to teach; and insufficient technology resources. All of these barriers share the characteristic in that they are external factors over which the early career teachers have little control. During the interview phase, interviewees were asked if they also felt these specific factors were barriers for their technology integration. Table 10 displays which barriers each interviewee recognized and which they did not. All items are listed in the order in which they were mentioned during the interview.

Table 10

*Technology Integration Barriers Recognized by Interviewees*

| Interviewee/ Pseudonym | Barriers | Not Barriers |
|---|---|---|
| Kim | | 1. time<br>2. technology<br>3. content |
| John | 1. time<br>2. content | 1. technology |
| Kelly | 1. content<br>2. time | 1. technology |
| Tracey | | 1. time<br>2. technology<br>3. content |
| Alexis | 1. time | 1. technology<br>2. content |

Table 10 reveals that, in contrast to the survey findings, none of the interviewees felt that access to technology resources was an issue for them. Three out of the five interviewees recognized time as a barrier for technology integration. John, a high school Math teacher, said, "It takes me like three hours [to create a technology-based lesson] and it's like 15 minutes of my lesson. So the ratio of how long it takes to how it is in class is a big drawback of really attempting to use technology." With regards to content, John also said:

> I would love to do more exploration learning and let them go on Geometer's Sketchpad, let them go onto some of the different websites that really allow them to explore math, but with SOLs and everything, we have to have so much content covered by a certain time.

Kelly, who is also a high school Math teacher, had a very similar response with regards to both content and time. She said, "Too much content to cover is always the biggest thing because you're always trying to prepare the next lesson that they have to get through that you don't have time in the classroom to let them do web-based investigations." Alexis, a high school Science teacher, said, with regards to time, "With everything else that is involved with teaching nowadays, it's definitely the time that creating a more technology-based lesson takes." Alexis, however, did not mention that covering content was a barrier for her.

From what these three teachers have shared, it can be concluded that they feel integrating technology into their instruction takes too much time, because they already feel pressure by having to cover a certain amount of content in a certain amount of time. All three indicated that they felt creating a lesson that was technology-based takes more time than a traditional lesson. They did, however, indicate a desire to utilize technology and that they wished their students could investigate and explore math or scientific concepts utilizing more technology.

Two individuals, both graduates of the English Education program, stated that none of these three factors were barriers for them in integrating technology instruction. In response to why these weren't barriers, Kim, a high school English teacher, said:

> Time, well if it's the best for the students and it's something I feel that is going to work, then that's a priority for me. Covering content, again, I think when technology is used correctly, it works seamlessly. I think if you're using it seamlessly and correctly, those skills are already going to be applicable in everything you're doing and that's my job to help bridge that connection with students. I take advantage of every resource I can get my hands on and make it work, whether it's group-based stations, or you're having them create something before you go into the lab.

Tracey, a middle school Language Arts teacher, had a very similar response to Kim. Tracey said:

> I usually just merge the two together, the content and the technology. I think honestly, content demands will fit in once you realize that and this ties in with time. You don't have to throw in 10 new technology ideas. Focus on one or two; gain confidence with that. Then your time gets cut down. Then you see that your content is already being covered.

Based upon these comments, both of these teachers demonstrated that they were confident in their use of technology in the classroom. Both shared in their interviews that part of this confidence originated from the way technology training was approached in their preservice experience. They have overcome the external factors that most of the other teachers identified as barriers to integrating technology. This has been done by merging the content with the technology, instead of relying on traditional instructional methods, because they feel presenting content this way should be a priority, and that students need to connect to content in this manner. Once these two have been merged, then time was not an issue anymore. As with the first three teachers, technology resources were not a barrier for Kim or Tracey either, but they both mentioned in their interviews that when technology resources are low, a teacher should be willing to take advantage of what's available.

***Suggestions to overcome barriers.*** Because these three external factors emerged in the survey data as barriers, the teachers were asked not only to respond to whether these were barriers, but also to offer suggestions as to how schools or school districts might be able to eliminate them as barriers. Kim suggested starting off small with the integration of technology-based lessons and not feeling as though you have to use a lot at one time. She said once you gain confidence, then your technology and content merge together and time is not an issue. With regards to technology resources, Kim recommended utilizing what resources are available and focusing on those. John suggested allowing teachers to have a common planning time so that they could plan and divide up tasks related to technology-based lessons. This, he felt, would address both the time and content issue.

Kelly was not sure how to address the content issue since the standards are set forth by the state, but she suggested utilizing pre-made technology lessons so that not quite as much time and energy would have to be devoted to making them. Tracey suggested, for teachers who do not feel they have the time to utilize technology-based lessons, allowing students the option to utilize technology to complete assignments out of the classroom. She continued and said, "I think the interest [to use technology for school assignments] is definitely there, but I think it's unfair to deprive them [the students] of that interest, especially when it's very real world, twenty-first century learning." Tracey echoed Kim's suggestion above, in that students should be allowed to complete projects using technology at home, but then eventually the school should make it "mandatory" to use technology in some way, so that teachers could gain confidence and build from there. Alexis suggested streamlining various computer programs together, for example, combining the student information database with such systems as the Senteo clicker system so that names would not have to be entered manually in order to use the clickers. This, she said, would save time and then more teachers might be inclined to utilize this specific instructional technology in the classroom.

***Summary of research question two interview results.*** In conclusion, three of the early career teachers felt that technology-based lessons took too much time for them to fully utilize its benefits in the classroom. They felt that the pressure to cover a certain amount of content in the designated time prevented them from having enough time to work more with technology. These teachers taught Math and Science, whereas the two English teachers seemed to feel more comfortable integrating technology within their content areas so that the technology they utilized did not infringe upon their time limits or content needs. Suggestions to alleviate these barriers ranged from starting with simple technology lessons and building from there; to providing teachers with common planning times in order to help each other create technology-based lessons and share; and lastly, to buying pre-made technology lessons for teachers to utilize. Alleviating such external barriers will likely be specific to each school. However, a beneficial first step would be for teachers and administrators to recognize these external barriers in their individual schools, and then to work together to come up with solutions on how to best support the teachers and students in minimizing them.

**Research question three.** What practices in their preservice teacher education do early career teachers identify as supportive or prohibitive of technology integration in the classroom?

***Factors that support technology knowledge and skills transfer***. During the interview process, the early career teachers were asked to name and describe practices or strategies from their preservice education that they felt promoted the transfer of technology integration skills into their own classroom practice. They were also asked to discuss any practices that did not promote technology integration transfer. Additionally, after being read the top factors identified in the literature and used in the survey that support the transfer of technology training, the interviewees were asked to prioritize the top two or three factors that they found to be the most supportive in their own discipline-specific programs. In order of high to low ranking, the factors are: modeling; reflecting; practicing and experimenting with technology; expert guidance; collaboration; hands-on, authentic experiences; scaffolding; and practice utilizing technology in real K-12 classrooms. These qualities were discussed in Chapter Two as factors that promote the transfer of learning (see Table 1). Table 11 details their responses for both supportive and prohibitive practices, as well as suggestions to improve field experiences, which was found to be one of the most prohibitive practices in each program.

Table 11

*Supportive and Prohibitive Practices in Teacher Education*

| Interviewee/ Pseudonym | Supportive Practices | Prohibitive Practices | Improving Field Experiences |
|---|---|---|---|
| Kim | • reflection<br>• modeling<br>• practicing and experimenting | • cooperating teacher discouraged use of technology in field experience | • teachers understand technology is a requirement of the program<br>• faculty support in field experiences |
| John | • modeling<br>• collaboration | • not enough time to practice with technology in field experience<br>• some guidance, but not expert | • utilize more technologically-savvy [younger] teachers |
| Kelly | • practicing and experimenting<br>• expert guidance | • lack of technology resources in field experience | • awareness of technology in schools<br>• invest in mobile technologies for field experiences |
| Tracey | • modeling<br>• collaboration<br>• hands-on experiences<br>• expert guidance | • none | • faculty support in field experiences |
| Alexis | • practicing and experimenting<br>• expert guidance<br>• practicing in real K-12 classrooms | • one technology class<br>• limited opportunity to practice with technology in content-specific and methods courses<br>• lack of collaboration in field experiences | • invest in mobile technologies field experiences |

***Teacher education practices that <u>support</u> technology integration***. As evidenced in Table 11, modeling, practicing and experimenting, and expert guidance with technology were listed by three of the interviewees. With regards to modeling, Kim acknowledged her program leader as making technology the focus of the English Education program. Kim said:

> I think just the overall broad range of ideas that were shared, or best practices where we actually had to try those [technology tools] out through hook activities before we did our teaching placements. So having that tryout period, for lack of better words, that opportunity to see and play and think about how we would incorporate that into the classroom and then having the chance to do that followed up by reflecting through our blogs.

Kim went on to say, "You were ideally creating things that you could integrate into the field placement, so that was helpful as well." Specifically, Kim said members of her cohort were constantly motivated to think about "So what, why are we using this? Why do we want to do that? These are things that are built upon to carry with us, whether it was our unit, or a mini-lesson, or whatever the case. We were constantly creating."

In the English Education program, Kim pointed out that she and fellow classmates were motivated to constantly evaluate the technology tools they were learning about by designing projects in which they incorporated these tools. Kim also said, "I personally, and it's kind of funny because I would not consider myself a tech-savvy person, especially when I started, at all; but, I was willing to try and see what I liked and what I didn't." So, even though Kim was not necessarily comfortable with technology at the beginning of her program, the technology-rich culture of the program made her feel like it was a safe environment for her to try out new things and that it was okay, maybe even expected, for her to take risks and be critical, since these learning experiences would eventually impact her students.

Tracey was also in the English Education program and her experiences were similar to Kim's. Tracey also said that the leadership in the English Education program was highly focused on technology integration, which would explain why she listed modeling, hands-on, authentic experiences and expert guidance as the top transfer components in her program. With regards to these, she said:

> So, they pretty much taught us how to use every tool and we actually had to use it and create projects using it. So, that was probably the most helpful, because we had to put ourselves in our students' shoes and actually complete the product from start to finish.

In addition to the modeling and practice, Tracey also commented on the fact that she and her fellow classmates received a plethora of technology resources, websites, and tutorials so that they would feel confident utilizing technology in their own classrooms.

Additionally, Tracey pointed out that her professors and field experience advisors were willing to come to her field experience classroom to help her with integrating technology. Tracey went on to say that, "I was encouraged to integrate during student teaching and so I think that was probably the most influential. They [faculty] modeled it [technology] in classes and we worked with peers and collaborated to do technology projects together and teach each other." Tracey said that because of this collaborative experience, where they shared the strengths and weaknesses of these technology-based projects, preservice teachers in the English Education program actually integrated technology very early on.

John also mentioned modeling as one of the top transfer factors in the Math Education program. He said, however, that certain applications like how to use the Geometer's Sketchpad were modeled by professors, but little time was devoted to actually practicing and experimenting with technology tools. In the interview, John placed more emphasis on the collaboration aspect.

He said, “We did get to collaborate. A lot of our classes that I remember with technology, we had a lot of group work, especially in my grad program. I felt like everything we ever did was in groups.”

Kelly, who was also a graduate of the Math Education program, said that although they only had one undergraduate class that focused on utilizing technology in math instruction, she felt as though they did have focused time that was spent on practicing and experimenting with various technology tools. Specifically, Kelly said:

> We got to play with the things [web-based tools and calculators] for like half the class and then they [students and professor] talked about stuff. So for me, it was really fun and important to be able to play and to be able to figure it out. So you had that knowledge that these things can do this and this, and then you kind of figured out how to get there. Instead of being told, we learned how to figure it all out so that even if we forgot, we'd know how to figure it out.

Kelly's experience seemed quite different from John's. Kelly spoke highly of the technology class, even though, she admitted, it was the only opportunity she had to experiment and learn about technology integration with math instruction. She classified the leadership in the course as expert guidance, whereas John said there was guidance, but that it was not necessarily “expert.”

Alexis, a middle school Science teacher, also characterized her program as one that only offered one technology course in which they learned basic technology, like Microsoft PowerPoint, to more advanced technologies, like Dreamweaver, in order to create a teaching electronic portfolio. Although Alexis only had one technology course, she did mention that her and her classmates were offered many opportunities to practice and experiment with technology both in their graduate school classroom, as well as in actual K-12 classrooms. She also said that they had guidance from faculty in the Science Education program. Alexis shared:

> I think the things that stand out the most to me are being able to practice what we're doing in the classroom, especially if it's available at a particular school. I think the technology and playing around with the actual technology itself, as well as pulling in somebody who would be an 'expect', so to speak.

Alexis's mention of expert guidance was similar to that of John in that although they had faculty who were familiar with some of the technology, they were not technically experts, but rather, knowledgeable.

In summary, modeling, experimenting and practicing with technology, as well as expert guidance were the top three factors mentioned in the five interviews. All of the programs appeared to have included some sort of experimentation and practice with technology during their graduate course of study. The Math and Science Education programs only exposed their preservice teachers to technology through one class, whereas the English Education program integrated their technology instruction throughout the program when these early career teachers went through their respective programs. Additionally, the English Education had faculty leadership that very much emphasized technology integration into instruction and would even travel to their preservice teachers' field experience schools in order to make sure that technology integration was carried out in the field experiences, as well as during the program's coursework. Most of these early career teachers also mentioned experiences that they wished their programs would have exposed them to in order to help them with technology integration in the classroom. These factors will be discussed next.

***Teacher education practices that <u>inhibit</u> technology integration***. As evidenced, again in Table 11, during the interview process, four out of the five interviewees mentioned their field experience as being a component of their teacher education program that was prohibitive in allowing them to practice technology integration in the classroom. In fact, because field experiences during the teacher education program surfaced in the survey as being a prohibitive proponent of transfer, a question was created for the interview protocol to more explicitly explore the issue. With regards to the field experiences, one interviewee specifically mentioned her cooperating teacher in the field experience; another mentioned that there was not enough time during the field experience; another explained that her school just did not have the technology resources readily available for her to integrate technology during the field experience; and another mentioned that collaboration among classmates and faculty decreased during her student teaching experience.

Kim, the English teacher noted, "If there was a negative thing, it had to do with my cooperating teacher. On my end, I was absolutely willing to try, jump out there. It was stepping into someone's classroom who discouraged every form of integration [that was prohibitive]." John, the Math teacher commented, "I don't know if it discouraged me, but we really didn't get the opportunity to practice as much as I was hoping [referring to both his observation and student teaching experiences]…So it didn't discourage me; it just never encouraged me."

Kelly, the other Math teacher, explained, in reference to the high school where she student taught:

> Teachers don't have their own computers. You have to go to the library to put in grades. Some rooms had projectors and some rooms didn't, but there was no consensus and I had

> to go between rooms. So, I didn't use any [technology] in my student teaching, except the gradebook they have online, which was hard because it would have been nice to actually be able to develop lessons that actually had technology things in them. We couldn't even do things as basic as the calculator because all the kids didn't have calculators.

Lastly, Alexis the Science teacher, mentioned that there was a lack of collaboration with her classmates and faculty members once she began participating in her student teaching, which was disappointing to her because she felt collaboration is an important aspect in education. Specifically she said:

> The whole concept of a PLC [professional learning community] and then helping the student teacher translate that into the in-classroom student teaching experience would have helped me to feel a little bit more prepared on how to collaborate with other teachers, especially when it was time to pull in some kind of technology-based lesson.

Interestingly, within the context of the negatives mentioned with regards to the field experiences, only one interviewee mentioned her teacher being the issue and another mentioned not getting to collaborate with classmates and faculty during her field experience. These are separate human resource issues. The other two interviewees, however, mentioned time and resources as the factors within the field experience scenario that prevented them from getting to utilize technology in the classroom. These are the same barriers that the early career teachers themselves mentioned as factors that had impeded them from integrating technology in the classroom and that were discussed in research question two. This observation suggests a potential question to research in the future: are more experienced teachers, who become cooperating teachers, negatively impacted by these same barriers of time and resources which then in turn negatively impact the field experiences of preservice teachers?

Other teacher education practices that were mentioned by the interviewees to be prohibitive of technology integration included guidance by faculty that was not necessarily expert; having only one instructional technology-related course and limited opportunities to practice with technology in content-specific and methods courses. Literature from Chapter Two demonstrated that programs characterized by effectively implementing these factors, as well as providing field experiences rich with technology opportunities positively promote the transfer of technology integration knowledge and skills to the classrooms of early career teacher more than programs that do not.

***Recommendations for improving field experiences***. The early career teachers, as part of one of the interview questions dealing with field experiences in the teacher education program, were asked to provide suggestions on how they felt these situations could be improved. Their suggestions have been summarized in the last column of Table 11. Kim and Kelly, both English teachers, identified faculty support as important factors that would be advantageous for preservice teachers in field experiences. Specifically, they referred to faculty support in that faculty members should be willing to travel to the participating school and aid the preservice, and even inservice teacher, in working with the technology and integrating it into the classroom instruction.

First, Kim commented that cooperating or mentor teachers should be made aware of the technology requirements, so that plans can be made to expose the preservice teacher to these opportunities in the classroom. She also added:

My cooperating teacher was not open to technology, which was the biggest problem. So thankfully I had an advisor and field supervisors who were all willing to continue to support me and help in that position. In addition, and perhaps more importantly, [they were] willing to help me tweak ideas to work for my particular situation.

Tracey provided a similar statement, "If the professors or advisors would be willing to go in the classroom with them [preservice and inservice teachers] and help them actually use it in the class. I think that would help a lot to give them the confidence they need to do it." Tracey went on to add that she felt this could be especially beneficial for cooperating teachers who are resistant to utilizing technology because "The mentor teacher is also in a learning process and sometimes I think they're resistant and they also need someone else other than the student teacher to say it's a great idea, that studies show it [technology-based lessons] supports student learning."

