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Secondary Preservice Teachers' Perception of Preparedness to Integrate Technology

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SECONDARY PRESERVICE TEACHERS' PERCEPTION OF PREPAREDNESS TO INTEGRATE TECHNOLOGY

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Integrating technology into the classroom has been an enduring topic in the field of education for decades. While the technology types may have changed from slide projectors and calculators, to laptops and smart phones, preparing preservice teachers to integrate technology in the classroom is a constant in teacher education programs. The pace for which technology advances has forced teacher educators to reconsider how to better prepare future teachers. Attention has shifted from preservice teacher awareness of specific technologies to preparing teachers who can effectively evaluate technologies for use in the classroom. In spite of reports that today's preservice teachers are not prepared to effectively integrate technology into the classroom, evidence from this study revealed the opposite.

To analyze each component and its possible relationship, a quantitative methodology was used to answer the following research questions: (1) What are the perceived levels of technology preparedness of secondary preservice teachers' as described by the TPACK framework?; (2) What are the perceived levels of self-efficacy with regards to technology integration of secondary preservice teachers?; and (3) What is the relationship between secondary preservice teachers' perceived level of technology

preparedness (TPACK) and their perceived level of self-efficacy (SE) with regards to technology integration?

Overall, the results indicated that preservice teachers from this sample are prepared to integrate technology into the classroom. The first indicator was the high self-efficacy levels, which are believed to be a predictor of future technology use. The second indicator was the high-levels of knowledge of the TPACK domains, a framework for effective technology integration. However, it is not as readily apparent whether the preparedness of the teachers was directly related to the teacher education programs, or the age of the participants (digital natives). It is possible that the effective modeling from the teacher educators and cooperating teachers played a part in the positive results. In essence, the positive results indicated that the secondary teachers from this study are prepared to effectively integrate technology in the classroom.

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To anyone trying to achieve one of your greatest challenges I leave you with this: "Let no feeling of discouragement prey upon you, and in the end you are sure to succeed."

~ Abraham Lincoln

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CHAPTER 1

THE PROBLEM

As the fast-paced availability of technology increases in schools, teachers from grades kindergarten through twelve are bombarded with terms such as *digital natives, digital immigrants*, and *21st century learners*. More than ever, districts are asking teachers, and even requiring them, to integrate technology in the classroom, yet many find themselves unprepared. While teachers who are more prepared to use technology are more likely to utilize technology in the classroom (Franklin, 2008), how they use technology is not always effective. This finding supports the asking of important questions. Are teacher education programs preparing teachers to become familiar with today's emerging technologies, and are they helping these preservice teachers develop strategies that will enable them to effectively integrate these technologies in the classroom?

"The technological preparation of preservice teachers has been an on ongoing challenge since the advent of computers in schools" (Lambert & Gong, 2010, p. 54). However, growing acceptance of technology as a tool to enhance student achievement by government and educational leaders has increased the urgency to better prepare preservice teachers. Historically, teacher education programs "attempted to develop preservice teachers' technology integration skills through an introductory course in educational technology" (Polly, Mims, Shepherd, & Inan, 2010, p. 863). This required course was designed to develop the preservice teachers' technology skills and focused on improving efficiency in the classroom. Teaching preservice teachers to create grade books, newsletters, seating charts, tests or presentations were common objectives of the technology course (Polly et al., 2010). Technology portions of teacher education programs were designed with the assertion that if preservice teachers were taught how to use technology, they would figure out how to integrate it into their lessons (Schaffhauser, 2009). “However, teachers’ technological skills do not necessarily result in the effective use of technology in elementary, middle and secondary schools in ways that are likely to impact student learning” (Polly et al., p. 863). Therefore, teacher education programs that focus primarily on developing technology skills alone would likely be ineffective. Teacher education programs need to assist preservice teachers in developing an understanding of how technology can be used as an aid to increase student learning and help them recognize which technology would be appropriate in their particular learning environment. It is no longer appropriate to only prepare preservice teachers for low-level technology use e.g., taking attendance, completing grade books, or creating presentations (Ertmer & Ottenbreit-Leftwich, 2010). Consequently, in order to initiate preservice teachers’ ability to meet the needs of the 21st century learner, their preparation needs to move beyond basic technology skills and use.

Today’s student is competing in a world that is bombarded with email, eCommerce and “e” everything. While it is necessary to help school-aged students acquire skills that enable them to keep current with today’s technology and to effectively communicate in this environment, teaching the utilization of tools will not be a primary focus of novice teachers. The challenge for preservice teachers is utilizing technology to transform student learning and meet lesson objectives that align to the curriculum. Hence, some teacher education programs have switched their focus from teaching features, affordances and limitations of particular technologies to developing a preservice teacher's ability to think strategically with respect to technology integration (Niess, 2011).

The popularity of integrating technology into classroom instruction was given new life in 2004 with the introduction of Web 2.0 which are free web-based tools that are completely functional using Internet browser technology (Solomon & Schrum, 2007). The vast collections of Web 2.0 tools have an array of uses in the classroom. Many "are social in nature and promote self-expression, such as community networks, blogs, and photo and video sharing sites" (Solomon & Schrum, p. 13), and other tools, such as GoogleDocs and wikis, allow for real-time student collaboration online. The growing availability of Web 2.0 tools highlights another reason why focusing teacher education programs on teaching specific technology may be unproductive as changes would continuously need to be made to programs to keep up with the rapid growth of technology.

In 2001, the National Council for Accreditation of Teacher Education (NCATE) announced its acceptance of the *National Educational Technology Standards* (NETS-T) for Teachers, published by the *International Society for Technology in Education* (ISTE). Acceptance of the NETS-T by NCATE initiated a shift in focus from simply teaching preservice teachers to become familiar with technology to providing preservice teachers ample opportunity to seek out and explore the availability and applicability of current technology. As an example, NCATE suggests preservice teachers look at tools, such as wikis and blogs, as devices that can be beneficial at increasing students' understanding of content, and be aware that simply using the tools is not technology integration. According to Wetzel, Foulger, and Jones (2008), educators "need to prepare students [preservice teachers] to learn how to learn" (p. 67). They also asserted that preservice teachers need to be able to think deeply about the content of their course and become lifelong learners themselves. Only when teachers know how to learn, have a solid foundation of content knowledge, and an awareness of technology pedagogy will the preservice teacher be prepared to effectively integrate technology.

While the advent of Web 2.0 sparked new interest, the idea of integrating technology dates to the early 1900s. From the first use of a motion picture in a classroom in 1910 (Cuban, 1986), to the use of current day blogs and wikis, the underlying theme of technology integration has stayed the same: What can teachers do to increase student knowledge and achievement?

"Passing on knowledge is the force that drives the engine of instruction" (Cuban, 1986, p. 3) and better ways to increase student knowledge are at the core of why integrating technology in the classroom remains crucial. However, the desire to increase student achievement is not the only similarity between today's and yesterday's use of technology in the classroom. Similarly, obstacles in utilizing technology remain as the primary reason why integrating technology innovations into the classroom are ineffective. Obstacles such as teachers' lack of skills to utilize equipment, inability to match the technology with the course content, and self-efficacy with regards to technology are historically found to be key barriers in using technology effectively (Cuban, 1986).

To that end, universities have attempted to modify teacher education programs to increase preservice teachers' effectiveness when combining technology with curricula. "This redirection exposes the importance of teachers' strategic thinking and actions with respect to integrating technologies as learning tools" (Niess, 2011, p. 300). However, when developing teacher education programs that will prepare preservice teachers to create engaging and effective classroom environments utilizing technology, "researchers have found both knowledge and [self-efficacy] beliefs to be useful in understanding the processes at work" (Abbitt, 2011, p. 134). "In fact, evidence suggests that self-efficacy may be *more important* than skills and knowledge among teachers who implement technology in their classrooms" (Ertmer & Ottenbreit-Leftwich, 2010, p. 261). If self-efficacy is defined as "how people judge their capabilities" (Bandura, 1986, p. 122), then it is plausible that their judgment can affect their actions with respect to combining technology with classroom curricula. That being said, this study will consider both knowledge of technology and self-efficacy to be at the core of effective preservice teacher preparation and constitutes the theoretical framework for this study.