John brought up another suggestion that is closely aligned with the aforementioned. He mentioned utilizing teachers that are "younger." His thinking was that if younger teachers are used, there is a better chance that they will be more apt to integrate technology into their instruction, than their elder counterparts. Although, this is not necessarily the case, an obvious suggestion for any teacher education program would be to only use teachers who are proficient with technology. Unfortunately, most programs are lucky just to get enough teachers to participate as mentor teachers and so, such a stipulation may be difficult to set as a requirement for mentor teachers. The suggestion offered by both Kim and Tracey in having faculty or even graduate assistants involved at the school site to aid in helping both the preservice and inservice teacher to integrate technology is a possible solution.

Kelly, a Math teacher, and Alexis, a Science teacher, both included statements in their interview responses indicating that the teacher education program needed to invest in more mobile technologies that preservice teachers could take to the cooperating schools in order to facilitate more technology integration. More specifically, Kelly noted that the program should be aware of what's available in the cooperating schools. The specific teacher education program in which these early career teachers participated does have an educational technology lab with some forms of technology that can be checked out by education graduate students. However, these two early career teachers did not seem to have an in-depth knowledge about this or didn't think the technology available was particularly appropriate for their content area. Alexis stated:

> If they the [teacher education program] were able to buy the things that could be a little bit more easily transportable, and then the student teachers could check out something like a clicker system to hook up with a projector that the school would have, or a document reader, the size of a computer. Or maybe they did [have technology to checkout] and I just didn't know about it. Then, I think that would help alleviate some of the discontinuities between the different schools that student teachers were assigned.

In conclusion, two specific responses were mentioned twice with regards to suggestions on how to improve field experiences for preservice teachers in their teacher education program. These consisted of getting faculty to be more supportive and making sure that the cooperating teachers are aware of the technology requirements for the student teachers, as well as making themselves available to travel to the participating schools to aid both the preservice and inservice teacher with integrating technology into the classroom. This also benefits those inservice teachers who have volunteered to be mentor teachers, but who may not be technologically savvy. Obtaining technologically proficient mentor teachers is not always within control of the teacher education program, so if faculty could be more supportive, this challenge could be mitigated. Faculty should also be aware of the technology access each participating school has and perhaps be willing to supplement their technology resources with relevant, mobile instructional technologies that the preservice teachers can checkout and take to the schools. It is also important that preservice teachers know that such services are available, as well as what is available for them to checkout.

Overall, these early career teachers suggested that faculty and members of the teacher education program take steps to be more involved and aware of what's going on in the participating schools, so that when a lack of resources or expertise confronts the student teacher, they can step in to help. Such support allows the preservice teacher to be able to gain the experiences they need in order to obtain the technology integration knowledge and skill set so that they will utilize technology effectively in their own classrooms.

**Useful and less useful instructional technology applications.** During the course of the survey, one question asked respondents to rank how often they utilized a variety of instructional technology tools in the classroom to support student learning. Survey participants ranked technologies, from most to least used, as follows: email, digital images, web browsers, spreadsheets, presentation software, SmartBoards, digital media (e.g. iMovie, PhotoStory, MovieMaker, etc.), web design authoring tools and digital video. Each interviewee was questioned specifically about this ranking and asked what they envisioned as the next most useful instructional technology tool; what current technologies they felt would remain in use as valuable teaching and learning supports; and which ones they thought may lessen in use because of lack of instructional impact. Table 12 details which instructional technology tools the interviewees identified as useful and less useful to support student learning in the classroom.

Table 12

*Useful and Less Useful Instructional Technology Tools*

| **Interviewee/ Pseudonym** | **Useful Instructional Technology** | **Less Useful Instructional Technology** |
|---|---|---|
| Kim | • web-authoring tools<br>• electronic porfolios | • SmartBoards |
| John | • learning management systems<br>• social media tool – Edmodo<br>• Promethean Boards | • video creation / editing tools - iMovie |
| Kelly | • SmartBoards<br>• Smart tablets | • video creation / editing tools |
| Tracey | • iPads<br>• tablets | • blogs |
| Alexis | • SmartBoards | • ELMO document readers |

Kim, the English teacher, was surprised that email and spreadsheets were high on the list. She envisioned web design authoring tools becoming more useful tools to utilize in the classroom. Specifically, Kim said, "Places or resources that help students create and where they're able to broadcast their voice, whether it's with movies, podcasts, whatever…a blog, somewhere where they can incorporate all that [different technologies for multimedia projects]." Kim went on to mention that she favors the use of electronic portfolios using web-based technologies, like Google Sites. As far as lessening in popularity, Kim differed from the other respondents in that she mentioned SmartBoards. Stating that it was "a lot of money for a big board, where that money might be best appropriated in, you know, other directions."

John, the Math teacher, mentioned Blackboard and various applications, like Safari Montage, that his school system utilized with the learning management system as an instructional technology that he felt would increase as far as usefulness in classrooms.

Blackboard, John said, allows teachers to create online classes and to facilitate discussions. Additionally, John also mentioned the web-based social media tool, Edmodo, which is similar to Facebook, but allows teachers and students to communicate via postings and in groups within a safe environment. In reference to Edmodo, John said, "I think it's a great service. I mean to be able to go and post stuff on a Facebook-type application. I think so many kids are on this stuff already, that it would be beneficial for the kids to access that." John also said he felt that Promethean Boards would continue to increase in popularity as an instructional technology. He mentioned being able to use digital images and spreadsheets in different ways, but that he didn't see software like iMovie or other video editing technology being useful for subjects like math, unless it was being utilized to film lectures and for online courses.

Kelly, who is also a high school Math teacher, described that she thinks the SmartBoard has been a very useful technology in her classroom, as well as the Smart tablet. The table allows students or the teacher to enter answers and other information while moving around the classroom or from a student desk. It eliminates the need of having to stand at the front of the class during an entire lesson, or the distraction and the time it takes for students to travel from their desk to the SmartBoard to participate in interactive activities. With regards to instructional technologies that she felt might lessen in popularity, Kelly reiterated what John said. She said:

> We don't do a lot of movies, recording, making movies, but I know some teachers are starting to do it because they want to start recording their lessons so they can put them on Blackboard, but it's just not seen very much because no one knows how to do it."

Tracey, the middle school Language Arts teacher, stated that she felt iPads or any type of tablet would be "the next big learning tool." She mentioned that she had utilized some of the "really awesome apps out there for learning" to do a podcasting poetry project. Tracey went on to describe why she thought mobile technologies were going to become more useful in education. She stated: "The laptop carts are also a huge burden on the teachers and students. Most of them are outdated and they are just so heavy to transport around the school. So, I think that discourages a lot of teachers from using the them." She highlighted some of the benefits of utilizing iPads in her response and these included the fact that they are very light and portable; the battery life is a lot longer than laptops; and because kids "just respond really well to new technology, touch screens, and the applications." In response to technologies that she thought would lessen in popularity, Tracey stated that she had been disappointed with using blogs. She said they could be useful if students had their own computer or laptop to use during class time and if it was part of the daily routine. Otherwise, she found dealing with issues of computer accessibility and protecting what students put out on the Internet to be too challenging, and overall, rather disappointing.

Alexis, the middle school Science teacher, like John and Kelly, was an advocate for SmartBoards and all the technological applications associated with the brand. She stated one reason she felt this way was the Smart brand's push to make learning more interactive and its advancement to allow more than one student to interact at a time. She compared this interaction to be like kids playing video games, and so, she was sure this was something that would appeal to students today. Alexis said:

> I think that [SmartBoards] is where a lot of emphasis is going to be placed as far as teaching materials and I really think that's going to be the best thing that a lot of schools are going to be able to really bring in, so that students can feel like they are really being engaged with twenty-first century technology and be that much

more interested in what they're learning, what the content is, and that much more engaged in the whole learning process.

Alexis, also mentioned that she felt as though traditional activities done with pencil and paper in the classroom would continually be de-emphasized and that class activities would transition to more digital means, like creating movies, where projects could serve dual purposes. When asked about technologies she felt might lessen in popularity, Alexis indicated that ELMO document readers would probably become more obsolete since they really only serve one purpose. She did, however, point out that she uses the ELMO document reader in conjunction with a telescope, which students can then watch her lab demonstrations on the SmartBoard. In conclusion, she said, "I think we're going to start seeing things that are more dual purpose and less that are geared towards more paper-based type of learning."

In conclusion, three out of the five early career teachers, felt that SmartBoards or Promethean Boards were a current technology that they considered useful in the classroom and also one that that would continue to increase in usage in K-12 classrooms. Because of the growing popularity and presence of interactive white boards, this instructional technology continues to advance its applications and capabilities. The two English teachers in this group did not mention any type of interactive white board. Rather, they focused on web design authoring software and mobile technologies. These two early career teachers came from a technology-rich program and may feel more comfortable stepping out beyond interactive white boards and trying other instructional technologies in which to engage students and to support learning.

The two Math teachers mentioned video creation and editing tools as technologies they did not feel were useful in their field. However, they did recognize that these technologies could become useful as more teachers learn how to utilize them to record their lessons to post online.

Despite the range in their responses, all the teachers seemed to share the same sentiment in that the instructional technologies they utilized in the classroom allowed students to connect their out-of-school lives with classroom activities, thus, making the learning experiences that involved technology, richer, more meaningful activities.

**Instructional technologies as useful tools to support student learning.** The final question in the interview protocol question asked to what degree each of the early career teachers felt that instructional technologies were useful tools to support learning for their students. All of the early career teachers indicated that utilizing instructional technologies in the classroom was useful to support learning for their students. Kim, a third-year, high school English teacher, responded that she "absolutely" felt that instructional technologies support learning for her students. She said it helps "them bridge those out-of-school literacies to we're what doing in my classroom. I think technology creates that bridge between, or can, if used effectively."

Kim went on to say that she has kids that go home to incredibly technology-rich homes, as well as kids who have little access to technology in the home. Either way, she reported:

> Whatever end of the spectrum that falls on [access to technology], what are the skills, critical thinking, the critical creating and producing they're going to need, no matter what they do down the road? So you know, using those technologies is only better benefitting the skills we've already been including in our classrooms without technology or big fancy labs.

She concluded her response by stating that utilizing the technology, especially projects that require collaboration and then sharing, really "builds a community within your classroom."

John, a fourth-year, high school Math teacher, was adamant about the usefulness of utilizing instructional technologies to support student learning in the classroom. He stated that he thought they were “awesome” and that he thought, “the more we use them, the more it’s going to benefit them [students].” John proceeded to share more about how he uses the Promethean Board with his students by utilizing an application called Activotes, which is like a polling system that allows him to play review games with his students. Kelly, a second-year, high school Math teacher as well, similarly extolled the value of instructional technologies by discussing the benefits of using the SmartBoard to support her classroom instruction, as well as the learning of her students. She illustrated her point by describing how the SmartBoard allowed her to turn everything she wrote on the SmartBoard into PDFs for her students. She also mentioned a software program, used by her school, called Horizon. This software has a large, multiple-choice online database and allows teachers to create tests and quizzes, then provides immediate feedback to students on their performance. Kelly said this software was beneficial to teachers because it provided data analysis by strands, or identified weak skill sets, so that the teachers could really target specific skills with individuals or groups of students.

Tracey, a fourth-year, middle school Language Arts teacher, also agreed that instructional technology tools were useful to support student learning. Specifically, she said, “I think anything that allows them to feel like they kind of published something just to view, for them to have an audience, because I think it’s more authentic and meaningful…something they’ll actually remember for the long run.” In her comment, Tracey reiterates the point that several of the early career teachers have made in that utilizing instructional technologies in the classrooms, if used effectively, can create a learning experience to which students can relate, because it’s either something they use in their own lives, or something they’ve seen in a real world context.

Tracey also said she uses software like iMovie, MovieMaker, and Audacity, a podcasting tool, to aid in the creating process. For the sharing element, she again spoke of using iPods and iPads for students to listen to and view projects. Although Tracey did not mention this earlier when specifically questioned about individual instructional technology tools and their usefulness, she stated at this point, that she's been a little disappointed with Promethean and SmartBoards. She stated, "I don't think it's very practical at the middle or high school level, because you just have too many students in your class to really allow them all to participate with that technology." She did recognize that using clickers with the boards can be useful for formative assessment.

The last interviewee, Alexis, a fourth-year middle school Science teacher, had a similarly strong response in favor of the usefulness of instructional technology in the classroom. She stated, "You know, I think, using instructional technologies is going to be more and more emphasized and useful as our entire society goes to being much more of an Internet and technology-based society." Similar to the other early career teachers, Alexis spoke of students today and their dependence on digital devices and because of this, she felt that it makes students more receptive to learning with instructional technologies as opposed to traditional pen and paper methods. In conclusion, she commented:

> I think if we're going to try to continue reaching our students we need to be integrating technology regardless of whether it's using laptops to have them go to different websites to help them do research on computers and pulling up books that the libraries have been cool enough to actually put in electronic format. You know, whatever it is, I think we're definitely going to go towards that.

In conclusion, all of the early career teachers, even with their varying degrees of instructional technology usage in the classroom, agreed that it is important to utilize technology to support student learning. Reasons that they felt this way included that it aids in bridging students' out-of-school activities with classroom content and skills; automates activities and makes them more appealing to students; can capture information from a lesson to be provided to students at a later date; collects data on student performance and allows teachers to pinpoint weak skill sets; allows students to collaborate and share projects they've created, thus broadening their audience and making the classroom more of a community; and lastly, allows learning to connect with students on a level with which they are familiar and feel comfortable.

**Recommendations for the School of Education.** Even though survey respondents were asked to provide recommendations or suggestions to improve the preservice teacher experiences within the School of Education, the question was posed again in the interview in the hopes of capturing richer data. Some suggestions were included as part of an interviewee's response to earlier questions. John, the high school Math teacher, added that the biggest component that he felt deserved more attention in his program was that of hands-on instruction, as well as the opportunity to practice and experiment with various technology tools. He commented that a lot of what he currently knows about instructional technology came more from his first year of teaching through experience utilizing technology and trying out various tools on his own. Further, he said, "I feel like if they gave us more time in the classroom to do that type of stuff, make the classes smaller, make more teachers involved that are expert teachers [faculty] that can help us with these types of technologies."

Kelly, the other high school Math teacher, who was a more recent graduate from the same program as John, felt that everyone going through teacher licensure should take a technology class devoted to instructional technologies within the various disciplines, like math, science or social studies. She felt that the technology and math education course she took as an undergraduate was very beneficial to her training in becoming a math teacher competent in utilizing technology in the classroom. She also commented that such a course should stay up-to-date with what is actually being utilized in the schools and within each content area. Specifically she said, "You may not necessarily be able to use them [technology tools] where you are, but you'll know about them. You can lobby your schools to buy them or they might be more willing to buy them if someone knows what they're talking about."

Tracey, a middle school Language Arts teacher, said she felt that her program taught her to use instructional technology in the classroom "perfectly." Specifically, she said the faculty members with whom she worked were "really gung ho about technology integration, which got us excited about it and everyone I know who graduated from the program uses technology a lot more in the classroom and we feel confident about technology." Tracey concluded by stating, "The director [program leader] has to make sure we walk away with our degree knowing the importance of integrating technology in the classroom."

In conclusion, suggestions with regards to instructional technology training within the preservice teacher programs included: providing more hands-on experiences; more opportunities to experiment and play with technology; smaller classes; faculty who are knowledgeable, enthusiastic, and recognize the importance of technology integration; and technology courses that focus on up-to-date instructional technology tools within each of the content areas. Each of these suggestions were recognized in Chapter Two as important qualities of teacher education programs who have had success in promoting the transfer of technology integration knowledge and skills to the classrooms of their teacher education graduates. Thus, these are very important and relevant suggestions to consider.

**Summary of interview findings.** Out of 24 survey respondents, five early career teachers volunteered for a 30-minute, follow-up interview. The pool of interviewees included two English teachers, two Math teachers and one Science teacher. They ranged in teaching experience from two to four years. The schools in which they taught varied in demographics and socio-economic status, but all possessed a high access level to technology. All of the early career teachers were located in Virginia, except one, who was located in Georgia.

Research question one dealt with how the early career teachers rated themselves with regards to technology skills. Survey data for each of the interviewees was brought forward to investigate how specifically they rated themselves in comparison to the total sample of early career teachers. Overall, these early career teachers rated themselves as skilled technology users who integrate technology in the classroom to support the varying needs of students, as well as to meet state/federal curricular demands and create engaging learning experiences. Items receiving a lower percentage included those dealing with collaboration and assessment in nontraditional ways.

Research question two dealt with identifying technology integration barriers that early career teachers experience, as well as the sources of these barriers. Survey data revealed that the top three barriers included: too much content to cover; insufficient time; and lack of technology resources. Interestingly, these barriers share the characteristic that they are external factors and are not related to technology integration knowledge, skills, or competency. The interviewees were also asked if they experienced any of these items as barriers. Three of the five interviewees identified time as a barrier and two of these identified content as a barrier in addition to the time. The two English teachers did not feel that any of these were barriers because they seemed to have learned how to integrate technology into their instruction comfortably and within the available time constraints. The two math teachers struggled with time and content as barriers. None of the interviewees listed technology as a barrier.