Theoretical Framework

The assertion that teacher knowledge is a critical ingredient for successful technology integration has brought about new directions for research. Consequently, gaining popularity in the area of educational research is the **T**echnological **P**edagogical and **C**ontent **K**nowledge (TPACK) or, as described by Koehler and Mishra (2008), "a framework for teacher knowledge" (p. 3). Koehler and Mishra (2008) suggested that integrating technology in the classroom is "a complex and ill-structured problem involving the convoluted interaction of multiple factors, with few hard and fast rules that apply across contexts and cases" (Koehler & Mishra, 2008, p. 10). Current studies relating to teacher knowledge suggest that TPACK "presents a dynamic framework for describing teachers' knowledge required for designing, implementing, and evaluating curriculum and instruction with technology" (Niess, 2011, p. 299). Koehler and Mishra (2008) argued:

> At the heart of good teaching with technology are three core components: *content, pedagogy, and technology* and the relationship between them. It is these interactions, between and among these components, playing out differently across diverse contexts that account for the wide variations seen in educational technology integration. (p. 12)

In other words, technology itself is not one-size-fits-all; it can be used in a variety of ways in varying content areas. Teachers need to be able to choose which technology is appropriate based on its usefulness to their course content and how utilizing it can enhance student learning.

Key concepts and components of TPACK were built on Lee Shulman's descriptions of PCK (pedagogy and content knowledge) (Shulman, 1986). Shulman claimed that teachers' content knowledge and pedagogy were being treated in isolation when preparing preservice teachers. He argued that treating the components separately would not effectively prepare preservice teachers for the classroom. In order to better prepare future teachers, his model, PCK (P=pedagogy and CK=content knowledge) represents the relationship between the two components (Mishra & Koehler, 2006). Shulman asserted:

> Mere content knowledge is likely to be as useless pedagogically as content-free skill. But to blend properly the two aspects of a teacher's capacities requires that we pay as much attention to the content aspects of teaching as we have recently devoted to the elements of teaching process. (1986, p. 8)

The simultaneous treatment of distinct bodies of knowledge in teaching is where Koehler and Mishra constructed their idea of TPACK (technological, pedagogical and content knowledge). According to Mishra and Koehler (2006), “The framework emphasizes the connections… between and among content, pedagogy, and technology” (p. 1025). Niess (2011) explained:

> Today’s teachers must utilize TPACK strategic thinking as they plan and prepare to guide students in exploring content topics with technologies. The wickedness of the problem is contained in this question: How and when do teachers develop this TPACK strategic thinking and ability if they have not learned the content with these technologies? (p. 308)

Research indicates that TPACK is an important factor to predict effective use of technology in the classroom, and additional research is needed to support these findings and reveal a clearer picture (Niess, 2011).

Interestingly, another factor found to be significant in predicting future technology use is the construct of self-efficacy. Anderson and Maninger (2007) found that teacher self-efficacy was an excellent predictor of intentions or future use of technology. According to Bandura (1982), self-efficacy is “the relationship between knowledge and action” (p.122). In other words, it is a person’s perception about their capability to carry out a course of action required in certain situations. After surveying 764 teachers, Wozney, Venkatesh, and Abrami (2006) found that a person’s self-efficacy was a major factor in achieving goals of using technology. Consequently, “time and effort should be devoted to increasing teachers’ [self-efficacy] for using technology…to achieve student learning” (Ertmer & Ottenbreit-Leftwich, 2010, p. 261). If self-efficacy was found to predict future use of technology, it seems plausible that preservice teachers with high self-efficacy using technology and knowledge of the TPACK framework would be in a better position to think strategically about integrating technology. With that in mind, at the core of this study are two theories: (a) technological, pedagogical and content knowledge (TPACK) and (b) self-efficacy (SE). The researcher will first measure the preservice teachers' level of TPACK and their level of SE with regards to technology and then look for a possible relationship between the components (see Figure 1).

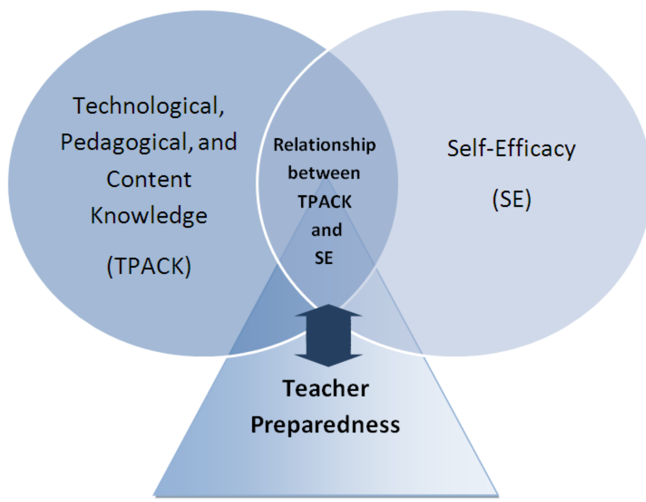

Figure 1. A graphical representation of the theoretical framework in the study depicting the core components (TPACK and SE) of the study and their possible relationship with regards to teacher preparedness. Created by the researcher.

The bottom line is that the teacher is the most significant piece of the technology integration puzzle (Chen, 2008). Regardless of outside influences from policies, standards, school administrators or parents, once the classroom door closes, it is the teacher who determines what goes on in the classroom. It is the teacher who determines the content. It is the teacher who chooses the best pedagogical strategies, and it is the teacher who decides whether or not to utilize technology. If successful technology integration is to be achieved by all teachers, teacher education programs are the logical places to start. By studying the perceived preparedness of the preservice teachers at the end of their teacher education program, the researcher will provide insight on how much closer universities are to effectively preparing teachers to utilize technology in the classroom.

Statement of the Problem

Preparing preservice teachers to integrate technology into instruction has been ongoing since the influx of computers in the schools. To ensure preparedness, colleges of education equipped their departments with computer labs and began developing the technological skills of preservice teachers. It became increasingly clear that developing the technology skills of teacher candidates did not necessarily translate to effective technology integration (Lambert & Gong, 2010). “We have entered a crucial time when fundamental shifts in the economy, changing nature of the workforce, demographic shifts, educational competitiveness, globalization of society, and computerization of the workplace make technological preparation of teachers an urgent problem we can no longer afford to marginalize” (Lambert & Gong, p. 55).

Historically, many in-service teachers have found themselves at a disadvantage when working with technology in the classroom, for the students they were teaching appeared to have the upper hand in utilizing digital tools. Educational consultant, Marc Prensky offered terminology that helped explain this gap that existed between the teachers and the students they were teaching. He referred to the students as *digital natives* who were “native speakers” born in the world of digital technology and the teachers as the *digital immigrants* who were new at and fascinated by the digital world

(Prensky, 2005). The *digital native-digital immigrant* labeling was a widely accepted explanation for the lack of technological preparedness of teachers. However, a new generation of teachers, more knowledgeable about technology than any before (digital natives), are entering classrooms yet still seem to have insufficient knowledge of how combine technology with instruction (Schaffhauser, 2009). Expecting today's preservice teachers to be able to integrate technology better than those of the past seems reasonable, but research indicates that these technology savvy natives are actually ill-prepared when it comes to effectively integrating it in the classroom (Lei, 2009). Even though many new teaching candidates have more experience using digital technology, there is still a separation between knowing how to use digital tools and being able to integrate them purposefully into the classroom.