Research question three dealt with identifying practices in preservice teacher education that are supportive or prohibitive of technology integration in the classroom. Research from Chapter Two pinpointed nine qualities characteristic of teacher education programs that positively promote the transfer of technology integration knowledge and skills to the classrooms of their teacher education graduates. Survey respondents were asked to rank each of these qualities using a Likert-scale that ranged from "Strongly Agree" to "Strongly Disagree." Analysis revealed that they were ranked in the following order, from highest to lowest: modeling; reflecting; practicing and experimenting with technology; expert guidance; collaboration; hands-on authentic experiences; scaffolding; and practice utilizing technology in real K-12 classrooms. With regards to the experiences of the interviewees and these qualities in their teacher education program, modeling, practicing and experimenting, and expert guidance with technology were mentioned by three of the five early career teachers. Four out of the five interviewees mentioned their field experiences as being a component of their teacher education program that was prohibitive in allowing them to practice technology integration in the classroom.

Interviewees also provided suggestions on how to improve field experiences for preservice teachers and the two specific responses that were mentioned twice included getting faculty to be more supportive of integrating technology in the field experience by having either a faculty member or representative, such as a graduate assistant, available to travel to the school site to support the preservice teacher during lessons that involve technology. The other response that was mentioned twice included the teacher education program investing in current, mobile or portable types of technological hardware and software that the preservice teachers can checkout and take to the schools with them in order to supplement the technology resources that the school may or may not have available.

Interview participants also commented on instructional technologies that they felt were currently useful, would emerge as useful learning tools, and might decrease in usage because of a lack of impact on learning. Three out of the five interviewees mentioned SmartBoards or Promethean Boards as a current technology that they considered useful to support student learning and as a technology they thought would increase as more advanced features were incorporated into the overall system. The other two teachers mentioned web design authoring software and mobile technologies. Video creation and editing tools were mentioned by the two math teachers as technologies they did not feel were useful in their field; however, they did recognize that these tools could become useful as more teachers learn how to utilize them to record their lessons to post online.

All of the early career teachers were very much in favor of utilizing instructional technology in the classroom because they did feel that it supported student learning. A summary of some reasons why included: it bridges students' out-of-school activities with classroom content and skills; automates certain activities, like reviewing for tests; captures data when students take quizzes or tests online as a method of formative assessment; and allows students to collaborate, create, and share, thus making the classroom more of a community that promotes learning.

In concluding the discussion of the interview findings, the interviewees provided recommendations in relation to the overall technology training they received during their preservice teacher education. Suggestions with regards to instructional technology training within the preservice teacher programs included: providing more hands-on experiences; more opportunities to experiment and play with technology; smaller classes; faculty who are knowledgeable, enthusiastic, and recognize the importance of technology integration; and technology courses that focus on instructional technology within each of the content areas. These suggestions were recognized in Chapter Two as important qualities of teacher education programs who have had success in promoting the transfer of technology integration knowledge and skills to the classrooms of their teacher education graduates, thus supporting current recommendations found in the literature.

**Summary of Chapter Four**

This study captured both survey and interview data in order to identify technology integration instructional strategies in preservice teacher education that contribute to the transfer of technology integration knowledge and skills to the classroom practices of early career teachers by asking practicing early career teachers themselves. In order to accomplish this purpose, the study employed a two-phase, sequential explanatory strategy, utilizing a mixed methods approach. A customized survey was administered to 330 early career teachers, who had been teaching four years or less. The 24 survey respondents were teachers from a variety of disciplines, grade levels, and geographical locations. Once the survey results were analyzed utilizing descriptive statistics, the interview protocol was created for the purpose of collecting richer, more descriptive data to aid in explaining the survey data and informing the three research questions. Five early career teachers were interviewed for the second phase of the research study.

For the survey results section, the early career teachers indicated that they felt that they had proficient knowledge of technology and how to integrate it in the classroom. Between 79% and 88% could utilize such instructional technologies as email, digital images, web browsers, spreadsheets, and SmartBoards independently. They, however, felt less comfortable with web design authoring tools, digital video and other forms of digital media. With regards to technology integration in the classroom, they reported highly on using technology-based activities within the curriculum; using technology to design new learning experiences; and to help support state/federal curricular standards and to differentiate lessons.

Additionally, the early career teachers recognized too much content to cover; lack of time to create and implement technology-enhanced lessons; and lack of technology resources as the top barriers to integrating technology. Lack of mentoring, knowledge about technology integration, and knowledge about technology were identified as less substantial barriers or inconsequential. When the early career teachers were questioned about practices in their teacher education programs that supported technology integration, responses included: faculty members in the content areas modeling uses of technology; reflecting upon the uses of technology; opportunities to practice and experiment with technology; access to expert guidance; and collaboration. Two practices identified as prohibitive for integrating technology were opportunities to work with technology and access to expert guidance while in field experiences. Overall however, the early career teachers reported that the technology training they received during their teacher education program did effectively prepare them for the classroom, perceiving the technology training provided as present throughout their coursework.

For the interview phase of this study, five early career teachers were interviewed. Participants were from the English, Math, and Science programs. Their experience ranged from two to four years. The early career teachers were questioned about the top three barriers from the survey data: too much content; lack of time; and lack of technology resources. Three of the five teachers felt that technology-based lessons took too much time. These were the Math and

Science teachers and they also felt that the pressure to cover a certain amount of content in a designated amount of time was part of what limited their time to utilize technology. The two English teachers however, were comfortable enough in their use of technology integration that they did not feel as though any of these barriers were an issue for them. Suggestions provided to aid in alleviating these barriers included: approaching technology integration in incremental steps and building upon small successes, and providing teachers with common planning times so that they could help each create technology-based lessons.

Interviewees were also asked to identify practices in their teacher education program that supported their technology integration once in their own classrooms. Three of the teachers identified modeling, practicing and experimenting, and expert guidance with technology as practices that aided in their technology integration transfer. All of the programs represented by the early career teachers incorporated some sort of experimentation and practice with technology into their programs. The Math and Science programs only exposed the preservice teachers to technology through one technology course, whereas the English program had a more integrated approach. As has been mentioned several times throughout this chapter, four out of the five interviewees mentioned their field experiences as being weaker components of their programs with respect to promoting technology use in the classroom. As far as recommendations on how to improve these preservice experiences, the following suggestions were made: more faculty support, even at the field placement site in order to help with integrating technology; making the cooperating teacher aware of the technology requirements for the program; utilizing cooperating teachers who are proficient with technology or at least open to it being integrated into their classrooms; and investing into mobile or portable instructional technologies that preservice teachers can take to their field experience sites to utilize for lessons.

When questioned about which instructional technology tools the early career teachers felt would remain useful or even grow in use, three out of the five mentioned SmartBoards or Promethean Boards and their related technologies. The two English teachers did not mention these boards, but rather they focused on web design authoring software and mobile technologies. Video-related software was mentioned by the two Math teachers as not being useful in their discipline. Despite differences in responses, all of the early career teachers felt that instructional technologies did impact student learning in a positive way, especially as a way to engage students and connect their out-of-school activities with the skills and content being taught in the classroom. Final study conclusions, recommendations and issues of future research will be discussed in Chapter Five.

## Chapter Five: Conclusions and Recommendations

The purpose of this study was to identify instructional technology integration strategies and practices in preservice teacher education that contribute to the transfer of technology integration knowledge and skills to the instructional practices of early career teachers.
This chapter presents a brief review of the study, as well as an exploration of conclusions and interpretations with regards to early career teachers' perceptions of the technology integration knowledge and skills developed during their preservice teacher education; the barriers to technology integration once teaching in their classrooms; the preservice teacher education practices supportive and inhibitive of technology integration transfer; and the value of instructional technology as a useful tool to support learning. The chapter will conclude with detailing the limitations of the study, as well as recommendations for future research and practice.

### Review of the Study

In an attempt to promote the transfer of technology integration knowledge and skills in preservice teachers, studies have attempted to identify effective instructional technology integration practices on the part of the teacher education program, as well as exemplary programs themselves (Hofer, 2005; Mergendoller et al., 1994; Strudler & Wetzler, 1999). Studies conducted within various programs report on instructional practices and programs that demonstrate a strong possibility of positive transfer (Brush et al., 2003; Brush & Saye, 2009; Keeler, 2008; Seels et al., 2003; Wilson et al., 2002). Features common to many of the "best practice" programs showcased included: technology training for preservice teachers that began in the content-specific methods and instructional technology courses, and included technology skills training and models of technology integration by faculty; opportunities for students to develop their own technology projects to support learning and teaching; and time for the students to reflect upon technology integration processes in order to encourage critical thinking skills regarding their choices (Brush, et al., 2003; Brush & Saye, 2009; Keeler, 2008).

The literature identifying instructional practices or programs that have been successful in producing teachers who utilize technology in their classrooms to support student learning appears limited. A close examination of the literature reveals that many of these programs have not actually followed early career teachers into their second through fourth years of teaching to discern their teaching practice with regards to technology integration in order to provide evidence of positive transfer. Therefore, the purpose of this study was to identify technology integration instructional strategies in preservice teacher education that contribute to the transfer of technology integration knowledge and skills to the classroom practices of early career teachers by asking teachers in years two to four of practice.

This study captured both survey and interview data in order to identify technology integration instructional strategies in preservice teacher education that contribute to the transfer of technology integration knowledge and skills to the classroom practices of early career teachers. The study employed a two-phase, sequential explanatory strategy, utilizing a mixed methods approach (Creswell, 2009). Twenty-four early career teachers, who had all graduated from the same School of Education and had been teaching four years or less, completed the customized survey. The survey respondents were teachers from a variety of disciplines, grade levels and geographical locations. Once the survey results were analyzed utilizing descriptive statistics, the interview protocol was created for the purpose of collecting richer, more descriptive data to aid in further explaining the survey data (Frankel & Wallen, 2006). Five early career teachers were interviewed for the second phase of the research study. All qualitative data were examined and coded in order to discover emerging themes (Creswell, 2009).

### Early Career Teacher Conclusions and Interpretations

Three research questions guided this study. The early career teachers were questioned through the use of survey and interview instruments in order to determine the following: a self-assessment with regards to their current level of technology integration knowledge and skills; the technology integration barriers they were experiencing, as well as sources of these barriers; and lastly, practices in their preservice teacher education that supported and inhibited technology integration transfer to their classrooms. Each of these areas will be discussed in the following sections in light of study findings, the relevant literature, and the professional experience of the researcher as a former teacher and current teacher educator.

**Technology integration self-assessment.** Current, early career teachers have grown up in a digital age of rapidly changing and advancing technology. As Dutt-Doner et al. (2005) found in their research, teacher educators should not assume that exposure to this digital era serves as "adequate preparation for understanding how to meaningfully integrate technology to transform learning" (p. 65). In this present study, a majority (75% - 100%) of the early career teachers surveyed, reported having access to the Internet, email, portable laptop carts, computer labs, LCD projectors and SmartBoards. A strong majority (83%) also reported having access to a technology resource teacher in their school or district. Learning management systems, iPads, iPod Touches, and distance-learning labs did not have a high level of reported access (4 – 17%) at the time of the survey.

With regards to the Stages of Adoption, a majority of the early career teachers (58%) aligned themselves with at the top level, Stage 6, indicating they feel able to apply technology knowledge in it's use as an instructional tool, as well as integrate it into instruction. Whereas, for the CBAM Levels of Use of an Innovation question, 8% aligned themselves with the highest stage, Level 6, the Renewal stage, indicating they consistently reevaluate their use of instructional technology in the classroom and often explore new ways to utilize it with students, so that their instruction remains engaging and innovative. Forty-two percent identified themselves with Level 5, the Integration stage, indicating they collaborate with other educators in order share best practices with instructional technology and maximize its impact in the classroom. Thirty-eight percent identified with Level 4B, the Refinement stage, indicating they utilize instructional technology in a variety of ways in order to maximize its impact and support of student learning.

In comparing these two survey items, the six levels of the Stages of Adoption item are similar to the first six levels of the CBAM item. For example, in the Stages of Adoption item, the Stage 6: Creative Application to New Contexts description is very similar to the Level 4B: Refinement description in the CBAM item. Both levels describe a user of technology who is comfortable integrating instructional technology into the classroom and varying its use in order to maximize its impact to support student learning. The CBAM item, however, has two additional levels for users of technology. One describes an individual who utilizes technology collaboratively with other teachers in order to maximize its impact with students (Level 5: Integration); and the top level describes an individual who consistently reevaluates the use of technology in the classroom, modifies its use instructionally in order to maximize its impact, and explores new, emerging technologies that may have potential as a learning tool in the classroom (Level 6: Renewal). Using the Stages of Adoption and CBAM survey items together allows a researcher to investigate whether survey participants are being consistent in the manner in which they rate their use and integration of technology into the classroom.

Five instructional technologies rose to the top (79% - 88%) as ones that the early career teachers reported that they could utilize independently. These top technologies included: utilizing the advanced features of email; importing and capturing digital images; utilizing the advanced features of web browsers; using digital spreadsheets; utilizing SmartBoards; and implementing digital presentations. Respondents reported less independence with three technologies: web design authoring tools, digital video, and digital media.

Three statements dealing with technology integration for learning received very high responses (96%) from the early career teachers and they included: integrating technology-based activities into the curriculum; using technology to support to content learning in the classroom; and using technology and its unique capabilities to design new learning experiences with students. Two statements that ranked lower included: having students use technology to demonstrate their knowledge of content in non-traditional ways (67%), and requiring students to use a variety of software tools and digital resources to support learning (59%).

Overall, it can be surmised that the early career teachers who responded to this survey assess themselves as being proficient users of instructional technologies, as evidenced by their responses to their Stages of Adoption, CBAM Levels of Use of an Innovation, and degree of independence questions. Not surprisingly, instructional technologies that may not be found in schools as much (e.g., web design authoring tools, digital video and digital media) had lower reported instances of use in the classroom. The lower instances of use could also correspond to these instructional technologies usually requiring more specialized knowledge and often involve a higher learning curve than the previously mentioned instructional technologies.

These findings are similar to those found by Lei (2009), who conducted research which explored preservice teachers' attitudes, experiences, strengths, and preparation needed in the field of technology. Lei (2009) found specifically that preservice teachers reported being quite proficient with basic technologies, but lacked experience with more advanced technologies, even though they expressed positive feelings towards utilizing technology in their instruction.

With regards to statements about technology integration and learning in the classroom, the early career teachers responded most favorably to statements dealing with utilizing technology-based activities to support content learning; designing new learning experiences with students; assisting in the support of state/federal curricular standards; and meeting the individual needs of a variety of students. Statements receiving a middle to lower range of responses included those dealing with perhaps more time-consuming activities like project- and problem-based learning; evaluating educational technology resources for student use; demonstrating the proficiency of student skills in non-traditional ways; and using a variety of technology tools to support student learning. This pattern of response, is again, supported by research conducted by Lei (2009). Additionally, the way the early career teachers responded to these statements could be due, at least in part, to the barriers they indicated that they face integrating technology in the classroom, which will be discussed next.

**Barriers to technology integration.** The strongest barriers (58% - 83%) recognized by the early career teachers included: too much content to cover; lack of time to create and implement technology-based lessons; and lack of software available in the school. These issues often prevent the effective integration of technology into the classroom and have been commonly cited in research over the last fifteen years (Ertmer 1999; Fabry & Higgs, 1997; Keengwe, Onchwari, & Wachira, 2008; Rogers, 2000; Royers & Richards, 2009). Additionally, it is interesting to point out that all of these barriers are external factors in that they are directly related to the classroom or school environment. Ertmer (1999) described external factors or barriers that affect both preservice and inservice teachers in their integration of technology in the classroom as first-order barriers. Items recognized as the weakest influences, or as not being barriers (12% - 29%), in preventing technology integration included: lack of mentoring; lack of knowledge about technology integration; and lack of knowledge about technology. Ertmer (1999) described these internal factors as second-order barriers.

These findings indicate that the early career teachers surveyed, found their school environments, or first-order barriers, to be more inhibitive of technology integration in the classroom than their own knowledge or access to knowledge, or second-order barriers, with regards to instructional technology and integrating it in the classroom (Ertmer, 1999). Consistent with Creswell's (2009) sequential explanatory strategy, the results from this survey section were formulated into an interview question in order to further investigate these issues.

Three of the five interviewees identified time as a barrier and two of these identified content as a barrier in addition to the time. The two English teachers did not feel that any of these items were barriers. They seemed to be able to integrate technology into their instruction comfortably and within the available time constraints, conveying a belief that if technology were utilized correctly and according to what's best for the students, methods would seamlessly take care of content and meet the applicable standards. This idea is consistent with Brill's (2002) findings regarding innovative teachers. The two Math teachers struggled with time and content as barriers. None of the interviewees listed technology as a barrier as they each had indicated that their respective schools possessed a high level of access to a variety of instructional technologies.

Suggestions to alleviate these barriers ranged from starting with simple technology lessons and building from there; to providing teachers with common planning times in order to help each other create technology-based lessons and share; to buying pre-made technology lessons for teachers to utilize. Alleviating these barriers would be specific to each school. What might be the most beneficial would be for teachers and administrators to be aware of first order barriers as potential obstacles and not assume a lack of teacher knowledge or skill. Then, if an external barrier is confirmed, they can work together to come up with solutions on how to best support the teachers and students.

**Teacher education practices supportive of technology integration.** Research from Chapter Two pinpointed nine factors characteristic of teacher education programs that positively promote the transfer of technology integration knowledge and skills to the classrooms of their teacher education graduates (see Appendix M). Survey respondents were asked to rank each of these qualities using a Likert-scale that ranged from "Strongly Agree" to "Strongly Disagree," in regards to how prevalent each of them were in their preservice teacher education. These qualities were ranked in the following order, from highest to lowest: modeling; reflecting; practicing and experimenting with technology; expert guidance in coursework; collaboration; hands-on, authentic experiences; meaningful activities; scaffolding; practice utilizing technology in real K-12 classrooms; and expert guidance in field experiences.

The following transfer factors were mentioned by three of the five early career teachers who were interviewed, as being the most prevalent in their respective teacher education programs: modeling; practicing and experimenting; and expert guidance with technology. These results were similar to the survey results. More specifically, all of the representative programs appeared to have included some sort of experimentation and practice with technology during their graduate course of study. As reported by the interviewed early career teachers, the Math and Science Education programs only exposed their preservice teachers to technology through one technology class, whereas the English Education program integrated their technology instruction throughout the program. Additionally, the English Education had faculty leadership that would even travel to their preservice teachers' field experience schools in order to make sure that technology integration was carried out in the field experiences, as well as during the program's coursework.

Strudler and Wetzler (1999) found that programs deemed to be exemplary in their technology training for preservice teachers integrated technology throughout all their educational courses and often coupled instructional technology courses with practicum experiences in order to provide more authentic applications of technology use in the classroom. Hofer (2005) also found programs that integrated technology through all components of their teacher education programs were more successful than those who relied only on a stand-alone instructionally technology course. Further, characteristics represented in the English Education program have been demonstrated to be best practices in teacher education programs effective in their technology integration training (Brush et al., 2003; Brush & Saye, 2009; Seels et al., 2003; Wright et al., 2002).

Weaving technology integration through the preservice teacher education experience, including field practice, seems to develop more agile teachers who are able to integrate instructional technologies despite common barriers (e.g., time, content, etc.), thus addressing a challenge described by Jacobsen and others. According to Jacobsen et al. (*2002*), the real challenge is to "develop fluency with teaching and learning with technology, not just with technology, itself" (p. 44). Keengwe et al. (2008) recognized that technology should be utilized as a method to improve and support learning, and not as a tool for the mere delivery of instruction. Additionally, Jacobsen et al. (2002) observed, "When you begin to think differently about technology and learning and you have different spaces in which to learn and teach, you can design different approaches to learning" (p. 27).

**Teacher education practices inhibitive of technology integration.** Field experiences during the teacher education program surfaced in the survey as being a component that prohibited technology integration knowledge and skills transfer. A question, therefore, was created for the interview protocol to more explicitly explore the issue. Research has demonstrated that providing preservice teachers with the opportunity to integrate technology during field experiences aids in transferring the subsequent knowledge and skills to future classrooms (Brush et al., 2003; Brush & Saye, 2009; Seels et al., 2003; Wright et al., 2002).

Interestingly, within the context of the negatives mentioned about field experiences, only one interviewee mentioned her teacher being the issue for not allowing technology integration and another mentioned not getting to collaborate with classmates and faculty during her field experience, which she felt may have helped with the technology integration experience. These are separate issues not related to any of the identified barriers discussed earlier. Two other interviewees, however, mentioned time and technology resources as the factors within the field experience environment that prevented them from getting to utilize technology in the classroom. These are the same barriers that the early career teachers themselves recognized as factors that had impeded them from integrating technology in the classroom.

Other teacher education practices that were mentioned by the interviewees to be prohibitive of technology integration included: guidance by faculty that was not necessarily expert; having only one instructional technology-related course; and limited opportunities to practice with technology in content-specific and methods courses. Literature from Chapter Two demonstrated that programs characterized by effectively implementing these factors, as well as providing field experiences rich with technology opportunities positively promote the transfer of technology integration knowledge and skills to the classrooms of early career teacher more than programs that do not (Brush et al., 2003; Brush & Saye, 2009; Seels et al., 2003; Wright et al., 2002). For example, during an analysis of an e-portfolio requirement for elementary education students, Sexton et al. (2009) found inclusion of the following factors would greatly benefit their existing program: content-specific area faculty must model innovative uses of instructional technology; teaching strategies requiring the use of technology must be utilized in methods courses as much as possible; and field experiences must provide technology-rich environments for the preservice teachers where they can observe the modeling of technology and practice utilizing it themselves

Two specific responses were mentioned twice with regards to suggestions on how to improve field experiences for preservice teachers in their teacher education program. These consisted of getting faculty to be more supportive and making sure that the cooperating teachers are aware of the technology requirements for the student teachers, as well as making themselves available to travel to the participating schools to aid both the preservice and inservice teacher with integrating technology into the classroom. Doing so would also benefit those inservice teachers who have volunteered to be mentor teachers, but who may not be technologically savvy. Wright et al., (2002) demonstrated that this was an effective component of the Master Technology Teacher (MIT) program, where education and instructional technology faculty from the university worked closely with preservice and supervising inservice teachers to brainstorm opportunities to integrate technology. Obtaining technologically proficient mentor teachers is not always within control of the teacher education program, so if faculty can be more supportive by visiting the field experience site, the issue may not be as pronounced.

Faculty should also be aware of the technology access each participating school has and perhaps be willing to supplement their technology resources with relevant, mobile instructional technologies that the preservice teachers can checkout and take to the schools. It is also important that preservice teachers know that such services are available, as well as what is available for them to checkout. Mobile instructional technologies were an important component of the MIT program discussed in the previous paragraph; preservice teachers were provided with the opportunity to utilize the university's Technology on Wheels (TOW) program in order introduce hardware and software provided by the program to the field experience school sites (Wright et al., 2002).

Overall, these early career teachers suggested that faculty and members of the teacher education program take steps to be more involved and aware of what's going on in the participating schools, so that when a lack of resources or expertise confronts the student teacher, the faculty can step in to help. Research has indicated that teacher education programs that do incorporate such scaffolds for their preservice teachers are more effective in the transfer of technology integration knowledge and skills (Brush et al., 2003; Brush & Saye, 2009; Seels et al., 2003; Wright et al., 2002). For example, West and Graham (2007) implemented a live modeling approach to an instructional technology course in the hopes of increasing knowledge transference for preservice teachers. The live modeling sessions were composed of three stages and included: example lessons taught by the instructor utilizing a form of technology coupled with the students completing a project correlated with the session; students collaborating to create an outcome that evidenced their comprehension of the technology and content area;

students being encouraged to reflect upon the experience; and relating the knowledge obtained to a potential classroom context (West & Graham, 2007). In the end, this allows the preservice teacher to be able to gain the experiences they need in order to obtain the technology integration knowledge and skill set so that they will utilize technology effectively in their own classrooms.

**Instructional technology as a useful tool to support learning.** Instructional technology has rapidly become a prominent force in the classroom as a learning tool, especially since the advent of personal computers and the introduction of the Internet in the early 1990's (Stallard & Cocker, 2001). As part of the interview process, the participating early career teachers were asked to share whether they felt utilizing instructional technologies in the classroom was useful as a learning tool to support student learning. All five teachers stated that they believed utilizing instructional technology in the classroom was definitely a useful tool to support student learning. Reasons that they felt this way included: it aids in bridging students' out-of-school activities with classroom content and skills; it automates activities and makes them more appealing to students; it can capture information from a lesson to be provided to students at a later date; it collects data on student performance and allows teachers to pinpoint weak skill sets; it allows students to collaborate and share projects they've created, thus broadening their audience and making the classroom more of a community; and lastly, it allows learning to connect with students on a level with which they are familiar and feel comfortable.

Even though their responses were a mix of utilizing technology as a productivity tool, as well as a learning tool, these early career teachers seemed to realize that innovative instruction that reaches students utilizes more than just technology. Innovative instruction comes from educators who incorporate a variety of learning theories (e.g., behavioral, cognitive, constructivist) and base it upon the desired outcome and also what is appropriate for the learner

(Venesky, 2004). Research corroborates this perspective. For example, Wenglinsky (2005) demonstrated in research with students from grades four through twelve that, when technology is utilized in relation to constructivist principles, students perform better than when it is only used with direct instructional methods.

**Study Limitations**

This study has three main limitations. The most outstanding limitation for the current study was the low response rate for both the surveys and interviews. This study only had 24 respondents from a pool of 330 early career teachers (7%). McMillan (2004) recommended a minimum of 30 subjects for non-experimental research; for qualitative studies, there is no recommended minimum. The characteristics and experiences of this pool of respondents could be greatly different from the rest of the respondents, and so, the findings cannot be counted as clearly representative of the entire group. A second limitation of this study was the population utilized. The research study only recruited early career teachers from a specific school of education at a large, research university located in the southeast. Therefore, the findings of this study cannot be generalized or applied to populations of early career teachers who have graduated from other teacher education programs. One last limitation encountered by this study is that the study participants were guaranteed anonymity, a non-negotiable requirement of the organization providing participant emails. Thus, the researcher could not obtain clarification or explanation from the respondents once the survey was submitted.

**Contributions of the Study**

Despite this study's limitations, the work provides three prominent contributions to the current literature base regarding technology integration training in teacher education programs. The first contribution is that this study provides teacher educators and scholars with empirical findings related to technology integration strategies in teacher education that both support and hinder the transfer of new knowledge and skills to the classroom practices of early career teachers. A review of the literature demonstrated that research in this realm was lacking. Secondly, the study provides teacher educators with naturalistic recommendations (Stake, 1995) on how to improve their programs that are corroborated by the literature.

Finally, the study offers an adapted survey that can be utilized by teacher educators or researchers to investigate technology integration transfer from the teacher education period to the earl classroom practice period of new teachers. The survey can serve as a valuable source of data for teacher education programs and specifically pinpoint areas that are strong and those that need improvement. Such evaluative data is vital in today's teacher education programs where preservice teachers are expected to be competent in the area of instructional technology and on how to utilize it in the classroom to support student learning (Howard, 2002; West & Graham, 2007; Whittier & Lara, 2006; Williams et al., 2009).

**Recommendations for Further Research**

In consideration of the findings, the first recommendation for further research is to study teacher education programs from various types of institutions to increase the opportunities of generalizability from one institution to another, and to overall, create a more robust literature base with regards to teacher education and effective technology integration training that transfers to the classrooms of early career teachers. Although, teacher education programs generally seek the same outcome - to produce effective teachers who are knowledgeable in their field, as well as with teaching practice and methodology, in order to provide high quality instruction for a variety of learners - specific programs can vary greatly with regards to size, structure and organization. Additionally, utilizing the survey in more research would be interesting in order to determine how findings are similar and different with regards to various types of teacher education programs.

A second recommendation for further research includes investigating early career teachers at the end of their first year and into their second year of teaching to determine how much of their current practice has been influenced by their teaching environment and experience; and how much has been promoted by their experiences in teacher education with regards to technology use and application. One early career teacher in the study indicated he learned more about technology during their first and second year teaching than he did during his preservice experience, because he was fortunate to be employed in a school that had a high access level to technology. This indicates that it can be challenging to discern between the influences provided by teacher education experiences and early career teaching experiences. Therefore, such research could benefit scholars and teacher educators in understanding the impact that teacher education training has on novice teachers in relation to applying their technology integration knowledge and skills, prior to the novice teachers adopting and implementing these skills during their early teaching experiences.

The third recommendation for research includes conducting case studies on the two English Education program graduates who were interviewed to discern what is different about their education/practice that enables them to have an early career practice not impacted by the barriers identified by others. A majority of the survey and interview respondents recognized barriers that inhibited technology integration including: too much content to cover; lack of time to create and implement technology-based lessons; and lack of software available in the school. These issues often prevent the effective integration of technology into the classroom and have been commonly cited in research over the last fifteen years (Ertmer 1999; Fabry & Higgs, 1997;

Keengwe, Onchwari, & Wachira, 2008; Rogers, 2000; Royers & Richards, 2009). The two English Education graduates, however, stated that they integrated technology into their instruction comfortably and within the available time constraints, conveying a belief that if technology were utilized correctly and according to what's best for the students, methods would seamlessly take care of content and meet the applicable standards. In depth case study research may illuminate what enables these early career teachers to already practice in a way that renders these barriers inconsequential.

**Recommendations for Further Practice**

This study sought to elaborate on the current knowledge base with regards to practices in teacher education that promote and even inhibit the transfer of technology integration knowledge and skills to the classrooms of early career teachers. In order to accomplish this goal, the study utilized technology questions related to knowledge, skills, barriers, classroom integration and teacher education to more fully explore the impact of technology-related instructional practices within teacher education. Several recommendations originated from the interview data with regards to these factors and a summary of these is included in the following paragraphs. All of these recommendations were demonstrated in Chapter Two as features from teacher education programs effective in their ability to promote technology integration knowledge and skills transfer in their teacher education graduates.

The first recommendation for practice is to maximize the field experiences for preservice teachers with regards to the opportunities that they have to practice integrating technology, especially with access to expert guidance along the way. Although teacher education programs have limited control over these situations, they can improve them by possibly supplementing a lack of technology resources at the field experience site with their own portable, mobile instructional technologies that preservice teachers can bring to the school. Another possibility is to locate faculty that can assist the preservice teacher at the school site with technology integration, if the inservice teacher is not comfortable with or open to utilizing technology in the classroom. This can benefit both the preservice and inservice teacher. Field experiences that provide opportunities for preservice teachers to integrate technology into the classroom have been demonstrated in literature to promote the transfer of technology integration knowledge and skills to the classrooms of teacher education graduates (Brush et al., 2003; Brush & Saye, 2009; Seels et al., 2003; Wright et al., 2002).

The second recommendation for practice in teacher education is a continued focus on content-specific technologies in both instructional technology courses and content-specific methods courses. The modeling of content-specific technologies is mentioned substantially in the related literature as being a very strong support for the transfer of technology integration knowledge and skills to the classrooms of teacher education graduates, especially when coupled with related field experiences (Brown et al., 1989; Brush & Saye, 2009; Hofer, 2005; Keeler, 2008; Mergendoller, 1994; Strudler & Wetzler, 1999; West & Graham, 2007; Williams et al., 2007). Literature also indicates that technology training that is integrated throughout a teacher education also supports the transfer of technology integration knowledge and skills to the classrooms of their teacher education graduates (Strudler & Wetzler, 1999; Hofer, 2005).

The third recommendation for practice is to ensure that each licensure program provides its preservice teachers with ample, hands-on opportunities with various types of instructional technologies, as well as time to practice and experiment. This study's survey data revealed that these transfer qualities were not necessarily lacking overall, but the interview data indicated that the early career teachers desired more opportunities to engage in such activities. Research also reveals that these are important qualities of effective teacher education programs with regards to technology integration training (Brown et al., 1989; Keeler, 2008; West & Graham, 2007; Williams et al., 2009; Wright et al., 2002).

The final recommendation for practice is to ensure each licensure program has access to faculty who can provide expert guidance to preservice teachers and who are enthusiastic about integrating technology in the classroom. Again, expert guidance is recognized in the literature as being an asset of effective teacher education programs with regards to technology integration training (Brown et al., 1989; Howard, 2002; Williams et al., 2009). It is beyond the scope of this study to discuss specific professional development with regards to technology integration knowledge and skills for teacher education faculty. However, Chapter Two does provide some suggestions on how to strengthen the technology competencies of said faculty. For example, Dexter et al. (2005) found the following to be "mandatory resources" for successful technology integration by faculty in their respective programs: "adequate access to supported resources, faculty members' opportunities and willingness to learn, and factors that facilitated communication and coordination" (p. 340).

**Summary of Chapter Five**

In summary, teacher educators can learn a lot about their own programs with regards to technology integration knowledge and skills and if their practices are promoting transfer to the classrooms of their early career teachers by employing some sort of a data collection method that regularly seeks input from recent graduates to investigate whether these practices are effective. The customized survey utilized in this research study provides one such vehicle. However, more research of this type needs to be conducted in order to fully understand the effectiveness of the transfer qualities investigated in this study and to analyze whether there are other practices that may be deemed effective as well.

Although the present study focused on nine instructional strategies (see Table 1) with regards to technology integration that evolved out of the current literature base, and four (e.g., meaningful activities; scaffolded activities; authentic contexts; expert guidance in field experiences) of those were listed previously as recommendations for increased and continued support, Kay (2006) found that, regardless of the strategy utilized to integrate the technology, modeling effective uses of technology and providing authentic instructional activities for preservice teachers were significant in order for transfer to occur from the university setting to the K-12 classroom. Brown and Warschauer (2006), who also summarized findings with regards to the same literature base, found that:

> These findings include the need for university faculty to upgrade their technological expertise, to model technology infusion curricula, and to provide a comfortable learning environment for technology application. These studies also pointed to the importance of placing student teachers in technologically rich and supportive environments (p. 601).

Ultimately, it is not about incorporating every instructional strategy related to technology integration represented in the literature, but rather, focusing on the ones that have provided the most impact, overall. Determining which strategies provide the most impact may be different for each teacher education program, but this study provides evidence of a positive starting point. Creating a plan to respond to the findings will be based upon the characteristics of a teacher education program that make it unique. Teacher education programs need to provide enough technology skills and instructional theory for their teacher graduates to begin smoothly, but just as important, instill the attitudes and desire to keep abreast of advancing instructional technologies in a dynamic field.

## References


Alderman, M., & Beyeler, J. (2008). Motivation in preservice teacher education: Possibilities for transfer of learning. *Teaching Educational Psychology*, *3*(2), 1-23.

Atkins, N. E. & Vasu, E. S. (2000). Measuring knowledge of technology usage and stages of concern about computing: A study of middle school teachers. *Journal of Technology and Teacher Education, 8*(4), 279-302.

Anderson, J. R., Reder, L. M., & Simon, H. A. (1996). Situated learning and education. *Educational Researcher*, *25*(4), 5-11.

Atkinson, R. C., & Wilson, H. A. (1969). Computer-assisted instruction. In R. C. Atkinson & H. A. Wilson (Eds.), *Computer-assisted instruction: A book of readings,* (pp. 3-14). New York: Academic Press.

Aust, R., Newberry, B., O'Brien, J. & Thomas, J. (2005). Learning Generation: Fostering innovation with tomorrow's teachers and technology. *Journal of Technology and Teacher Education, 13*(2), 167-195.