Technology itself is not necessarily a vehicle for change. Teacher education programs that focus on technology separately, without somehow combining it with pedagogy and content, may find their programs to be ineffective. Society is moving forward with technology leading the charge. The importance of using technology in the classroom is not only important to increase student achievement, but also vital in helping students achieve the base knowledge necessary to compete and prosper in the world today. The initiation of new standards and pressure from policymakers has developed a sense of urgency for teacher education programs to effectively prepare preservice teachers to integrate technology.

Research related to self-efficacy and the TPACK knowledge of preservice teachers has indicated positive results when studied as individual factors. However, there are limited studies relating to the relationship between both factors. Additionally, quantitative studies relating to TPACK have not targeted secondary preservice teachers. Finding an effective measure to analyze the preparedness of secondary preservice teachers will be essential in solving the problems related to effective technology integration.

Purpose of the Study

The purpose of this study is to examine secondary preservice teachers' perceptions of their preparedness to effectively integrate technology into classroom instruction. More specifically, the study will examine the relationship between their level of technological, pedagogical and content knowledge (TPACK) and their level of self-efficacy (SE) with regards to technology integration. Even though many new teacher candidates (digital natives) have more experience using technology than current classroom teachers, a gap still exists between knowing how to use technology and being able to effectively integrate it into the classroom. This study is rooted in the hypothesis that preservice teachers "being able to use technology does not necessarily mean being able to use technology critically, wisely, or meaningfully" (Lie, 2009, p. 88). To support this assertion, the underlying theme in this research is based on the theoretical framework described by Keohler and Mishra (2009). The framework for teacher knowledge of technology integration is known as TPACK (Technological, Pedagogical, and Content Knowledge) (Koehler & Mishra, 2009). "The TPACK framework suggests that integrated knowledge of technology, pedagogy, and content is an essential condition to be effective and innovative at classroom teaching using technology" (Abbitt, 2011, p. 137). Therefore, prior experience utilizing technology, or teaching preservice teachers to use technology alone may not be enough to develop the essential skills to effectively integrate technology into the classroom. “Thus, [preservice] teachers need the **T**otal **PACK**age (Thompson & Mishra, 2007, p. 38). In other words, the understanding and awareness of the intersection between content, pedagogy and technology (Thompson & Mishra, 2007). However, with the research to support that “self-efficacy beliefs…influence a teacher’s ability to create learning environments that use technology in meaningful ways” (Abbitt, 2011, p. 137), the researcher of this study will further attempt to identify a possible relationship between TPACK and self-efficacy (SE) beliefs in secondary preservice teachers. Considering a correlation between TPACK and SE may provide relevant information to stakeholders in teacher education in order to more successfully prepare preservice teachers to integrate technology.

Research Questions

In order to complete a descriptive analysis of secondary preservice teachers’ preparedness, the following research questions will be examined based on the perceptions of the participants:

1. What are the perceived levels of technology preparedness of secondary preservice teachers’ as described by the TPACK framework?
2. What are the perceived levels of self-efficacy with regards to technology integration of secondary preservice teachers’?
3. What is the relationship between secondary preservice teachers’ perceived level of technology preparedness (TPACK) and their perceived level of self-efficacy (SE) with regards to technology integration?

Methodology

Currently there is no standard framework used to prepare preservice teachers to effectively integrate technology into the classroom. Therefore, teacher education programs employ different methods. Even without a universally-accepted teacher education model, the outcomes of teacher education programs instill similar results – preparedness to integrate technology into classroom instruction. Consequently, this quantitative study will focus on secondary preservice teachers from the 14 Pennsylvania State System of Higher Education (PASSHE) schools. Data will be obtained from the sample population at the end of the participants' student teaching phase of a teacher education program, for this is the stage of the program where preservice teachers apply the knowledge they have gained throughout the program.

In order to examine the research questions, data will be collected by utilizing a web-based survey instrument derived from two existing survey instruments: (a) *Survey of Teachers' Knowledge of Teaching and Technology*, used to measure the level of perceived knowledge in the area of TPACK (Schmidt et al., 2009); and (b) the *Technology Integration Confidence Scale (v2)*, used to measure the level of self-efficacy regarding technology integration (Browne, 2007). Both surveys were available for use under the public domain and were free to use as is or modified. Data from the web-based survey instrument will be analyzed resulting in a descriptive study that will examine the relationship between perceived TPACK knowledge and perceived self-efficacy with regards to technology integration. While confidence and self-efficacy are not exactly the same, this researcher assumed that self-efficacy cannot be achieved without confidence. Therefore, reference to confidence and self-efficacy will be considered equivalent.

Significance of the Study

Since 2005, nearly 100% of schools have Internet access in their instructional rooms. Yet even though accessibility to computers and technology is less of a major concern, a 2009 survey found that teachers are using technology predominately for classroom presentations, preparation or grading. In order to meet the needs of the 21st century learner, low-level use of technology by teachers is no longer acceptable (Ertmer & Ottenbreit-Leftwich, 2010). In accordance with the NETS-T, the 21st century learner should be able to: (a) demonstrate creativity and innovation, (b) communicate and collaborate, (c) conduct research and use information, (d) think critically and solve problems, and (e) use technology effectively and productively (2011). Hence, “today’s educators must provide a learning environment that takes students beyond the walls of their classrooms and into a world of endless opportunities.…ensuring that digital-age students are empowered to learn, live, and work successfully today and tomorrow” (International Society for Technology in Education [ISTE], 2011, para. 1).

The results from this study will add a body of knowledge on the preparedness of today’s preservice teachers to effectively integrate technology into the classroom. Results from this study will be important to federal, state and local policymakers in order to improve technology integration and prioritize funding. Of equal importance, this research will be significant to universities offering teacher education programs by providing evidence that will assist universities in preparing a new population of preservice teachers entering colleges and universities. Results will provide insight into whether adequate educational training is being provided to preservice teachers in the area of technology integration. In turn, universities may make changes to current practices based on the results of the study.

Additionally, the results will help to ensure that future educators are adequately prepared to effectively integrate technology and make certain that the students they teach will receive quality instruction relating to the use of technology and implementation. Underscoring the significance of the study is the positive influence successful research in technology integration will have on today's students. Making strides toward effective technology use by preservice teachers ultimately has the potential to have a positive effect on student achievement.

Definition of Terms

1. Preservice Teacher – In this study, the preservice teacher refers to the target population and only includes individuals who are at the student-teaching phase of their educational program.
2. Technology Integration – Utilizing technology as a tool to enhance student learning, develop a better understanding of the course content and develop higher-order thinking skills.
3. International Society for Technology Education (ISTE) – An organization for educators and educational leaders committed to improving learning and teaching by advancing effective technology use in schools and teacher education (International Society for Technology in Education [ISTE], 2011).
4. National Educational Technology Standards (NETS) – A set of technology standards developed by ISTE as a roadmap for preparing teachers, administrators and students

for the digital world (International Society for Technology in Education [ISTE], 2010).

5. National Educational Technology Standard (NETS) for Teachers – Standards developed to assist educators to transform education by preparing digital-age students gain a sense of empowerment to learn, live, and work successfully today and tomorrow (International Society for Technology in Education [ISTE], 2010).
6. Traditional Software-based Programs – A method of preparing teachers to integrate technology by requiring courses that will teach the preservice teachers how to use various software programs such as Microsoft Office and Internet Explorer. The assertion of this type of program is that if you are able to use the programs, you will be able integrate technology in the classroom (Stubbs, 2007).
7. Technology-Integrated Programs – A method of preparing teachers to integrate technology by incorporating technology throughout the preservice teachers' coursework, modeling by faculty and across field experiences. These preservice teachers are not required to take a specific computer course (Stubbs, 2007)
8. Digital Natives – Individuals who are born between 1981 and 2001 and are native speakers of the digital language (Prensky, 2001).
9. Digital Immigrants – The term used by Prensky to describe the teachers that teach the digital natives. These immigrants believe all learners are the same as the past and it is not necessary to modify classic methods in order to teach them (Prensky, 2001).
10. PCK Framework – Lee Shulman's (1987) work on pedagogical content knowledge (PCK) resulted in the idea that teachers should possess knowledge related to both content and pedagogy, and that teacher education and in-service professional

development programs should provide learning opportunities for teachers to develop these (Polly & Brantley-Dias, 2009).