Barbousas, J. (2009). The visual education movement: The emergence of visual technology in education. *The International Journal of Learning*, *16*(10), 169-180.

Bianchi, W. (2008). Education by radio: America's schools of the air. *TechTrends: Linking Research and Practice to Improve Learning*, *52*(2), 36-44.

Bitter, G. G., & Pierson, M. E. (2005). *Using technology in the classroom*, 6th ed. Boston, MA: Pearson Education, Inc.

Bloom, B. S., & Krathwohl D. R. (1956). *Taxonomy of educational objectives: The classification of educational goals, by a committee of college and university examiners. Handbook 1: Cognitive domain*. New York, NY: Longmans.

Bransford, J. D., & Schwartz, D. L. (1999). Rethinking transfer: A simple proposal with multiple implications. *Review of Research in Education*, *24*, 61-100.

Briggs, L. J. (1972). Problems and solutions relating to the use of multi-media instruction. In F. J., & R. J. Goff (Eds.), *Technology in education: Challenge and change* (pp.115-122). Worthington, OH: Charles A. Jones.

Brill, J. M. (2002). School by design: How members of one school community create (and recreate) student success through inquiry. (Unpublished doctoral dissertation). University of Georgia, Athens, GA.

Brinkerhoff, J. (2006). Effects of a long-duration, professional development academy on technology skills, computer self-efficacy, and technology integration beliefs and practices. *Journal of Research on Technology in Education, 39*(1), 22-43.

Brinkerhoff, J., Ku, H., Glazeski, K., & Brush, T. (2001). Development, results and validation of technology integration surveys for preservice and practicing teachers. Presentation at the meeting of the Association for Educational Communications and Technology, Atlanta, GA.

Brown, A. L. (1990). Domain-specific principles affect learning and transfer in children. *Cognitive Science, 14*(1), 107-133.

Brown, D. & Warschauer, M. (2006). From the university to the elementary classroom: Students' experiences in learning to integrate technology in instruction. *Journal of Technology and Teacher Education, 14*(3), 599-621.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, *18*(1), 32-42.

Bruner, J. S. (1966). *Toward a theory of instruction*. Cambridge, MA: Belknap Press.

Brush, T., Glazewski, K., Rutowski, K., Berg, K., Stromfors, C., Van-Nest, M. H., Stock, L., & Sutton, J. (2003). Integrating technology into a field-based teacher training program: The PT3@ASU project. *Educational Technology Research and Development, 51*(1), 57–72.

Brush, T. & Saye, J. (2009). Strategies for preparing preservice social studies teachers to effectively integrate technology: Models and practices. *Contemporary Issues in Technology and Teacher Education, 9*(1), 46-59.

Brzycki, D. & Dudt, K. (2005). Overcoming barriers to technology use in teacher preparation programs. *Journal of Technology and Teacher Education, 13*(4), 619-641.

Bucci, T. T., Copenhaver, J., Johnson, L., Lehman, B. & O'Brien, T. (2003). Technology integration: Connections to educational theories. *Contemporary Issues in Technology and Teacher Education, 3*(1), 30-46.

Butterfield, E. C. & Nelson, G. D. (1989). Theory and practice of teaching for transfer. *Educational Communications and Technology Journal, 37*(3), 5-38.

Cambre, M.A. (1995). The state of the art of instructional television. In G.J. Anglin, (Ed.), *Instructional technology, past, present, and future*, (2nd ed.) (pp. 296-304). Englewood, CO: Libraries Unlimited.

Chambers, J. A., & Sprecher, J. W. (1983). *Computer-assisted instruction: Its use in the classroom.* Englewood Cliffs, NJ: Prentice-Hall.

Cherup, S. & Snyder, L. (2003). A model for integrating technology into teacher education: One college's journey. *Contemporary Issues in Technology and Teacher Education, 3*(1), 47-56.

Clark, R. E. (1983). Reconsidering research on learning from media. *Review of Educational Research*, *53*(4), 445-459.

Coburn, P., Kelman, P., Roberts, N., Snyder, T., Watt, D., & Weiner, C. (1982). *Practical guide to computers in education*. Reading, MA: Addison-Wesley.

Cognition and Technology Group at Vanderbilt (CTGV). (1990). Anchored instruction and its relationship to situated cognition. *Educational Researcher, 19*(6), 2-10.

Collins, A. (1991). Cognitive apprenticeship and instructional technology, In L. Idol and B. F. Jones (Eds.). *Educational values and cognitive instruction: Implications for reform*, (pp. 121-138). Hillsdale, NJ: Erlbaum.

Collins, A., Brown, J. S., & Newman, S. E. (1987). *Cognitive apprenticeship: teaching the craft of reading, writing and mathematics (Technical Report No. 403). BBN Laboratories, Cambridge, MA: Centre for the Study of Reading, University of Illinois.*

Collins, A., Brown, J. S., & Holum, A. (1991). Cognitive apprenticeship: Making thinking visible. *American Educator, 15*(3), 6-11, 38-46.

Contemporary Issues in Teacher Education (CITE). (2003). *Implementing the NETS*T: Stories from the first-round winners of the ISTE NETS Distinguished Achievement Awards*. Retrieved from http://www.citejournal.org/vol3/iss1/general/article1.cfm

Corbin, J., & Strauss, A. (2008). *Basics of qualitative research* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five approaches.* Thousand Oaks, CA: Sage Publications.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Los Angeles, CA: SAGE Publications, Inc.

Cunningham, A. (2003). Supporting student-centered teaching and learning: Technology in Wake Forest University education programs. *Contemporary Issues in Technology and Teacher Education, 3*(1), 57-70.

Dexter, S., Doering, A.H. & Riedel, E. (2006). Content area specific technology integration: A model for educating teachers. *Journal of Technology and Teacher Education, 14*(2), 325-345.

Dale, E. (1969). *Audio-visual methods in teaching* ($2^{nd}$ ed.). New York, NY: Holt, Rinehart and Winston.

Diamond, R. M. (1964). Instructional television: its potentials and problems. In R. M. Diamond (Ed.), *A guide to instructional television,* (pp. 192-211). New York, NY: McGraw-Hill.

Dias, L. & Shoffner, M. (2003). Assessing inservice educator performance of state and national technology standards. In C. Crawford et al. (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference* (pp. 2191-2198).

Driscoll, M. P. (2005). *Psychology of learning for instruction*. Boston, MA: Pearson, Allyn & Bacon.

Dutt-Doner, K, Allen, S. M., & Corcoran, D. (2005). Transforming student learning by preparing the next generation of teachers for type II technology integration. *Computers in the Schools, 22*(3/4), 63-75.

Ely, D. (2008). Frameworks of educational technology. *British Journal of Educational Technology*, *39*(2), 244–250, doi: 10.1111/j.1467-8535.2008.00810.x.

Ertmer, P. (1999) Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development, 47*(4), 47-61.

Ertmer, P. (2003). Transforming teacher education: Visions and strategies. *Educational Research and Development*, *51*(1), 124-128. doi: 10.1007/BD02504522

Espinoza, S. & Pennington, A. (2007). From studenting to teachering – Authentic and engaging. In R. Carlsen et al. (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference* (pp. 1031-1035).

Fabry, D. L., & Higgs, J. R. (2000). Barriers to the effective use of technology in education: Current status. *Journal of Educational Computing Research, 17*(4), 385-395.

Finley, L. & Hartman, D. (2004). Institutional change and resistance: Teacher preparatory faculty and technology integration. *Journal of Technology and Teacher Education, 12*(3), 319-337.

Fraenkel, J. R., & Wallen, N. E. (2006). *How to design and evaluate research in education* (6th ed.). New York, NY: McGraw Hill.

Gagne, R. (1965). *The conditions of learning*. New York, NY: Holt, Rinehart & Wilson, Inc.

Glaser, R. (1963). Instructional technology and the measurement of learning outcomes: Some questions. *American Psychologist, 18*(8), 519-521. doi: 10.1037/h0049294

Gick, M. L., & Holyoak, K. J. (1987). The cognitive basis of knowledge transfer. In Stephen M. Cormier & Joseph D. Hagman (Eds.). *Transfer of learning: Contemporary research and applications,* (pp. 9-46). San Diego, CA: Academic Press.

Grable, L., Osborne, J. & Corbell, K. (2006). Internal reliability and factor analysis of Performance Standards for Inservice Teachers: Assessment of teachers' NETS-T expertise. In C. Crawford et al. (Eds.), *Proceedings of Society for Information*

*Technology & Teacher Education International Conference 2006* (pp. 898-903).

Greeno, J. G., Collins, A. M., & Resnick, L. B. (1996). Cognition and learning. In D. Berliner & R. Calfree, (Eds.), *Handbook of education psychology,* (pp. 15-46). New York, NY: Macmillian.

Guberman, S. R., & Greenfield, P. M. (1991). Learning and transfer in everyday cognition. *Cognitive Development*, *6*(3), 233-260.

Gustafson, K. L., & Branch, R. M. (2002). *Survey of instructional development models* (4th ed.) Syracuse, NY: ERIC Clearinghouse on Information & Technology.

Hall, G., Loucks, S., Rutherford, W., & Newlove, B. (1975). Levels of use of the innovation: A framework for analyzing innovation adoption. *Journal of Teacher Education, 26*(1), 52-56.

Halpern, D. F., & Hakel, M. F. (2003). Applying the science of learning to the university and beyond: Teaching for long-term retention and Transfer. *Change, 35*(4), 37–41.

Hancock, R., Knezek, G., & Christensen, R. (2007). Cross-validating measures of technology integration: A first step toward examining potential relationships between technology integration and student achievement. *Journal of Computing in Teacher Education, 24*(1), 15-21.

Hargreaves, A., & Fullan, M. (1992). *Understanding teacher development*. New York: NY Teachers College Press.

Harris, S., Lowery-Moore, H., & Farrow, V. (2008). Extending transfer of learning theory to transformative learning theory: A model for promoting teacher leadership. *Theory into Practice, 47*, 318-326.

Harwood, P. G. & Asal, V. (2007). *Educating the first digital generation.* Westport, CT: Praeger Publishers.

Haskell, R. (2001). *Transfer of learning*. London: Academic Press.

Hew, K. F. & Brush, T. (2007). Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research. *Educational Technology Research and Development, 55*(3), 223-252. doi:10.1007/s11423-006-9022-5

Hobbs, R., & Jensen, A. (2009). The past, present, and future of media literacy education. *Journal of Media Literacy Education*, *1*(1), 1-11.

Hofer, M. (2005). Technology and teacher preparation in *exemplary* institutions: 1994 to 2003. *Journal of Computing in Teacher Education*, *22*(1), 5-14.

Holcomb, L. B. & Beal, C. M. (2010). Capitalizing on web 2.0 in the social studies context. *TechTrends: Linking Research and Practice to Improve Learning, 54*(4), 28-33, doi: 10.1007/s11528-010-0417-0

Howard, J. (2002). Technology-enhanced project-based learning in teacher education: Addressing the goals of transfer. *Journal of Technology and Teacher Education, 10*(3), 343-364.

Howell, D. C. (2010). *Statistical methods for psychology* ($7^{th}$ ed.). Belmont, CA: Wadsworth, Cengage Learning.

International Society for Technology in Education (ISTE). (n.d.). *About ISTE*. Retrieved from http://www.iste.org/AM/Template.cfm?Section=About_ISTE/.

International Society for Technology in Education (ISTE). (2008). *National educational technology standards for teachers*. Eugene, OR: Author.

Ito, M., Horst, H., Bittanti, M., boyd, d., Herr-Stephenson, B., Lange, P. G., et al. (2008). Living and learning with new media: Summary of findings from digital youth project. Chicago: The John D. and Catherine T. MacArthur Foundation.

Jacobsen M., Clifford P., & Friesen, S. (2002). Preparing teachers for technology integration: creating a culture of inquiry in the context of use. *Contemporary Issues in Technology and Teacher Education, 2*(3). Retrieved from http://www.citejournal.org/vol2/iss3/currentpractice/article2.cfm

Jamison, D. T., & McAnany, E. G. (1978). *Radio for education and development*. Beverly Hills, CA: Sage Publications.

Johnson, W. G. (2008). "Making learning easy and enjoyable:" Anna Verona Dorris and the visual instruction movement, 1918-1928. *TechTrends: Linking Research and Practice to Improve Learning,* 52(4), 51-58.

Jorgensen, M. A., & Hoffman, J. (2003). *History of the No Child Left Behind Act of 2001 (NCLB): Assessment report.* San Antonio, TX: Pearson Education.

Judd, C. (1939). *Educational psychology*. Boston, MA: Houghton Mifflin.

Kajder, S. B. (2010). *Adolescents and digital literacies: Learning alongside our students*. Urbana, IL: National Council of Teachers of English.

Kay, R. (2006). Evaluating strategies used to incorporate technology into preservice education: A review of the literature. *Journal of Research on Technology in Education, 38*(4). 383-408.

Keeler, C. G. (2008). When curriculum and technology meet: Technology integration in methods courses. *Journal of Computing in Teacher Education, 25*(1), 23-30.

Keller, F. S., (1978). Instructional technology and educational reform: 1977. *Behavioral Analysis, 1*(1), 48-52.

Keengwe, J., Onchwari, G., & Wachira, P. (2008). Computer technology integration and student learning: Barriers and promise. *Journal of Science Education and Technology, 17*(6), 560-565.

King, K. (2008). Television in the schools: Instructional television and educational media resources at the National Public Broadcasting Archives. *TechTrends: Linking Research and Practice to Improve Learning, 52*(4), 59-65.

Knezek, G. A., Christensen, R. W., Miyashita, K. T., Ropp, M. M. (2000). *Instruments for assessing educator progress in technology integration*. Denton, TX: Institute for the Integration of Technology into Teaching and Learning.

Konkola, R., Tuomi-Gröhn, T., Lambert, P., & Ludvigsen, S. (2007). Promoting learning and transfer between school and workplace. *Journal of Education & Work*, *20*(3), 211-228. doi:10.1080/13639080701464483

Kozma, R. B. (1991). Learning with media. *Review of Educational Research*, *61*(2), 179-212.

Kumata, H. (1977). A decade of teaching by television. In W. Schramm (Ed.), *The impact of educational television: Selected studies from the research sponsored by the National Educational Television and Radio Center,* (pp. 176-192). Westport, CT: Greenwood Press.

Lambert, J., Gong, Y. & Cuper, P. (2008). Technology, transfer and teaching: The Impact of a single technology course on preservice teachers' computer attitudes and ability. *Journal of Technology and Teacher Education, 16*(4), 385-410.

Lave, J. (1993). Situated learning in communities of practice. In L. B. Resnick, J. M. Levin, & S. D. Teasley, (Eds.), *Perspectives on socially shared cognition* (pp. 63–82). Washington D.C.: American Psychological Association.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York, NY: Cambridge University Press.

Leach, E. E. (1983). Tuning out education: The cooperation doctrine in radio. *History of Public Broadcasting in the United States.* Retrieved from http://www.current.org/coop/

Leberman, S., McDonald, L., & Doyle, S. (2006). *The transfer of learning: Participants' perspectives of adult education and training*. Hampshire, England: Gower Publishing.

Lei, J. (2009). Digital natives as preservice teachers: What technology preparation is needed? *Journal of Computing in Teacher Education, 25*(3), 87-97.

Levie, W. H. & Dicke, K. E. (1973). The analysis and application of media. In R. Travers (Ed.), *The second handbook of research on teaching* (pp. 858-881). Chicago: Rand McNally.

Lowther, D. L., Inan, F. A., Strahl, D. J., & Ross, S. M. (2009, April). Do one-to-one initiatives bridge the way to 21st century knowledge and skills? Paper presented at the meeting of American Educational Research Association National Conference*,* San Diego, CA.

Maduakolam, I. & Bell, E. (2003). A product-based faculty professional development model for infusing technology into teacher education. *Contemporary Issues in Technology and Teacher Education, 3*(3), 340-352.

Market Data Retrieval. (2004). *Technology in education highlights*. Retrieved from http://www.schooldata.com/mdrtechhilites.asp.

McCombs, B. L. (1986). The Instructional Systems Development (ISD) Model: A review of those factors critical to its successful implementation*. Educational Communications and Technology, 34* (2) 67-81.

McMillan, J. H. (2004). *Educational Research: Fundamentals for the Consumer*. Boston: Pearson Education.

Mergendoller, J., Johnston, J., Rockman, S., & Willis, J. (1994). *Exemplary approaches to training teachers to use technology. Volume 1: Case studies*. U.S. Office of Technology Assessment: Washington, DC and Beryl Buck Institute of Education.

Mishra, P., & Koehler, M. (2006). Technological Pedagogical Content Knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017-1054.

Mishra, P., Koehler, M., & Kereluik, K. (2009). The song remains the same: Looking back to the future of educational technology. *TechTrends: Linking Research & Practice to Improve Learning*, *53*(5), 48-53. doi:10.1007/s11528-009-0325-3.

Molenda, M. (2008). The programmed instruction era: When effectiveness mattered. *TechTrends: Linking Research and Practice to Improve Learning, 52*(2), 52-58.

National Center for Education Statistics. (2005). Internet access in U.S. public schools and classrooms: 1994-2003. Retrieved from http://nces.ed.gov/surveys/frss/publications/2005015/

National Center for Education Statistics. (2005). *Internet access in U.S. public schools and classrooms: 1994-2003.* (NCES 2005-015). Washington DC: U.S. Department of Education.

National Center for Education Statistics. (2010). *Educational technology in U.S. public schools: Fall 2008*. (NCES 2010-034). Washington DC: U.S. Department of Education.

National Council for Accreditation of Teacher Education. (1997). *Technology and the new professional teacher: Preparing for the 21st century classroom.* Washington DC: Author.

Niederhauser, D.S., Lindstrom, D.L. & Strobel, J. (2007). Addressing the NETS*S in K-12 classrooms: Implications for teacher education. *Journal of Technology and Teacher Education, 15*(4), 483-512.

Niederhauser, D., & Perkmen, S. (2008). Validation of the Intrapersonal Technology Integration Scale: Assessing the influence of intrapersonal factors that influence technology integration. *Computers in the Schools*, *25*(1/2), 98-111. doi:10.1080/07380560802157956.

Palincsar, A. S., & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction*, *1*(2), 117-175.

Papert, S. (1980). *Mindstorms*. New York: Basic Books.

Perkins, D. N., & Saloman, G. (1988). Teaching for transfer. *Educational Leadership, 46*(1), 22-32.

Perkins, D. N., & Salomon, G. (1994). Transfer of learning. *International Encyclopedia of Education*, (pp. 6452-6457). Oxford, England: Elsevier.

Pett, D. & Grabinger, S. (1995). Instructional media production. In G.J. Anglin, (Ed.), *Instructional technology, past, present, and future* (2nd ed.) (pp. 305-313). Englewood, CO: Libraries Unlimited.

Preparing Tomorrow's Teachers to use Technology. (n.d.). *Home*. Retrieved from http://www.pt3.org/.

Pycior, S. W. (1984). The future of teaching the past: Computer-assisted instruction in history. *Computers and the Humanities, 3*(4), 205-214, doi: 10.1007/BF02267224

Rea, L. M. & Parker, R. A. (2005). *Designing & conducting survey research: A comprehensive guide* (3rd ed.). San Francisco: Jossey-Bass.

Reiser, R. A. (2001a). A history of instructional design and technology: Part I: A history of instructional media. *Educational Technology Research and Development*, *49*(1), 53-64, doi: 10.1007/BF02504506

Reiser, R. A. (2001b). A history of instructional design and technology: Part II: A history of instructional design. *Educational Technology Research and Development*, *49*(2), 57-67, doi: 10.1007/BF02504928.

Roblyer, M. D., Edwards, J., & Havriluk, M. A. (1997). *Integrating educational technology into teaching*. Upper Saddle River, NJ: Prentice Hall.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York, NY: Free Press.

Rogers, P. L. (2000). Barriers to adopting emerging technologies in education. *Journal of Educational Computing Research, 22*(4), 455-472.

Rossman, G. B., & Rallis, S. F. (2003). *Learning in the field: An introduction to qualitative research* (2nd ed.). Thousand Oak, CA: Sage.

Royer, R. & Richards, P. (2009). Field experiences in digital storytelling: Increasing teacher confidence and transfer into the classroom. In I. Gibson et al. (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference* (pp. 1307-1311).

Russ-Eft, D. & Preskill, H. (2001). *Evaluation in organizations: A systematic approach to enhancing learning, performance, and change.* Cambridge, MA: Basic Books.

Saettler, L. P. (1968). *A history of instructional technology*. New York, NY: McGraw-Hill.

Saettler, L. P. (1990). *The evolution of American educational technology*. Englewood, CO: Libraries Unlimited.

Sahin, I. & Thompson, A. (2007). Analysis of predictive factors that influence faculty members technology adoption level. *Journal of Technology and Teacher Education, 15*(2), 167-190.

Saldena, J. (2009). *The coding manual for qualitative researchers.* Thousand Oaks, CA: Sage Publications.

Salomon, G., & Perkins, D. N. (1989). Rocky roads to transfer: Rethinking mechanisms of a neglected phenomenon. *Educational Psychologist 24*(2): 113-142.

Scardamalia, M., Bereiter, C, & Steinback, R. (1984). Teachability of reflective processes in written composition. *Cognitive Science, 8*(2), 173-190.

Schrock, S. A. (1995). A brief history of instructional development. In G. J. Anglin, (Ed.), *Instructional technology, past, present, and* future (2nd ed.) (pp. 11-19). Englewood, CO: Libraries Unlimited.

Seels, B., Campbell, S., & Talsma, V. (2003). Supporting excellence in technology through communities of learners. *Educational Technology Research and Development, 51*(1), 91–104.

Seels, B., & Richey, R. (1994). *Instructional technology: The definition and domains of the field*. Washington, DC: Association for Educational Communications and Technology.

Seidman, I. (2006). *Interviewing as qualitative research: A guide for researchers in education and the social sciences* (3rd ed.). New York, NY: Teachers College Press.

Sexton, C., Gordon, M. & Guimond, P. (2009). Knowledge transference: From skill to innovation - what our student e-portfolios tell us. In I. Gibson et al. (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2009* (pp. 176-183).

Shrock, S. A. (1995). A brief history of instructional development. In G. J. Anglin (Ed.), *Instructional technology: Past, present, and future*. (pp. 11-19). Englewood, CO: Libraries Unlimited.

Skinner, B. F. (1968). *The technology of teaching*. Englewood Cliffs, NJ: Prentice-Hall.

Stake, R. E. (1995). *The art of case study research.* Thousand Oaks, CA: Sage Publications.

Stallard, C. K., & Cocker, J. S. (2001). *The promise of technology in schools: The next 20 years*. Lanham, MD: Scarecrow Education.

Strudler, N., & Wetzel, K. (1999). Lessons from exemplary colleges of education: Factors affecting technology integration in preservice programs. *Educational Technology Research and Development, 47*(4), 63-81.

Swain, C. (2006). Preservice teachers self-assessment using technology: Determining what is worthwhile and looking for changes in daily teaching and learning practices. *Journal of Technology and Teacher Education, 14*(1), 29-59.

Thorndike, E. L., & Woodworth, R. S. (1901). The influence of improvement in one mental function upon the efficiency of other functions (1). *Psychological Review, 8*(3), 247-261. doi: 10.1037/h0074898

Venezky, R. (2004). Technology in the classroom: steps toward a new vision. *Education, Communication & Information*, *4*(1), 3-21.

Wenglinsky, H. (2005). *Using technology wisely: The keys to success in schools*. New York, NY: Teachers College Press.

West, R., & Graham, C. (2007). Benefits and challenges of using live modeling to help preservice teachers transfer technology integration principles. *Journal of Computing in Teacher Education*, *23*(4), 131-141.

Williams, M. K., Foulger, T. S. & Wetzel, K. (2009). Preparing preservice teachers for 21st century classrooms: Transforming attitudes and behaviors about innovative technology. *Journal of Technology and Teacher Education, 17*(3), 393-418.

Willis, J. (2003). Instructional technologies in schools: Are we there yet? In D. L. M. Johnson, & C. D. Maddux, C. D. (Eds), *Technology in education: A twenty-year retrospective*, (pp. 11-33). New York: Haworth Press.

Wright, V., Wilson, E., Gordon, W., & Stallworth, J. B. (2002). Master technology teacher: A partnership between preservice and inservice teachers and teacher educators. *Contemporary Issues in Technology and Teacher Education* [Online serial], *2*(3). Retrieved from http://www.citejournal.org/vol2/iss3/currentpractice/article1.cfm.

Wilson, E., Wright, V., & Stallworth, B. (2003). Secondary preservice teachers' development of electronic portfolios: An examination of perceptions. *Journal of Technology and Teacher Education*, *11*(4), 515-527.

Whittier, D. & Lara, S. (2006). Preparing Tomorrow's Teachers to use Technology (PT3) at Boston University through faculty development: Assessment of three years of the project. *Technology, Pedagogy and Education*, *15*(3), 321-335. doi:10.1080/14759390600923816

**Appendix A**

Survey Instrument

# Technology Integration Knowledge and Skills of Early Career Teachers Survey

**This survey is for a dissertation study that is focused on identifying technology integration instructional strategies in preservice teacher education that contribute to the transfer of technology integration knowledge and skills to the classroom practices of early career teachers.**

**Technology in this survey relates primarily to computer-based hardware, software and other devices that can be used in conjunction with effective pedagogy to support student learning and achievement.**

**Your feedback is very important and could potentially be utilized to improve technology training in teacher education programs. The survey should take about 20 minutes to complete. All of your responses will be kept confidential.**

**Thank you for your time and feedback. Questions or concerns can be forwarded to the principal investigator, Dr. Jennifer M. Brill (jennifer.brill@vt.edu).**

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## Directions: Read each question carefully and then choose the response that best describes how you relate to the statement.

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## Part I: Background Information

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**1. Did you complete a teaching master's degree program from the University School of Education?**

- ○ Yes
- ○ No

---

**2. How many years have you been teaching?**

- None
- One
- Two
- Three
- Four
- Five or more

---

**3. What is your gender?**

- Male
- Female
- Other

---

**4. What grades have you taught or are teaching now? (Check all that apply)**

- Preschool
- Kindergarten
- First Grade
- Second Grade
- Third Grade
- Fourth Grade
- Fifth Grade
- Sixth Grade
- Seventh Grade
- Eighth Grade
- Ninth Grade
- Tenth Grade
- Eleventh Grade
- Twelfth Grade

Other: ______

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**5. What subject do you primarily teach?**

- ○ English
- ○ Science
- ○ Social Studies
- ○ Mathematics
- ◉ Elementary - Specify any focal points (e.g. math, science, etc.)

[ ]

**6. If your subject was NOT listed above, please write it here.**

[ ]

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**7. What technologies are available to you and your students for teaching and learning purposes? (Check all that apply.)**

- ☐ Internet
- ☐ Email
- ☐ Computer Lab(s)
- ☐ Portable Laptop Station
- ☐ Learning Management System
- ☐ SmartBoards
- ☐ iPod Touches
- ☐ iPads
- ☐ Digital Cameras
- ☐ Digital Video Cameras
- ☐ Scanners
- ☐ Document Camera
- ☐ LCD Projectors
- ☐ Distance Learning Lab

Other(s): [ ]

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**8. How many computers, if any, are currently available in your classroom?**

[ ]

---

**9. Is there a Technology Resource Teacher / Coordinator available in your school or district?**

- Yes
- No

---

**10. Which teacher education program did you complete at the University? (i.e. English, Math, Social Studies, etc.)**

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**11. What is the geographical location of your current teaching assignment (city and state)?**

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## Part II: Stages of Adoption

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**12. Please read the descriptions of each of the six stages related to the adoption of technology. Choose the stage that best describes where you are in the adoption of technology. Think about your use of different technological applications, if applicable, in your own instructional productivity and with students to support learning as a whole.**

**Stage 1: Awareness** - I am aware that technology exists but have not used it, perhaps I am even avoiding it. I am anxious about the prospect of using technology for teaching and learning.

**Stage 2: Learning the Process** - I am currently trying to learn the basics. I am sometimes frustrated using technology. I lack confidence when using technology.

**Stage 3: Understanding and Application of the Process** - I am beginning to understand the process of using technology and can think of specific tasks in which it might be useful.

**Stage 4: Familiarity and Confidence** - I am gaining a sense of confidence in using technology for specific tasks. I am starting to feel comfortable using technology.

**Stage 5: Adaptation to Other Contexts** - I think technology provides tools to help me and am no longer concerned about its use. I can use it in many applications and as an instructional aid.

**Stage 6: Creative Application to New Contexts** - I can apply what I know about technology in the classroom. I am able to use it as an instructional tool and integrate it into the curriculum.

## Part III: Concerns-Based Adoption Model (CBAM) Levels of Use of an Innovation

**13. Please read the descriptions of each of the eight levels related to the adoption of technology. Choose the stage that best describes where you are in the adoption of technology. Think about your use of different technological applications, if applicable, in your own instructional productivity and with students to support learning as a whole.**

○ **Level 0: Non-use** - I have little or no knowledge of information technology in education, no involvement with it, and I am doing nothing toward becoming involved.

○ **Level 1: Orientation** - I am seeking or acquiring information about information technology in education.

○ **Level 2: Preparation** - I am preparing for the first use of information technology in education.

○ **Level 3: Mechanical Use** - I focus most effort on the short-term, day-to-day use of information technology with little time for reflection. My effort is primarily directed toward mastering tasks required to use the information technology.

○ **Level 4 A: Routine** - I feel comfortable using information technology in education. However, I am putting forth little effort and thought to improve information technology in education or its consequences.

○ **Level 4 B: Refinement** - I vary the use of information technology in education to increase the expected benefits within the classroom. I am working on using information technology to maximize the effects with my students.

○ **Level 5: Integration** - I am combining my own efforts with related activities of other teachers and colleagues to achieve impact in the classroom.

○ **Level 6: Renewal** - I reevaluate the quality of use of information technology in education, seek major modifications of, or alternatives to, present innovation to achieve increased impact, examine new developments in the field, and explore new goals for myself and my school or district.

## Part IV: Technology Skills

**14. SmartBoards: Use a SmartBoard interactively with students to teach specific concepts in a lesson.**

- 1 = I can't do this.
- 2 = I can do some of this.
- 3 = I can do this with some assistance.
- 4 = I can do this independently.
- 5 = I can teach others how to do this.

---

**15. iPod Touch / iPad: Allow students to use these devices in order to support developing specific skills.**

- 1 = I can't do this.
- 2 = I can do some of this.
- 3 = I can do this with some assistance.
- 4 = I can do this independently.
- 5 = I can teach others how to do this.

---

**16. Web 2.0 Tools: Use various tools (e.g. concept mapping, online bookmarking, blogs, wikis, etc.) with students to develop specific skills.**

- 1 = I can't do this.
- 2 = I can do some of this.
- 3 = I can do this with some assistance.
- 4 = I can do this independently.
- 5 = I can teach others how to do this.

---

**17. Digital Media: Use digital media (e.g. iMovie, Windows Movie Maker, Photo Story, etc.) to enable students to create digital artifacts.**

- 1 = I can't do this.
- 2 = I can do some of this.
- 3 = I can do this with some assistance.
- 4 = I can do this independently.
- 5 = I can teach others how to do this.

---

**18. Digital Presentations: Work with students to create a presentation (e.g. using PowerPoint, Prezi, Slide Rocket, etc.) with graphics, transitions, animation, and hyperlinks.**

- 1 = I can't do this.
- 2 = I can do some of this.
- 3 = I can do this with some assistance.
- 4 = I can do this independently.
- 5 = I can teach others how to do this.

---

**19. Digital Spreadsheets: Work with students to use the basic functions of a spreadsheet tool (e.g. Excel, Google Docs, etc.) to create column headings and enter and manipulate data.**

- 1 = I can't do this.
- 2 = I can do some of this.
- 3 = I can do this with some assistance.
- 4 = I can do this independently.
- 5 = I can teach others how to do this.

---

**20. Learning Management System (LMS): Use an LMS (e.g. Blackboard, Moodel, etc.) so that students can access class documents or other media.**

- 1 = I can't do this.
- 2 = I can do some of this.
- 3 = I can do this with some assistance.
- 4 = I can do this independently.
- 5 = I can teach others how to do this.

---

**21. Email: Use advanced features of email (e.g. attachments, folders, contacts, create groups) to communicate with students for instructional purposes.**

- 1 = I can't do this.
- 2 = I can do some of this.
- 3 = I can do this with some assistance.
- 4 = I can do this independently.
- 5 = I can teach others how to do this.

---

**22. Use advanced features of a web browser (e.g. install plug-ins, download files and programs, download images) so that students can access information relevant to class instruction.**

- 1 = I can't do this.
- 2 = I can do some of this.
- 3 = I can do this with some assistance.
- 4 = I can do this independently.
- 5 = I can teach others how to do this.

---

**23. Use a web design authoring tool (e.g. Kompozer, Dreamweaver, Google Sites, etc.) for students to create basic webpages with text and images.**

- 1 = I can't do this.
- 2 = I can do some of this.
- 3 = I can do this with some assistance.
- 4 = I can do this independently.
- 5 = I can teach others how to do this.

---

**24. Digital Images: Use with students so that they can import an electronic digital image (e.g. clip art, picture) into a document.**

- 1 = I can't do this.
- 2 = I can do some of this.
- 3 = I can do this with some assistance.
- 4 = I can do this independently.
- 5 = I can teach others how to do this.

---

**25. Digital Images: Use various tools with students (e.g. scanner, digital camera, or video camera) so that they can capture a digital image.**

- 1 = I can't do this.
- 2 = I can do some of this.
- 3 = I can do this with some assistance.
- 4 = I can do this independently.
- 5 = I can teach others how to do this.

---

**26. Use a photo editing tool (e.g. Photoshop, Elements, Windows Picture Editor) so that students can manipulate a digital image.**

- 1 = I can't do this.
- 2 = I can do some of this.
- 3 = I can do this with some assistance.
- 4 = I can do this independently.
- 5 = I can teach others how to do this.

---

**27. Desktop Publishing: Use a desktop publishing software (e.g. Word, Publisher, PageMaker) so that students can create a newsletter, pamphlet or award certificate.**

- 1 = I can't do this.
- 2 = I can do some of this.
- 3 = I can do this with some assistance.
- 4 = I can do this independently.
- 5 = I can teach others how to do this.

---

**28. Video: Use a video editing software (e.g. iMovie, Windows Movie Maker) so that students can perform basic edits to a video.**

- 1 = I can't do this.
- 2 = I can do some of this.
- 3 = I can do this with some assistance.
- 4 = I can do this independently.
- 5 = I can teach others how to do this.