11. TPACK Framework – Described as a framework for teacher knowledge, TPACK requires a thoughtful interweaving of three key sources of knowledge: technology, pedagogy, and content (Mishra & Koehler, 2006).
12. Blog – A method of online communication that allows the user to publish information, express ideas, and have an authentic audience (Solomon & Schrum, 2007).
13. Wiki – A webpage created by the user that is accessible to anyone with internet connection. This free website allows users a means of expressing themselves (Solomon & Schrum, 2007).
14. Web 2.0 – Often referred to as the New Web, these tools are obtained on the web and free to use. Examples included blogs, wikis, photo and video sharing, and social networking (Solomon & Schrum, 2007).
15. Self-efficacy – A person's judgment of how he/she can execute courses of action in the face of obstacles or aversive situations (Bandura, 1982).

Limitations of the Study

There are several limitations to this study. First, the information gathered from the participants is based on their perceptions. Hence, the self-reported data is limited to the respondents' abilities to formulate accurate evaluations of themselves. Second, the study is primarily descriptive in nature, and the quantitative data does not measure the actual technology use of the participant. Third, the study is limited to secondary preservice teachers from 14 state universities in Pennsylvania. It cannot be assumed that the results of this study will coincide with results from universities in different parts of the country. Also, while the sample population of secondary preservice teachers is similar because they all attend one of the 14 Pennsylvania State System of Higher Education (PASSHE) universities, the teacher education programs in each school may differ in educational technology methodology or offered technology courses. Additionally, the participants in the study will be preservice teachers nearing the end of their teacher education program, but differences in technology ability prior to entering the program may not always be equivalent.

Summary

As the world embraces advanced technology, a new culture has emerged that challenges the status quo of k-12 education and encourages redefinition of its foundational elements (Wetzel, Foulger, & Williams, 2008). While new teachers coming from teacher education programs are thought to be more advanced when utilizing technology, many find themselves steps behind when it comes to the reality in the classroom. Teacher education programs can move preservice teachers from users of technology to effective technology integrators. A current evaluation of the population of students nearing the end of teacher education programs can provide insight into how close we are to successfully preparing preservice teachers to be technology integrators. It is the intention of the researcher to provide additional support for the TPACK framework, as it is related to the predictive nature of self-efficacy beliefs with regards to technology integration. Hopefully, this bridge between TPACK and the knowledge of self-efficacy beliefs will provide outcomes that can be utilized in developing teacher education programs that will effectively prepare teachers for the technology integration challenge.

The forthcoming chapter will serve as a review of current and past research relating to technology use in the classroom. The review of pertinent literature was used as a guide in developing the research questions and the instrument used for analysis. Chapter Two will begin by outlining the progression of technology in education, build a case for the importance of technology integration in teacher education, and examine how universities have attempted to infuse technology into its teacher education curricula. The chapter will conclude by examining the TPACK model and the self-efficacy theory which constructs the theoretical basis of this study.

CHAPTER 2

REVIEW OF THE LITERATURE

Opportunities to use technology in the classroom to improve student learning have increased dramatically in the last two decades. As a result, there has been increased pressure for teachers to develop skills that make effective use of technology (Kim & Baker, 2008). The preservice teachers serving as participants in this study should be steps ahead of many in-service teachers if their university programs have prepared them to use technology effectively in the classroom, yet research indicates that many of them will feel inadequately prepared (Gronseth et al., 2010). While teacher education programs have revamped curricula to better prepare preservice teachers for the technology challenge, questions still exist about their preparedness to effectively integrate technology in the classroom. In order to thoroughly examine the problems associated with preservice teacher preparedness, this review will encompass the following topics: (1) evolution of technology in education, (2) significance of technology integration in teacher education, (3) educational technology methods in teacher education programs, (4) the theoretical framework of Technological Pedagogical and Content Knowledge (TPACK), and (5) the predictive power of self-efficacy beliefs on the future use of technology.

Evolution of Technology in Education

Technology integration is a common phrase in today's k-12 classroom. More specifically, the term *technology* has become widely used in the field of education. Used quite loosely, reference to integrating technology can infer the teachers' use of a computer, the Internet, an interactive whiteboard, or various electronic devices in the classroom for the purpose of increasing student knowledge. This portion of the literature review will offer an overview of the evolution of technology and how it has permeated in today's educational system.

Invention of the Electronic Computer

The modern computer age began in the 1940s with the invention of the MARK1 in 1944 and ENIAC (Electronic Numerical Integrator and Computer) in 1946 (Diem, 1981; Molnar, 1997). These early electronic computers, which were mostly used as a mathematical problem-solving tool, were comparable in size to a school bus. They weighed several tons, were very costly and used thousands of vacuum tubes to operate. Then in 1947, a major breakthrough occurred when Bell Laboratories came out with the transistor that replaced the unreliable vacuum tubes used previously (Diem, 1981). While the early computers were improving, they still were not available to the public or for educational use. Computers were not available for commercial use until 1951 with the introduction of UNIVAC (Universal Automatic Computer).

The Teaching Machine

In 1960, The University of Illinois introduced PLATO, the first large-scale use of computers in education (Molnar, 1997; Troutner, 1991). PLATO (Programmed Logic for Automatic Teaching Operation) is considered to be the beginning of educational software. The several thousand terminal system provided 30 courses to colleges, universities and elementary schools. While working on PLATO, the students saw only a television screen and a keyboard, but never saw the actual computer that ran the system as it was housed in a different location. This "teaching machine," as it was called, had the ability to provide tutorial instruction, inquiry logic, and research. The machine supplied a film for the students to watch and then asked a series of questions relating to the content. Students could answer the questions at their own pace and ask for help when needed (Troutner, 1991).

While the literature indicates that PLATO was the first large-scale system available in the field of education, discussions of the so-called teaching machine began as early as 1924 in the field of psychology. Dr. S. L. Pressey spoke of a simple machine that would have the ability to teach, give a test, and score the test. His belief was that this machine would free teachers from doing some burdensome tasks and give them more time for inspirational, thought-provoking activities (Troutner, 1991). A decade later, B. F. Skinner provided a different view of the teaching machine. Skinner thought that the machine could not actually teach, but was primarily a private tutor for students. He also emphasized that the success of the teaching machine depended on the quality of programs available (Troutner, 1991).

Computer-Assisted Instruction

Advancements to the teaching machine continued throughout the 1960s. In the mid to late 1960s, new terminology, CAI (Computer Assisted Instruction), emerged to describe the innovative purpose of these machines. The programs (software) for CAI were designed to provide direct instruction and skill development. CAI machines offered drill, practice and problem-solving opportunities for students (Caissy, 1987). Finally in 1966, twenty years after ENIAC, IBM developed the 1500 instructional system. Noted as the first computer designed for educational use, the minicomputer contained an audio system, a cathode ray tube (CRT) display with a light pen, a typewriter keyboard and a picture projector (Troutner, 1991). This experimental computer allowed students to work through various leaning activities (drill and practice) at their own stations and independent from others working at other stations. The program files were stored in a central location and controlled the lesson content, order, and timing, and visual material was based on the student's responses (Terlet, 1967). While more suitable and convenient in size for classroom use, the 1500 was still large in comparison to the soon-to-be introduced microcomputer. Even with efforts to develop this technology specifically for educational purposes, many schools were not acquiring this new innovation (Dockterman, 1990). Uncertainties about the prohibitive cost of the 1500 system and doubts about its long-term usefulness were still preventing school participation.