---

## Part V: Technology Integration

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**29. I integrate technology-based activities into the curriculum.**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

---

**30. Technology use supports content learning in my class.**

1 = Strongly Disagree
2 = Disagree
3 = Agree
4 = Strongly Agree

---

**31. Students work collaboratively on technology-based activities in my classroom.**

1 = Strongly Disagree
2 = Disagree
3 = Agree
4 = Strongly Agree

---

**32. I locate and evaluate educational technologies including software, hardware, and online resources that students use in my classroom.**

1 = Strongly Disagree
2 = Disagree
3 = Agree
4 = Strongly Agree

---

**33. I require students to use a variety of software tools and digital resources to support learning.**

1 = Strongly Disagree
2 = Disagree
3 = Agree
4 = Strongly Agree

---

**34. I use technology to support project- and problem-based learning activities in my classroom.**

1 = Strongly Disagree
2 = Disagree
3 = Agree
4 = Strongly Agree

---

**35. I use technology in my classroom to help support the state/federal curricular standards.**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

---

**36. I use technology to help me meet the individual needs of a variety of students in my classroom.**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

---

**37. My students use technology to demonstrate their knowledge of content in non-traditional ways (e.g. websites, multimedia products).**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

---

**38. I use technology and its unique capabilities to design new learning experiences for students.**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

---

## Part VI: Technology Integration Barriers

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**39. Lack of/or limited access to computers and/or hardware in schools.**

- 1 = Not a Barrier
- 2 = Barrier
- 3 = Major Barrier

**40. Lack of/or limited access to software available in schools.**

- 1 = Not a Barrier
- 2 = Barrier
- 3 = Major Barrier

**41. Lack of knowledge about technology.**

- 1 = Not a Barrier
- 2 = Barrier
- 3 = Major Barrier

**42. Lack of knowledge about ways to integrate technology into the curriculum.**

- 1 = Not a Barrier
- 2 = Barrier
- 3 = Major Barrier

**43. Too much content to cover in class.**

- 1 = Not a Barrier
- 2 = Barrier
- 3 = Major Barrier

**44. Lack of mentoring to help me increase my knowledge about technology.**

- 1 = Not a Barrier
- 2 = Barrier
- 3 = Major Barrier

**45. Lack of time in class to implement technology-based lessons.**

- 1 = Not a Barrier
- 2 = Barrier
- 3 = Major Barrier

**46. Insufficient time to prepare for technology-integrated curriculum projects.**

- 1 = Not a Barrier
- 2 = Barrier
- 3 = Major Barrier

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## Part VII: Teacher Education and Technology Integration

These questions should be answered in relation to the technology integration training you received in your preservice teacher education program.

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**47. The faculty member(s) who taught my content-area methods courses (e.g. English, Math, Science, etc.) modeled how to effectively integrate technology into instruction for K-12 students.**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

**48. If you answered strongly agree or agree to the above question, please describe at least one memorable situation in which this occurred.**

---

**49. I had many opportunities in my teacher education courses to practice and experiment with creating technology activities that could be used in the classroom to support student learning.**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

**50. If you answered strongly agree or agree to the above question, please describe at least one memorable situation in which this occurred.**

---

**51. I had access to expert guidance (e.g. peers, faculty, teachers, etc.) with regards to learning about the use of technology in K-12 instruction to support student learning during my coursework.**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

**52. If you answered strongly agree or agree to the above question, please describe at least one memorable situation in which this occurred.**

**53. I had access to expert guidance (e.g. peers, faculty, teachers, etc.) with regards to learning about the use of technology in K-12 instruction to support student learning during my field experiences.**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

**54. If you answered strongly agree or agree to the above question, please describe at least one memorable situation in which this occurred.**

---

**55. The activities I engaged in with regards to learning how to use technology in K-12 instruction during my preservice teacher education program were meaningful in a way that helped me to actually use it in my own classroom.**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

**56. If you answered strongly agree or agree to the above question, please describe at least one memorable situation in which this occurred.**

**57. The activities I engaged in with regards to learning how to use technology in K-12 instruction during my preservice teacher education program included hands-on, authentic experiences with technology that helped me to actually use it in my own classroom.**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

**58. If you answered strongly agree or agree to the above question, please describe at least one memorable situation in which this occurred.**

**59. I had opportunities to collaborate with others (e.g. peers, faculty, teachers, etc.) in learning how to integrate technology in classroom instruction during my preservice teacher education program.**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

**60. If you answered strongly agree or agree to the above question, please describe at least one memorable situation in which this occurred.**

**61. I had opportunities to practice integrating technology in my instruction in real K-12 classrooms during my program through field experiences (e.g. internships, student teaching, special projects including students, etc.).**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

**62. If you answered strongly agree or agree to the above question, please describe at least one memorable situation in which this occurred.**

---

**63. I was required to reflect upon the uses of technology in the classroom during my preservice teacher education program in order to improve my instruction for future teaching.**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

**64. If you answered strongly agree or agree to the above question, please describe at least one memorable situation in which this occurred.**

---

**65. Faculty members provided experiences in learning how to integrate technology that increasingly became more challenging that helped me gradually build my knowledge about technology integration.**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

**66. If you answered strongly agree or agree to the above question, please describe at least one memorable situation in which this occurred.**

---

**67. Overall, the technology integration training I received in my teacher education program, prepared me to utilize technology in the classroom.**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

**68. The focus on technology integration for use in the K-12 classroom was incorporated in much of my coursework.**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

**69. The focus on technology integration for use in the K-12 classroom was incorporated in much of my field experiences.**

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Agree
- 4 = Strongly Agree

**70. I would estimate that I integrate technology into student-based activities:**

- 1 = Never
- 2 = Once a month
- 3 = Once or twice a week
- 4 = Three or four times a week
- 5 = Five or more times a week

**71. Now that you have experience teaching, what aspects of your teacher education program best prepared you for utilizing technology in the classroom? Please be specific.**

**72. Now that you have experience teaching, what types of experiences or instruction with regards to technology integration knowledge and skills were missing or would have been beneficial in your specific teacher education program?**

**IMPORTANT! If you would be interested in participating in a 30 minute post-survey interview in order for the researchers to collect additional information about your experiences as an early career teacher, please submit the survey. You will be prompted on the last screen to click on a link.**

**Here, you will be asked to provide your name and contact information (email or phone number). Participation in the interview and providing your contact information is completely voluntary. And, again, any responses will be kept confidential. If you do provide contact information, one of the researchers will be in touch with you soon. Thank you so much for your time and participation in this survey.**

## Appendix B

Permission to Use Instrument(s) Email (Rhonda Christensen)

# Re: Survey Instrument Request

Inbox x
abrenner@vt.edu x

Rhonda Christensen rhonda.christensen@gmail.com 3/18/11
to abrenner, Gerald

Hello Aimee,
The instruments should be linked with the online booklet. However, I looked this week and the links are no longer there. We will work on this next week and get those back. In the meantime, I will attach the instruments that seem like the ones you might be interested in using.
Kind regards,
Rhonda Christensen

> Hello Dr. Christensen,
>
> I recently read the booklet you co-authored,"Instruments for Assessing Educator Progress in Technology Integration." The language in the booklet seems to indicate that the survey instruments in their entirety are available, however, I have not been able to locate them in the booklet or on your website. Could you please direct me to where I can take a look at these instruments?
>
> My doctoral research involves examining technology integration instructional practices in teacher education programs that contribute to the learning transfer of technology skills and knowledge in early career teachers. Therefore, I'm looking at surveys right now in order to develop one that is appropriate for this purpose. I feel the ones described in this booklet might provide some insight.
>
> I appreciate your help.
>
> Best,
> Aimee
>
> --
> Aimee M. Brenner
> Virginia Polytechnic Institute and State University
> Graduate Assistant, Faculty Development Institute
> PhD Candidate, Instructional Design & Technology

--
******************************
Rhonda W. Christensen, Ph.D.
Research Scientist
Middle Schoolers Out to Save the World (MSOSW) Project Coordinator
Institute for the Integration of Technology into Teaching and Learning (IITTL)

**Appendix C**

Permission to Use Instrument(s) Email (Jonathan Brinkerhoff)

# Re: Technology Beliefs and Competencies Survey

Inbox x

abrenner@vt.edu x

Jonathan Brinkerhoff jbrink@unm.edu 3/25/11

to abrenner

Hi, Aimee:

Feel free to use or modify the instrument. It's rather old, so the technologies covered need updating. As computer self-efficacy impacts technology use, I've included an instrument for that as well.

Jonathan

At 08:32 PM 3/23/2011, you wrote:

> Dr. Brinkerhoff,
>
> I have recently read a couple articles authored by you that utilize the Technology Beliefs and Competencies Survey. My doctoral research involves examining technology integration instructional practices in teacher education programs that contribute to the learning transfer of technology skills and knowledge in early career teachers.
>
> I think the Technology Beliefs and Competencies Survey possesses many of the aspects that I need to complete the quantitative portion of my study. I wanted to see what the appropriate protocol would be if I was interested in utilizing this survey or modifying portions of it for my study, or if that would be a possibility at all?
>
> I noticed there are several other authors for the survey, but that you were the first author, so I thought I would start by contacting you. Please let me know your thoughts at your earliest convenience.
>
> Much appreciation,
> Aimee M. Brenner

## Appendix D

Interview Protocol Instrument

Technology Integration Knowledge and Skills of Early Career Teachers
Interview Protocol

These interview questions are for a dissertation study that is focused on identifying technology integration instructional strategies in preservice teacher education that contribute to the transfer of technology integration knowledge and skills to the classroom practices of early career teachers. Technology in this interview relates primarily to computer-based hardware, software and other devices that can be used in conjunction with computers, as well as web-based applications.

You were provided with a copy of the Informed Consent Form prior to our interview time today. Do you have any questions about this research study or the interview that will take place today? If so, what are they? If not, please understand that participating in this interview means that you fully understand the Informed Consent and are voluntarily participating in this interview process. This interview will be limited to 30 minutes and focus on the questions listed below. However, follow-up questions from your responses may be asked in order to capture more insight to your experiences in your preservice education program and how that has influenced your technology integration practices in the classroom.

Your responses will be kept completely confidential and you will be permitted to review the transcription of this interview in order to make corrections or any changes you feel necessary. This interview will be recorded to ensure accuracy during the transcription process. Thank you, in advance, for your participation!

**Interview Questions:**

1. Describe your current teaching situation. For example: characteristics of the school, size, demographics of student population, school culture, grade and subjects you teach, etc.

2. Research has identified certain factors as helping professionals transfer knowledge and skills to the workplace. What specific aspects of your preservice experience most supported you in integrating technologies into your teaching once you had your own classroom? Were there any aspects that discouraged integration?

3. On the survey, three external factors - insufficient time, insufficient technology resources (software and hardware), and too much content to cover - were identified as being the most common barriers to the use of technology to support student learning. How do these factors affect you personally? What do you think could be done in your school / district to get more time, better technology resources, and/or lessen content demands?

4. For many of the survey respondents, field experiences and opportunities to practice technology integration and/or having access to expert guidance in field experiences were listed as weaker elements of the preservice experience. What specific suggestions do you have

for strengthening this area?

5. On the survey, email, digital images, web browsers, spreadsheets, presentations and SmartBoards were indicated to be highly used technologies to support student learning; whereas, digital media (e.g. iMovie, PhotoStory, Movie Maker), web authoring tools, and digital video were not indicated to be used as much. What do you envision as the next most useful instructional technology tool(s) to be used in your classroom/school? What current technologies do you see remaining in use as valuable teaching/learning supports? Which ones do you think may lessen in use because of lack of instructional impact?

6. Now that you have been teaching for __ years, to what degree do you see instructional technologies as useful tools to support learning for your students? Why or why not?

Those are the questions that I have for you today. Do you have anything that you would like to add before we conclude? Do you have any questions about this interview or any of the questions you were asked to answer today? Thanks again for participating. This recorded interview will be transcribed very soon and you will be provided with the transcript in order to make corrections or any changes you feel necessary. Please do not hesitate to contact me if you have any questions. I will be in touch soon. Have a nice day.

# Appendix E

## Virginia Tech Institutional Review Board Approval Letter

VirginiaTech

**Office of Research Compliance**
Institutional Review Board
2000 Kraft Drive, Suite 2000 (0497)
Blacksburg, Virginia 24060
540/231-4606 Fax 540/231-0959
e-mail irb@vt.edu
Website: www.irb.vt.edu

**MEMORANDUM**

**DATE:** November 2, 2011

**TO:** Jennifer Brill, Aimee Ratliff

**FROM:** Virginia Tech Institutional Review Board (FWA00000572, expires May 31, 2014)

**PROTOCOL TITLE:** Promoting the Transfer of Technology Integration Knowledge and Skills: What Preservice Teachers Need to Become Innovators in their Own Classrooms during their Early Careers

**IRB NUMBER: 11-914**

Effective October 31, 2011, the Virginia Tech IRB Chair, Dr. David M. Moore, approved the new protocol for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at http://www.irb.vt.edu/pages/responsibilities.htm (please review before the commencement of your research).

**PROTOCOL INFORMATION:**
Approved as: **Expedited, under 45 CFR 46.110 category(ies) 6, 7**
Protocol Approval Date: **10/31/2011**
Protocol Expiration Date: **10/30/2012**
Continuing Review Due Date*: **10/16/2012**
*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

**FEDERALLY FUNDED RESEARCH REQUIREMENTS:**
Per federally regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals / work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

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## Appendix F

Initial Email Inviting Participation

Email Subject Line: Important Survey for Recent University SOE Graduates

Dear University School of Education Graduate,

This email details an Instructional Design and Technology dissertation research study that is currently being conducted through the University's School of Education. The purpose of this study is to identify technology integration instructional strategies in preservice teacher education that contribute to the transfer of technology integration knowledge and skills to the classroom practices of early career teachers.

Your participation will be beneficial in identifying instructional practices with regards to preservice technology training that lead to the transfer of technology integration practices in the K-12 classroom. It will also aid in identifying potential weaknesses in preservice technology training and promote the design of more effective practices in teacher education programs with regards to technology integration.

If you would like to participate, please first read the attached letter of consent. This outlines all elements of the study. Then you may proceed to the link below, which will take you to the online survey. By taking this survey, it is implied that you agree to all terms outlined in the letter of consent. Please complete the survey no later than two weeks from today's date. The survey will only take 20 minutes of your time. The survey can be located at this web address:

https://survey.vt.edu/survey/entry.jsp?id=1320272756171

In addition to this survey, the researchers will also be conducting 30-minute follow-up interviews as part of the study in order to gain more comprehensive insight with regards to technology integration training during preservice teacher education. If you would be interested in participating in such an interview, please click on the link provided after the survey, in order to provide your name and contact information. Participation in the interview and providing your contact information is completely voluntary. All responses for both the survey and interview will be kept confidential.

Thank you so much for your time. For more information or if you have any questions, please contact the supervisor of this research: Dr. Jennifer M. Brill, jennifer.brill@vt.edu.

Sincerely,

Dr. Jennifer M. Brill

## Appendix G

Reminder Email Inviting Solicitation

Email Subject Line: An Important Message from the University School of Education's Director and Assoc. Director

Dear Recent Graduate of the University School of Education,

On November 14, you received an email from Dr. Jennifer Brill requesting your participation in a research study investigating technology integration in teaching and learning. We believe that this study will provide valuable information to the School of Education on how to improve the preparation of preservice teachers in regards to technology integration in teaching practice. Please take the time to participate in this important study. Your feedback is essential to supporting the School of Education's goal of continuous improvement.

For your convenience, you can find a recap of the instructions and web site link for participating in the study below our message in this same email.

Thank you,

Dr. Director of SOE
Dr. Associate Director of SOE
University School of Education

Dear University School of Education Graduate,

Recently you received an email detailing an important dissertation research study that is currently being conducted through the University's School of Education. The purpose of this study is to identify technology integration instructional strategies in preservice teacher education that contribute to the transfer of technology integration knowledge and skills to the classroom practices of early career teachers.

If you have already responded to our first email, please accept our sincere thanks and feel free to stop reading here. If you have not yet responded, please read on…

**As a recent School of Education graduate, your input is crucial to learning about and improving technology integration in teacher education at the University!** Please invest 20-30 minutes of your time to participate in the study.

To participate, please first read the attached letter of consent. This outlines all elements of the study. Then, proceed to the link below, which will take you to the online survey. By taking this survey, it is implied that you agree to all terms outlined in the letter of consent. **Please complete the survey no later than one week from today's date (December 8, 2011).** The survey will only take 20 minutes of your time.

The survey can be located at this web address:

https://survey.vt.edu/survey/entry.jsp?id=1320272756171

Thank you so much for your time. For more information or if you have any questions, please contact the supervisor of this research: Dr. Jennifer M. Brill, jennifer.brill@vt.edu.

Sincerely,

Dr. Jennifer M. Brill

**Appendix H**

Final Reminder Email Inviting Participation

Email Subject Line: An Important Message from the University School of Education's Director and Associate Director

Dear Recent Graduate of the University School of Education,

On November 14, Dr. Jennifer Brill sent you an email requesting your participation in a research study investigating technology integration in teaching and learning. This email may *not* have reached you because of dated contact information. And so, we are reaching out to you *one last time* through an alternative email address provided by you to the University.

We believe that this study will provide valuable information to the School of Education on how to improve the preparation of preservice teachers in regards to technology integration in teaching practice. **Please take the time to participate in this important study. Your feedback is essential to supporting the School of Education's goal of continuous improvement.**

For your convenience, you can find a recap of the instructions and web site link for participating in the study below our message in this same email.

Thank you,

Dr. Director of SOE
Dr. Associate Director of SOE
University School of Education

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Dear University School of Education Graduate,

Recently you received an email detailing an important dissertation research study that is currently being conducted through the University's School of Education. The purpose of this study is to identify technology integration instructional strategies in preservice teacher education that contribute to the transfer of technology integration knowledge and skills to the classroom practices of early career teachers.