The Microcomputer

Early computers such as the 1500 instructional system were only a taste of what was to become available for schools. In the 1970s, the invention of the microchip and subsequently the microcomputer, revolutionized the future of computers in schools putting high technology in the hands of ordinary people. Microcomputers were more affordable, stand-alone devices that were capable of performing the same functions large computers of the past (Caissy, 1987; Lindelow, 1983). At this time, various companies began to produce these low-cost computers, but the dominate choice for schools was the affordable Apple IIe which emerged in the early 1980s (Troutner, 1991). The popular Apple IIe (**e**nhanced) was small in size and had enhanced features from previous versions of the Apple II. Changes in the keyboard and devices that could be attached to the computer afforded other options for users and provided ample opportunity for software development. Computers were finally starting to be seen in schools more frequently, so the rush for educational software began. Significantly, more software became available for classroom use. The software was divided into six main categories: (1) drill and practice, repetitive practice for students; (2) tutorial programs, quizzed students on material; (3) simulation programs, provided students with real-world examples; 4) interactive video programs, taught concepts using video clips; (5) utility programs, for teacher use such as grade books; and (6) tool software, used to increase productivity such as word processors (Troutner, 1991). The computer or information *revolution* had begun in the nations schools (Dockterman, 1990; Cuban, 1986).

The use of computers in the 1980s brought about changes in society. Businesses, industry and homes were flooded with these new machines. In turn, there was a new sense of urgency to bring computers into the schools. Technology in schools became more about preparing kids for the future than just teaching kids with computers (Cuban, 1986; Dockterman, 1990). This urgency to outfit the schools with computers also brought about controversy. Little data existed on how computers should be used in the classroom or whether using computers would increase student achievement (Cuban, 1986). The early days of the "revolution" had some believing that the computer would change lives, yet others believed it was just a passing fad. In any case, with the increased pressure from parents and the business community, schools were buying computers.

By the late 1980s, it became clear that "computers in the school [were] not a fad" (Caissy, 1987, p. 9). Schools were taking different avenues to use computers. New courses such as computer literacy, computer programming, and word processing were offered to students; whereas teachers were still using the popular computer assisted instruction (CAI) and utility software available for administrative functions (Caissy, 1987). It was common practice during this time for schools to have a computer lab available for teachers to use. The future of computers in the school looked promising, but many teachers had a different view. As Dockerman (1990) stated, “the technology had been introduced with such hope and promise, but I couldn’t see what the machine was doing for me” (p. 17). In 1986, Larry Cuban predicted:

> Most teachers will use computers as an aid.… In elementary schools where favorable conditions exist, teacher use [of computers] will increase but seldom exceed more than 10% of weekly instructional time. Pulling out students for a 30-45 minute period in a computer lab will be popular…Teachers who are serious computer users will secure machines, but school wide use will be spotty…In secondary schools, the dominant pattern of use will be to schedule students into one or more elective (rather than required) class where a score of desk-top computers sit…In no event would I expect general student use of computers in secondary schools to exceed 5 percent of the weekly instructional time. (Cuban, 1986, p. 99)

The literature reflected these judgments by indicating barriers that were preventing effective use of computers, including: (1) lack of high-quality software that integrates computer features with the needs of the teachers and students, and (2) inadequate training for teachers on how to think about computers (Hawkins, 1982). Additionally, even though the momentum for computer use in education was accelerating, there was a need to move beyond just computer literacy training for students. Acceptance of the computer as a tool to increase student learning was beginning to gain recognition. Attention was shifting toward the teacher to integrate computers into the teaching and learning process, or technology integration (Preston, 1989). Statistics indicated that over 95% of schools had two or more microcomputers, and student-to-computer ratio for schools in the United States was an average of 25:4. Although the 1980s brought the computer revolution to society, integrating computers in education lagged behind. Cuban's predictions became a reality.

The Internet

Classroom technology use in the 1990s began as the revolution that fizzled. Excellent learning outcomes resulted when microcomputers entered the classroom, but straightforward successes were minuscule (Elmer-Dewitt, 1991). Researchers started to realize that integrating technology was not easy for teachers and began focusing on barriers that were preventing teachers from integrating technology. Teacher educators were also beginning to take notice. Faison (1994) indicated:

> Electronic media and technologies of instruction have the potential to be an integral part of the teaching-learning environment at all levels. One way to increase the appropriate use of technology in our k-12 classrooms is through the education and training of preservice teachers. (p. 183)

Researchers began to report on teacher efficacy, beliefs and attitudes with respect to using technology, and what exactly was *effective* use of technology. At the same time, education and society were headed for one of the most significant technology transformations in history (Ian, 2004). In the early 1990s, researchers from CERN (Conseil Européen pour la Recherche Nucléaire) Laboratories in Europe were working on the creation of the World Wide Web (WWW). This WWW technology, and subsequent web browsers, would make it possible for anyone to use the Internet. By 1994, the Internet era had begun (Ian, 2004). During this era, the White House's National

Information Infrastructure (NII) initiative challenged the nation's schools and classrooms to connect to the Internet by the year 2000. To assist in the challenge, funds were made available through the federal Education Rate (E-rate) program to make technologies in telecommunications available to schools at a discount based on income level (Williams, 2000). According to a February 2000 report from the National Center for Educational Statistics (NCES), "the percentage of public schools connected to the Internet increased each year, from 35% in 1994 to 95% in 1999" (Williams, p. 1). Although the data was impressive, Internet access in the classroom where instruction was taking place was not always the case.

Despite advances in availability, utilizing technology to increase student learning was limited. Subsequently, technology integration became an essential part of school reform at the end of the 20th century. National organizations were answering the call for improvement by instituting national guidelines and standards. In 1998, the International Society for Technology in Education (ISTE) developed the National Educational Technology Standards (NETS) for Students, and eventually NETS-T for Teachers in 2000. Also, the National Council for Accreditation of Teacher Education (NCATE) set forth accreditation guidelines that focused more on the technology integration in professional teacher preparation programs (Vannatta, 2000). In order to meet the nation's need for a well-educated workforce in the 21st century, President Clinton and Vice President Gore "challenged the nation's educators and high technology industry leaders to work together on new ways to accelerate student learning with technology" (Steele, 1998, p. 8).

The end of the 1990s brought about an array of technology devices for schools, and state and national agencies believed there was a real need for technology integration. However, an established understanding about technology integration, or how it should be used did not exist (Mize & Gibbons, 2011).

The New Century

The 21st century brought new issues with regards to technology integration. Literature during the early days of the new century began to shift with the changes in the educational system and innovations in educational technology. Standards, professional development, pedagogy and the digital divide were widespread topics of the day. The age of accountability had arrived and would prove to have positive implications to the area of educational technology.

Of specific note, the No Child Left Behind Act (NCLB) was signed by President George W. Bush on January 8, 2002. The Act was described by the administration as "a landmark in education reform designed to improve student achievement and change the culture of America's schools" (United States Department of Education, 2002, p. 9). In brief, the NCLB Act "envisions equity of outcomes among student populations and seeks to provide quality educational programs to all disadvantaged children. NCLB builds upon previous federal initiatives and takes significant steps to ensure that academic results are produced" (Donlevy, 2002, p. 257). In order to meet the requirements of NCLB, schools were put on high alert to improve student achievement. The Act was often met with negative responses from schools and brought about terms such as parental choice, accountability, adequate yearly progress (AYP), and high-stakes testing. Undeniably, NCLB would, "affect states and public schools for years" (Recio, Clark, Sevol, & Nuzzo, 2002, p. 49) for various reasons, but usually less noted is the tremendous impact that NCLB had on the availability of technology.

While the NCES 2000 report indicated that 95% of schools in the United States had Internet access, a digital divide was exposed when comparing the numbers of schools that had Internet in instructional rooms. More specifically, the report indicated:

> Thirty-nine percent of instructional rooms had Internet access in schools with high concentrations of poverty (71 percent or more students eligible for free or reduced-price lunches), compared with 62 to 74 percent of instructional rooms in schools with lower concentrations of poverty. The percentage of instructional rooms with Internet access in public schools with [a] high concentration of poverty did not increase between 1998-1999, while there were increases in the percentage of connected instructional rooms in schools with lower concentrations of poverty. (Williams, 2000, p. 3)

To narrow the digital divide that existed along district economic lines and support for effective technology integration, NCLB included a technology component. According to Learning Point Associates (2007), specific goals for the component, referred to as NCLB Act – Part D of Title II – Enhancing Education Through Technology (EETT), were as follows:

1. To improve student achievement through the use of technology in elementary schools and secondary schools.
2. To assist every student in crossing the digital divide by ensuring that every student is technologically literate by the time the student finishes eighth grade,

regardless of the student’s race, ethnicity, gender, family income, geographical location, or disability.

3. To encourage the effective integration of technology resources and systems with teacher training and curriculum development to establish research-based instructional methods that can be widely implemented as best practices by state education agencies and local education agencies.

In order to achieve the goals of EETT, grant funds were made available to schools in high-poverty areas, those that serve at least one low-performing school, or to those which have a substantial need for technology (United States Department of Education, 2002).

EETT Grants provided by NCLB were instrumental in providing technology in many school districts. Technology in instructional rooms became more available for teachers and students. However, the 2000s brought about contradicting views of how technology should be used in the classroom. Educational technology leaders were advising teachers to shift to a more constructivist view where students construct new ideas based on prior knowledge and develop lessons that are authentic in nature in order to provide real-world experiences relevant to their daily lives. Focus in the classroom needed to change from “teaching” to “learning,” and the role of the teacher needed to change from the “leader” to “facilitator” (Harris, 2005). While this was a time of standards-based educational reform, standards-based education did not support or create tests for accountability based on a constructivist view. Technology reform and educational reform were seemingly at odds (Keller & Bichelmeyer, 2004).

Despite conflicting points of view during this time, technology continued to arrive in the classroom during the first decade of the 21st century. States began offering their own initiatives to improve technology integration in schools. For example, in 2006 Pennsylvania began its Classrooms for the Future (CFF) initiative. According to the Pennsylvania Department of Education:

> The *Classrooms for the Future* (CFF) initiative has transformed the way high school teachers teach and how students learn in over 540 Pennsylvania high schools, affecting over 12,000 teachers and 500,000 students, by equipping English, math, science and social studies classrooms with enhanced technology, internet connected laptop computers for teachers and every student, and other state-of-the art resources. Teachers are creating assignments that not only use technology, but offer students opportunities to develop 21st Century skills such as collaboration, problem solving, creativity and innovation. (Pennsylvania Department of Education, 2011, ¶ 2)

As part of the CFF initiative, school districts were provided funds to train and employ CFF Technology Coaches. The purpose of the CFF coach was to assist classroom teachers to integrate technology.

In the late 2000s, the International Society for Technology in Education (ISTE) developed new National Educational Technology Standards (NETS) to support and encourage technology integration. The NETS-S for students in 2007, NETS-T for teachers in 2008, and the NETS-A for administrators in 2009 were designed to use as a guide to transform schools. The standards could provide guidelines used for hiring teaching candidates, as well as evaluation and professional development of teachers (ISTE, 2010).

The emphasis on technology as part of school reform brought about an array of areas to research. However, with the many initiatives occurring during this decade, much of the literature focused on professional development for technology integration. Regardless of NCLB and national technology plans, making progress toward significant technology use in schools fell by the wayside. Public school teachers struggled to keep up with the everyday demands of teaching and did not have time to think about how to integrate technology (Cowan, 2008; Plair, 2008). Professional development was thought to be necessary to help veteran teachers learn the proper use of technology. A popular argument for lack of technology use by teachers was the lack of teacher knowledge and the widening digital divide that existed between themselves and their tech-savvy students (Plair, 2008). In 2001, Marc Prensky's research on this digital divide or gap that existed between teachers and students would create a new phenomenon and way of thinking in the field of educational technology.

Digital-Natives and Digital-Immigrants

In 2001, Marc Prensky referred to individuals who were native speakers of the digital language as "digital natives" (Prensky, 2001). While other terminology existed including Generation Y or Millennials, "born between 1981 and 2001" (Black, 2010, p. 92), and Generation N (for Net)-gen or Generation D (for digital)-gen, Prensky found the most useful designation for this unique group was the digital natives, for they were born surrounded by technology.

According to Prensky (2001a), students born after 1980 are *digital natives* because they have grown up exposed to an array of digital media (Guo, Dobson, & Petrina, 2008). From cell phones, computer games, email and the Internet, this generation of students do not remember a time without digital technology. Once Prensky identified the *natives*, he referred to the teachers who taught them as the *digital immigrants*. "The digital immigrant accent can be seen in such things as turning to the Internet for information second rather than first, or in reading the manual for a program rather than assuming the program itself will teach us to use it" (Prensky, 2001, p. 2). Immigrants believe learners of today are the same as in the past, and the necessity to modify classical methods in order to teach them would not be necessary (Prensky, 2001).

Prensky's distinction between the *natives* and *immigrants* revealed one of the biggest problems in the educational system – the digital gap between the students and their teachers (Guo et al., 2008). According to Prensky, digital natives required a new type of learning that utilized methodology that met the needs of students whose brains were physically different (Prensky, 2001). The natives' brains crave interactivity and multi-tasking, yet this need is usually ignored by most educators. The discovery of this digital gap during the 1990s forced universities and school districts to reexamine ways to teach these students.

In the last fifty years, regardless of the technology being promoted, classroom teachers were expected to make substantial changes in day-to-day practices and invite new innovations with open arms. Yet, as Cuban (2001) suggested, it is difficult for teachers to manage all of their normal classroom duties and have time to learn new technologies and how to integrate technology. While in-service teachers usually incur the blame for unsuccessful technology integration in schools, "it is time for teacher education programs to find greater parallels between the experiences that they provide their teacher candidates and what is occurring in classrooms" (Donovan & Green, 2009, p. 45).

Significance of Technology Integration in Teacher Education

Integrating technology in the classroom has been an issue in the field of education for the past 40 to 50 years. Past presidents, such as Bill Clinton and George W. Bush, enacted policy changes or offered initiatives to improve student achievement through the use of technology. Similar to these prior leaders, President Obama signed the American Recovery and Reinvestment Act (ARRA) of 2009 that put 90 billion dollars toward education and allocated 650 million toward technology (Waters, 2010). Throughout recent history, our country has fostered a strong belief that technology can change student outcomes or improve achievement. Otherwise, our nation would not continue to invest so much into bringing advanced technology into schools. Lei (2010) stated, "For technology to have meaningful impact on teaching and learning, close attention must be paid to the quality of technology use; how it is being used; what [type] is used and for what purposes" (p. 468). Consequently, preservice teachers in this century need to be prepared to utilize available technologies in and out of their field, to understand how these technologies are used in the classroom, and to ensure that the purpose for use of these technologies is to reinforce specific content objectives. That said, this portion of the literature review will examine two essential reasons preservice teachers need to be prepared to integrate technology: (1) technology can be used to increase student achievement and (2) acceptance of technology standards by university accrediting agencies.

Technology and Student Achievement

The most compelling case that can be made for preservice teachers learning effective methods for integrating technology is the belief that technology integration can increase student learning. While some literature exists that refutes the use of technology as a tool to improve student achievement, most research supports its use and its impact on positive student outcomes.

For example, the Glen Grove School District of Glen Grove, New York implemented a plan that “use[d] technology to drive learning and teaching by inspiring creativity, passion, and innovation” (Camhi, 2010, p. 13). After considering the limited budget available, the district devised a systematic plan that distributed technology according to its appropriateness to the curriculum and student interest. Instead of supplying each classroom and teacher with the same resources, teachers had an array of technology tools available to borrow through the library. Interestingly, the district did not provide technology (whiteboards and interactive handheld devices) to teachers until they were adequately trained to effectively utilize the equipment. In addition, the district instituted a professional development program geared toward good pedagogical practices (Camhi, 2010). Results from Glen Grove’s technology integration plan were impressive. “State assessment scores in grades 3–8… increased dramatically. English language arts scores [raised] by 9–29% across the district, and math scores [raised] 12–41%” (Camhi, 2010, p. 15).