If you have already responded to our email and completed the study survey, please accept our sincere thanks and feel free to stop reading here. If you have not yet responded, please read on…

**As a recent School of Education graduate, your input is crucial to learning about and improving technology integration in teacher education at the University!** Please invest 20-30 minutes of your time to participate in the study.

To participate, please first read the attached letter of consent. This outlines all elements of the study. Then, proceed to the link below, which will take you to the online survey. By taking this survey, it is implied that you agree to all terms outlined in the letter of consent. **Please complete**

**the survey by Monday, February 13, 2012.** The survey will only take 20 minutes of your time. The survey can be located at this web address:

https://survey.vt.edu/survey/entry.jsp?id=1320272756171

Thank you so much for your time. For more information or if you have any questions, please contact the supervisor of this research: Dr. Jennifer M. Brill, jennifer.brill@vt.edu.

Sincerely,

Dr. Jennifer M. Brill

**Appendix I**

Follow-up Interview Sign-up Survey

# Technology Integration Knowledge and Skills of Early Career Teachers Follow-up Interview Sign-up

**This follow-up interview is for a dissertation study that is focused on identifying technology integration instructional strategies in preservice teacher education that contribute to the transfer of technology integration knowledge and skills to the classroom practices of early career teachers.**

**Your feedback is very important and could potentially be utilized to improve technology training in teacher education programs. If you are willing to participate in a short, 30-minute post-survey interview, please provide your name and contact information below. Providing your contact information and participating in the interview is completely voluntary. All of your responses and personal information will be kept confidential.**

**Thank you for your time and feedback. Questions or concerns can be forwarded to the principal investigator, Dr. Jennifer M. Brill (jennifer.brill@vt.edu).**

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**Thank you so much for your willingness to participate in this follow-up interview.**

**Appendix J**

Informed Consent for the Survey Instrument

**VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY**

**Informed Consent for Participants**
**In Research Projects Involving Human Subjects**

**Title of Project:**

Promoting the Transfer of Technology Integration Knowledge and Skills: What Preservice Teachers Need to Become Innovators in their own Classrooms during their Early Careers

**Investigators:**

Dr. Jennifer M. Brill, Associate Professor of Instructional Design and Technology, Virginia Tech and Ms. Aimee M. Brenner, PhD Candidate in Instructional Design and Technology, Virginia Tech

**I. Purpose of this Research Study:**

The purpose of this study is to identify technology integration instructional strategies in preservice teacher education that contribute to the transfer of technology integration knowledge and skills to the classroom practices of early career. The total number of subjects in the sampling pool is 330. The targeted sample population for this research study will consist of male and female early career teachers who have completed a graduate level teacher education program through the university's School of Education between the years of 2008 – 2010; earned licensure; and are teaching in the K-12 educational system.

**II. Procedures:**

The procedures involved in participating in this research study include opening and reading the solicitation email sent by the investigators advertising the study, which will take approximately two minutes. Next, you will need to download the attached letter of consent, which is the document you are reading right now. Reading this document thoroughly is important and should only take about five minutes. If you agree to participate in the study, you will need to click on the link for the online survey.

The online survey is a secure, data collection environment, hosted by Virginia Tech. The survey will ask you for some background information as well as questions about your technology skills, beliefs, perceived barriers, and about the preservice technology training you received at the university's School of Education. The survey should take you approximately 20 minutes to complete. When you are finished, you will need to submit the survey in order for the information to be properly captured.

In addition to this survey, 30-minute follow-up interviews will also be conducted as part of the study in order to gain more comprehensive insight with regards to technology integration training during preservice teacher education. If you would be interested in participating in such an interview, a link will be provided at the end of the survey for you to provide your contact information. The researcher will contact you within a couple of days after the survey has been closed to set-up an interview. The interview date, time and location will then be set up and executed. You will be asked to sign a letter of consent prior to the interview. All responses for both the survey and interview will be kept confidential. All interviews will be audio-recorded so that the researcher can ensure that the original words are captured and for accuracy. Audio recordings will be transcribed shortly after the interview.

**III. Risks**

There are no known risks involved in participating in this study.

**IV. Benefits**

Participants may benefit from being involved with this study in that the survey will stimulate thinking with regards to their technology skills and how they utilize these in the classroom. The proposed study will benefit teacher education programs in three ways. First, the study will provide scholars with empirical findings regarding technology integration strategies in teacher education that support or hinder the transfer of new knowledge and skills to the classroom practices of early career teachers. Second, the study will provide preservice teacher education faculty with recommendations on how to improve their programs. Third, the study will offer an adapted survey that can be utilized by other researchers to investigate technology integration transfer from the teacher educational level to the classroom practices of early career teachers. Because of these three benefits, the results of this study may be published or presented in professional venues; however, identifying information of any respondent will not be included or revealed. No promise or guarantee of benefits has been made to encourage you to participate.

**V. Extent of Anonymity and Confidentiality**

Subject responses collected in the survey and interview for purposes of this study will remain confidential. Only the investigators will have access to the data. The data will be kept for six months following the completion of the study and then destroyed. It is possible that the Virginia Tech Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research.

**VI. Compensation**

There will be no compensation for participating in this study.

**VII. Freedom to Withdraw**

Subjects are free to withdraw from the study at any time without penalty. Subjects are also free not to answer any survey questions that they choose without penalty. Additionally, subjects are free not to answer any interview questions that they choose without penalty.

**VIII. Subject's Responsibilities**

I voluntarily agree to participate in this study. I have the following responsibilities:

- Read the letter of consent.
- Ask questions if there is any portion I do not understand.
- Complete the online survey.
- Answer the questions as honestly as I can.
- Submit the online survey when I am finished.

**IX. Subject's Permission**

I have read the Consent Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my consent.

If I should have any questions, I may contact:

Dr. Jennifer M. Brill, Associate Professor, Virginia Tech School of Education, telephone: (540) 231-8328; email: jmbrill@vt.edu; address: 300B War Memorial Hall (0313), Blacksburg, VA 24061

If I should have any questions about the protection of human research participants regarding this study, I may contact:

Dr. David Moore, Chair Virginia Tech Institutional Review Board for the Protection of Human Subjects, telephone: (540) 231-4991; email: moored@vt.edu; address: Office of Research Compliance, 2000 Kraft Drive, Suite 2000 (0497), Blacksburg, VA 24060.

**Appendix K**

Informed Consent for the Interview Instrument

**VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY**

**Informed Consent for Participants**
**In Research Projects Involving Human Subjects**

**Title of Project:**

Promoting the Transfer of Technology Integration Knowledge and Skills: What Preservice Teachers Need to Become Innovators in their own Classrooms during their Early Careers

**Investigators:**

Dr. Jennifer M. Brill, Associate Professor of Instructional Design and Technology, Virginia Tech and Ms. Aimee M. Brenner, PhD Candidate in Instructional Design and Technology, Virginia Tech

**I. Purpose of this Research Study:**

The purpose of this study is to identify technology integration instructional strategies in preservice teacher education that contribute to the transfer of technology integration knowledge and skills to the classroom practices of early career. The total number of subjects in the sampling pool is 330. The targeted sample population for this research study will consist of male and female early career teachers who have completed a graduate level teacher education program through the University School of Education between the years of 2008 – 2010; earned licensure; and are teaching in the K-12 educational system.

**II. Procedures:**

The procedures involved in participating in this research study include opening and reading the solicitation email sent by the investigators advertising the study, which will take approximately two minutes. Next, you will need to download the attached letter of consent, which is the document you are reading right now. Reading this document thoroughly is important and should only take about five minutes. If you agree to participate in the study, you will need to click on the link for the online survey.

The online survey is a secure, data collection environment, hosted by Virginia Tech. The survey will ask you for some background information as well as questions about your technology skills, beliefs, perceived barriers, and about the preservice technology training you received at the University School of Education. The survey should take you approximately 20 minutes to complete. When you are finished, you will need to submit the survey in order for the information to be properly captured.

In addition to this survey, 30-minute follow-up interviews will also be conducted as part of the study in order to gain more comprehensive insight with regards to technology integration training during preservice teacher education. If you would be interested in participating in such an interview, a link will be provided at the end of the survey for you to provide your contact information. The researcher will contact you within a couple of days after the survey has been closed to set-up an interview. The interview date, time and location will then be set up and executed. You will be asked to review and agree to a letter of consent prior to the interview. Any questions you may have will be answered prior to the interview. All responses for both the survey and interview will be kept confidential. All interviews will be audio-recorded so that the researcher can ensure that the original words are captured and for accuracy. Audio recordings will be transcribed shortly after the interview.

**III. Risks**

There are no known risks involved in participating in this study.

**IV. Benefits**

Participants may benefit from being involved with this study in that the survey will stimulate thinking with regards to their technology skills and how they utilize these in the classroom. The proposed study will benefit teacher education programs in three ways. First, the study will provide scholars with empirical findings regarding technology integration strategies in teacher education that support or hinder the transfer of new knowledge and skills to the classroom practices of early career teachers. Second, the study will provide preservice teacher education faculty with recommendations on how to improve their programs. Third, the study will offer an adapted survey that can be utilized by other researchers to investigate technology integration transfer from the teacher educational level to the classroom practices of early career teachers. Because of these three benefits, the results of this study may be published or presented in professional venues; however, identifying information of any respondent will not be included or revealed. No promise or guarantee of benefits has been made to encourage you to participate.

**V. Extent of Anonymity and Confidentiality**

Subject responses collected in the survey and interview for purposes of this study will remain confidential. Only the investigators will have access to the data. The data will be kept for six months following the completion of the study and then destroyed. It is possible that the Virginia Tech Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research.

**VI. Compensation**

There will be no compensation for participating in this study.

## VII. Freedom to Withdraw

Subjects are free to withdraw from the study at any time without penalty. Subjects are also free not to answer any survey questions that they choose without penalty. Additionally, subjects are free not to answer any interview questions that they choose without penalty.

## VIII. Subject's Responsibilities

I voluntarily agree to participate in this study. I have the following responsibilities:

- Read and agree to the letter of consent.
- Ask questions if there is any portion I do not understand.
- Participate in the 30-minute follow-up interview at the designated time and place.
- Ask for clarification about any question I do not understand.
- Answer as honestly as I can.

## IX. Subject's Permission

I have read the Consent Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent by participating in the interview.

If I should have any questions, I may contact:

Dr. Jennifer M. Brill, Associate Professor, Virginia Tech School of Education, telephone: (540) 231-8328; email: jmbrill@vt.edu; address: 300B War Memorial Hall (0313), Blacksburg, VA 24061

If I should have any questions about the protection of human research participants regarding this study, I may contact:

Dr. David Moore, Chair Virginia Tech Institutional Review Board for the Protection of Human Subjects, telephone: (540) 231-4991; email: moored@vt.edu; address: Office of Research Compliance, 2000 Kraft Drive, Suite 2000 (0497), Blacksburg, VA 24060.

## Appendix L

Instructional Technology Use to Support Student Learning

| Technology / Application | 5 = I can teach others how to do this. | 4 = I can use this indepen dently. | 3 = I can use this with some assistance. | 2 = I can use some of this. | 1 = I cannot / do not use this. | No response |
|---|---|---|---|---|---|---|
| Email: Use advanced features of email (e.g. attachments, folders, contacts, create groups) to communicate with students for instructional purposes. | 63% | 25% | 0% | 8% | 0% | 4% |
| **Aggregate** | **88%** | | | | | |
| Digital Images: Use with students so that they can import an electronic digital image (e.g. clip art, picture) into a document. | 79% | 8% | 8% | 4% | 0% | 0% |
| **Aggregate** | **87%** | | | | | |
| Digital Images: Use various tools with students (e.g. scanner, digital camera, or video camera) so that they can capture a digital image. | 71% | 13% | 8% | 8% | 0% | 0% |
| **Aggregate** | **84%** | | | | | |
| Web Browsers: Use advanced features of a web browser (e.g. install plug-ins, download files and programs, download images) so that students can access information relevant to class instruction. | 63% | 17% | 13% | 4% | 4% | 0% |
| **Aggregate** | **80%** | | | | | |
| Digital Spreadsheets: Work with students to use the basic functions of a spreadsheet tool (e.g. Excel, Google Docs, etc.) to create column headings and enter and manipulate data. | 42% | 38% | 13% | 8% | 0% | 0% |
| **Aggregate** | **80%** | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| SmartBoards: Use a SmartBoard interactively with students to teach specific concepts in a lesson. | 54% | 25% | 8% | 4% | 8% | 0% |
| **Aggregate** | **79%** | | | | | |
| Digital Presentations: Work with students to create a presentation (e.g. using PowerPoint, Prezi, Slide Rocket, etc.) with graphics, transitions, animation, and hyperlinks. | 46% | 33% | 13% | 8% | 0% | 0% |
| **Aggregate** | **79%** | | | | | |
| Desktop Publishing: Use a desktop publishing software (e.g. Word, Publisher, PageMaker) so that students can create a newsletter, pamphlet or award certificate. | 42% | 33% | 8% | 13% | 0% | 6% |
| **Aggregate** | **75%** | | | | | |
| Learning Management Systems (LMS): Use an LMS (e.g. Blackboard, Moodle, etc.) so that students can access class documents or other media. | 38% | 25% | 17% | 4% | 17% | 0% |
| **Aggregate** | **63%** | | | | | |
| iPod Touches / iPads: Allow students to use these devices in order to support developing specific skills. | 25% | 33% | 13% | 17% | 13% | 0% |
| **Aggregate** | **58%** | | | | | |
| Web 2.0 Tools: Use various tools (e.g. concept mapping, online bookmarking, blogs, wikis, etc.) with students to develop specific skills. | 25% | 33% | 21% | 17% | 4% | 0% |
| **Aggregate** | **58%** | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Photo Editing: Use a photo editing tool (e.g. Photoshop, Elements, Windows Picture Editor) so that students can manipulate a digital image. | 29% | 29% | 25% | 13% | 4% | 0% |
| **Aggregate** | **58%** | | | | | |
| Web Design: Use a web design authoring tool (e.g. Kompozer, Dreamweaver, Google Sites, etc.) for students to create basic webpages with text and images. | 38% | 17% | 21% | 13% | 8% | 4% |
| **Aggregate** | **55%** | | | | | |
| Digital Video: Use a video editing software (iMovie, Windows Movie Maker) so that students can perform basic edits to a video. | 25% | 29% | 21% | 17% | 8% | 0% |
| **Aggregate** | **54%** | | | | | |
| Digital Media: Use digital media (e.g. iMovie, Windows Movie Maker, Photo Story, etc.) to enable students to create digital artifacts. | 25% | 21% | 21% | 29% | 4% | 0% |
| **Aggregate** | **46%** | | | | | |

*Note.* Bolded percentages represent the aggregate percentage between the "5=I can teach others how to do this" and "4=I can use this independently" categories.

## Appendix M

Teacher Education and Technology Integration Instructional Strategies

| **Questions** | **4 = Strongly Agree** | **3 = Agree** | **2 = Disagree** | **1 = Strongly Disagree** | **No Response** |
|---|---|---|---|---|---|
| The faculty member(s) who taught my content-area methods courses (e.g. English, Math, Science, etc.) **modeled** how to effectively integrate technology into instruction for K-12 students. | 25% | 54% | 8% | 13% | 0% |
| **Aggregate** | **79%** | | | | |
| I was required to **reflect** upon the uses of technology in the classroom during my preservice teacher education program in order to improve my instruction for future teaching. | 38% | 38% | 21% | 4% | 0% |
| **Aggregate** | **76%** | | | | |
| I had many opportunities in my teacher education courses to **practice and experiment** with creating technology activities that could be used in the classroom to support student learning. | 21% | 50% | 17% | 13% | 0% |
| **Aggregate** | **71%** | | | | |
| I had access to **expert guidance** (e.g. peers, faculty, teachers, etc.) with regards to learning about the use of technology in K-12 instruction to support student learning during my coursework. | 25% | 46% | 21% | 8% | 0% |
| **Aggregate** | **71%** | | | | |
| I had opportunities to **collaborate with others** (e.g. peers, faculty, teachers, etc.) in learning how to integrate technology in classroom instruction during my preservice teacher education program. | 21% | 50% | 25% | 4% | 0% |
| **Aggregate** | **71%** | | | | |

| | | | | | |
|---|---|---|---|---|---|
| The activities I engaged in with regards to learning how to use technology in K-12 instruction during my preservice teacher education program included **hands-on, authentic experiences** with technology that helped me to actually use it in my own classroom. | 25% | 42% | 21% | 13% | 0% |
| **Aggregate** | **67%** | | | | |
| The activities I engaged in with regards to learning how to use technology in K-12 instruction during my preservice teacher education program were **meaningful** in a way that helped me to actually use it in my own classroom. | 29% | 33% | 29% | 8% | 0% |
| **Aggregate** | **62%** | | | | |
| Faculty members provided experiences in learning how to integrate technology that **increasingly became more challenging** that helped me gradually build my knowledge about technology integration. | 17% | 42% | 33% | 8% | 0% |
| **Aggregate** | **59%** | | | | |
| I had opportunities to **practice** integrating technology in my instruction in **real K-12 classrooms** during my program through field experiences (e.g. internships, student teaching, special projects including students, etc.). | 29% | 29% | 38% | 4% | 0% |
| **Aggregate** | **58%** | | | | |
| I had access to **expert guidance** (e.g. peers, faculty, teachers, etc.) with regards to learning about the use of technology in K-12 instruction to support student learning during my field experiences. | 21% | 29% | 42% | 8% | 0% |
| **Aggregate** | **50%** | | | | |

*Note.* Bolded percentages represent the aggregate percentage between the “4=Strongly Agree” and “3=Agree” categories.