In contrast to Glen Grove's systematic technology integration plan, 1:1 computing programs have emerged as a means to improve student achievement by integrating technology. Based on the belief that increased access to technology improves teaching and learning, 1:1 computing initiatives create an environment where technology is available to everyone and is not shared. Hence, it is common for these types of programs to provide a laptop computer to all teachers and students. Examples of 1:1 computing initiatives that reveal positive results included the Texas Technology Immersion Project (TIP) and the Maine Learning Technology Initiative (MLTI) (O'Hanlon, 2007).

At the onset of TIP, the Brady Middle School in Brady, Texas was a low-performing school; it did not meet Adequate Yearly Progress. After implementing the program, the percent of students passing the state test rose across the board. In 2006, sixth-grade reading scores were up 17 points from 2004, and seventh-grade math scores were up 13 points. Givens (2007) stated, "The students have become more responsible for their learning, more engaged in the classroom and much more knowledgeable about the role of technology in problem solving" (p. 21). Another school district in the program, the Floydada Independent School District in Floydada, Texas, also showed dramatic progress as a result of the TIP initiative. In the first year of the program, tenth-grade scores in math rose 36 points and science scores rose 34 points.

Sharp and Trotter (2007), reported that the MLTI program increased student achievement in writing. According to the authors, students who used computers in more phases of the writing process were twice as likely to score higher on state tests. In 2000, only 29% of eighth-grade students were proficient in writing, compared to 49% in 2005. Virginia Rebar, the principal of Piscataquis Community Middle School, in Guilford, Maine, states "It's just a lot easier to edit and to self-critique. Our teachers engage students in a lot of peer-editing. Not only are they helping themselves, but they're helping each other as they get to their final projects" (Sharp & Trotter, 2007, p. 11).

Similar results were found by Maninger (2006). The study focused on two questions: (1) how much difference could integrating technology make on state-mandated tests, and (2) how would at-risk students' motivation and behavior vary as a result of technology integration. In the study, students were separated into two groups (at-risk students and the general population). One teacher taught at-risk students using a 1:1 ratio of computers, and the teacher of the other general population class used no technology. The results from the study found a high success rate in both groups. However, the at-risk students (predicted to perform at a lower level than the non at-risk students) outperformed the general population group (Maninger, 2006). Student motivation was extremely high and the student behavior indicated a strong commitment to the classroom activities. The teacher reported that the use of technology improved the students' achievement and gave the students an atmosphere of active learning (Maninger, 2006).

More recently, Bebell and O'Dwyner (2010) reported evidence from four empirical studies on 1:1 computing initiatives. According to the report, "while the implementation and outcomes of the programs varied across schools…1:1 computing led to measurable changes in teacher practices [and] student achievement" (Bebell & O'Dwyer, 2010, p. 11). More importantly, it was evident "that teachers play an essential role in the effective implementation of 1:1 initiatives and that the onus of responsibility for implementation often falls to the teacher" (Bebell & O'Dwyer, 2010, p. 8).

Providing laptops for every child is only one way schools attempted to increase student learning. Trotter (2007) discusses the impact of algebra software on student achievement. Computer software shows students visual models of mathematical concepts and lets them manipulate those models. SimCalc MathWorlds is one example of this type of software and is providing evidence that the approach can lead to gains in student learning. On tests before and after a unit, students using SimCalc on average increased their scores by 46 percent. In contrast, the students who used traditional methods of instruction on average increased their scores by 19 percent. The average SimCalc student moved from the 50th percentile to the 80th percentile on a test of proficiency in those math concepts (Trotter, 2007).

There is an array of literature proving the positive impact of technology integration on student outcomes, but there are also studies that refute this claim. In 2007, a study was conducted by Mathematica Policy Research, Inc., on the effect of computer software on the teaching of math and reading (Barlow, 2007). The study focused on whether students had higher test scores in reading and math when the teacher had access to software designed to support learning in reading and math. The subjects involved included first grade reading, fourth grade reading, sixth grade math and ninth grade algebra. The findings for all of the groups were similar. The products in all four groups did not affect tests scores by amounts that were statistically significant (Barlow, 2007).

Mitchell, Bailey, and Monroe (2007), conducted a study in three high school geometry classes taught by the same teacher. In this study, the teacher used traditional methods with the first group, presentation and web page software with the second group, and student-created instructional modules (designed by the second group) with the third group. The focus of this study was to detail the experience of a non-technological, seasoned teacher's technology integration and to measure if the integration had increased the students' understanding of the concepts. The results indicated no significant difference between the outcomes of student achievement regardless of the method used. In the end, the teacher was not convinced that the pedagogical change of this magnitude would produce learning equal to his more non-traditional methods. The teacher's perception was that the added time needed to use technology would actually decrease learning of the students (Mitchell, Bailey, & Monroe, 2007).

While evidence can be found to refute claims that technology integration will increase student achievement, measuring positive effects is not always straightforward. According to Joe Hofmeister, Cincinnati County Day School, "If a kid gets excited about *Hamlet* because he worked on a set design on his tablet PC in class, or he got to speak with actors playing in *Hamlet* at the Globe Theatre in London via videoconference, how do you measure that? Passion is a hard thing to measure" (O'Hanlon, 2007, p. 28). Increased student engagement, improved student behavior and increased student attendance, all have a positive effect on learning (Fletcher, 2006). According to a report from the Educational Testing Service, about one-third of students do not graduate after four years of high school (Fletcher, 2006). There is nothing you can do to increase student achievement once they drop out of school, so if technology helps to keep them in school, that would have to be considered a positive result.

Conflicting results relating to technology integration and student outcomes can be found throughout literature of the last several decades, and inconsistencies in research make it difficult to make recommendations to educators on the value of technology integration (Lei, 2010). Nevertheless, a key factor is that “teachers nearly always control how and when students access and use technology during the school day” (Bebell & Kay, 2010, p. 47), and it is not possible to overemphasize the role individual teachers play in the success or failure of technology integration (Bebell & Kay, 2010). “Technology has the potential to improve teaching and learning. However, for this potential to be realized, it must be ‘properly’ used” (Lei, 2010, p. 468).

> Hence, to make technology an agent of education change, the field needs to understand the kinds of learning outcomes that technology can enhance and the circumstances under which that enhancement will be realized in practice. Sound guidance on how to implement technology in ways that produce student learning gains is integral to efforts to use technology as a lever for education change. (Means, 2010, p. 287)

The aforementioned literature indicates that teachers need to be aware of how to properly work with technology. Teacher education programs that successfully prepare preservice teachers to integrate technology focus on the “how” to integrate technology and not the “whether or not” to integrate technology (Ertmer & Ottenbreit-Leftwich, 2010). Additionally, “knowing how to use tools is only the foundation. Teaching with technology requires teachers to expand their knowledge of pedagogical practices across multiple aspects of the planning, implementation, and evaluation processes” (Ertmer & Ottenbreit-Leftwich, 2010, p. 260). Clearly, without proper use, proper planning, and proper implementation by the classroom teacher, technology cannot increase student achievement.

Acceptance of Technology Standards

Standards are not new to the field of education. Brought about primarily by the standards-based reform movement of the mid 1980s, standards were an effort to improve the decline in student and school performance (Delandshere & Petrosky, 2004). In the years that followed, the term *standards* became affixed to an array of areas in education. To no surprise, technology integration became an integral part of contemporary standards.

In May of 2000, the National Council for Accreditation of Teacher Education [NCATE] announced new technology standards to be used for evaluating teacher education programs (Dexter & Riedel, 2003; Burke, 2000). Developed by the International Society for Technology in Education [ISTE], these performance-based standards were designated to assist new teaching candidates in developing technology integration skills. Adoption of the technology standards by NCATE required institutions to demonstrate that technology standards were embedded throughout the teacher education program as part of accreditation.

Following the initial adoption of ISTE standards were more and more technology skills penetrating throughout our society. Schools were receiving increased pressure to ensure students will be able to apply technology skills creatively. Higher-order thinking and digital citizenship were thought to be critical for school-aged students to achieve success in the emerging global society (ISTE, 2010). To address rapid changes in technology, instruction and learning environments, the 2000 ISTE standards refreshed the original standards to transform how students learn and teachers teach. By developing audience-specific standards for school-aged students (NETS-S), teachers (NETS-T) and administrators (NETS-A), ISTE standards addressed the needs across the entire education system. The International Society for Technology in Education (2007) identified the following updated standards for school-aged students [NETS-S]:

1. Creativity and Innovation: Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.
2. Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
3. Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.
4. Critical Thinking, Problem Solving, and Decision Making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
5. Digital Citizenship: Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
6. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems, and operations.

In order to facilitate these standards, classroom educators need to exhibit the aptitude and behaviors of digital-age professionals, and proficiency with technology is at the core (International Society for Technology in Education [ISTE], 2011). By developing new technology standards for teachers, ISTE provided a roadmap to effectively teach with technology. To assist teachers in leading the transformation of our classrooms and ensure that digital-aged students are prepared for successful futures (ISTE, 2010), the International Society for Technology in Education (2008) identified the following updated standards for teachers (NETS-T):

1. Facilitate and Inspire Student Learning and Creativity: Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments.
2. Design and Develop Digital-Age Learning Experiences and Assessments: Teachers design, develop, and evaluate authentic learning experiences and assessment incorporating contemporary tools and resources to maximize content learning in context and to develop the knowledge, skills, and attitudes identified in the NETS•S.
3. Model Digital-Age Work and Learning: Teachers exhibit knowledge, skills, and work processes representative of an innovative professional in a global and digital society.
4. Promote and Model Digital Citizenship and Responsibility: Teachers understand local and global societal issues and responsibilities in an evolving digital culture and exhibit legal and ethical behavior in their professional practices.
5. Engage in Professional Growth and Leadership: Teachers continuously improve their professional practice, model lifelong learning, and exhibit leadership in their school and professional community by promoting and demonstrating the effective use of digital tools and resources.

Since teacher education programs are guided and accredited through the National Council for Accreditation of Teacher Education (NCATE), acceptance of the NETS-T by NCATE created new sense urgency for universities to better prepare preservice teachers for technology use in the classroom. The rush was on to create the 21st century teacher. According to Berry (2010):

> Current teacher education programs…are at best preparing teachers for late 20th century schools – not ones filled with second language learners and students who are growing up in a Web 2.0 world. A re-conceptualized system of teacher preparation, built on a new generation of policy-fueled partnerships and performance assessments, can offer opportunities for individuals from many backgrounds to enter teaching through different routes while also promoting the spread of effective teaching and the identification of our most expert teachers – all in support of transforming teaching into a *practice-based profession* for the 21st century. (Center for Quality Teaching [CTQ], 2010, p. 11)

The continued emergence and acceptance of new and updated technology standards indicates a consensus in the field of educational technology that preservice teachers need to experience the use of technology throughout their teacher educational programs (Dexter & Riedel, 2003). The next section in this review provides an overview of how teacher education programs have attempted to increase preservice teachers' preparedness to utilize technology effectively.

Infusing Technology into Teacher Education

Prior to NCATE's adoption of the ISTE technology standards, assumptions were made by many educators that preservice teachers enrolled in programs after the year 2000 would be well-versed with technology and, therefore, more willing and able to integrate technology in the classroom (Hall, 2006). These assumptions mirror the historical beliefs that a single tools-based technology course would prepare preservice teachers to effectively integrate technology in the classroom (Greer, 2008; Polly, Mims, Shepherd, & Inan, 2010). "However, teachers' technological skills do not result in the effective use of technology in elementary, middle and secondary schools in ways that are likely to impact student learning" (Polly et al., p. 863). This section of the literature review will provide an overview of the research reported since adoption of the ISTE standards in teacher education programs.

"Teacher technology preparation has consistently been emphasized in technology policies and reports in the last two decades as 'the single most important step' toward integrating technology into education" (Lei, 2009, p. 87). During this time, many projects and grants were developed to enhance preservice teacher preparedness to integrate technology. For example, extensive research is available on projects that utilized the federal grant program, Preparing Tomorrow's Teachers to use Technology (PT3). The PT3 program was "designed to ensure that new teachers are prepared to use computers and other technology when they reach the classroom" (Rockman, 2004, p. i). Projects utilizing PT3 funding focused on course, program and faculty development in order to create a model that would better prepare preservice teachers to utilize technology in the classroom (Department of Education, 2006). While the grant programs consistently used NCATE adopted ISTE standards as the basis of their approach, the models that were more prevalent were (a) modeling, (b) infusion, and (c) changes to the required technology course.

Several PT3 programs reviewed referred to “modeling” as part of their approach to increase preservice teacher preparedness (e.g., Banister & Vannatta, 2006; Hall, 2006; Nelson & Thomeczek, 2006; Wentworth, 2006). The premise behind *modeling* was that, “teacher candidates must see technology modeled by faculty in their universities and [by classroom teachers] in field placements” (Banister & Vannatta, p. 210). Programs instituting modeling as part of their enhanced technology integration provided extensive professional development opportunities. For example, Hall (2006) described a program that not only provided professional development to university faculty, but also perspective cooperating teachers from surrounding school districts. In some cases, incentives or rewards were offered to teachers completing professional development in order to increase participation.

Other grant programs requiring professional development of faculty were those that infused technology throughout the curriculum. Goals of this model “infuse[d] instructional technology more deeply into the teacher education curriculum in both education core courses and selected majors” (Brzycki & Dudt, 2005, p. 620). Technology was integrated into courses by requiring technology-enhanced assignments and syllabus revisions that would incorporate the appropriate use of technology. Other stipulations of this method require that observations and field experiences include the use of technology (Brzycki & Dudt, 2005).

Additional grant programs made changes to the required educational technology course. “Tools-based technology courses have been a staple of almost every college of education across the country” (Greer, 2008, p. 167). Traditionally, these courses concentrated on how to utilize software and increase the comfort level of the preservice teachers. PT3 programs that made changes to these courses would focus more on what preservice teachers could do with technology to promote student achievement in the classroom instead of just how to use or operate specific technologies. Students were given more experience creating lessons that they could actually use in their specific content area.

The PT3 grant initiative offered strategies to enable universities to implement models of change to their curriculum, but researchers have yet to agree on a standard model to guide teacher education programs in developing technology integration skills in preservice teachers. In reviewing the impact of PT3, Polly et al. (2010) found that preservice teachers who actually witnessed or were involved in creating technology integration activities developed a more positive attitude toward technology integration. However, if teachers were sent on field experiences where technology was not used in practice, their view about the benefits of technology integration decreased (Polly et al., 2010). Professional development of faculty was found to be successful in increasing one's level of technology skills, but it was not a guarantee that it would lead to changes in classroom practice (Basham, Palla, & Pianfetti, 2005). Because of the time consuming nature of technology integration, incentives in the form of technology tools, substitute teachers, release time, or summer pay were found to increase faculty and k-12 teacher participation (Duffield & Moore, 2006).   More recently, in a needs assessment survey to investigate preservice teacher preparedness to use educational technology, Koc and Bakir (2010) concluded:

> On the whole, teacher education programs should provide preservice teachers with learner-centered, collaborative, authentic and inquiry-based learning

environments in order to help them understand how to use technologies as tools to enhance their teaching and students' learning. Such environments should be in the way to enable them to (a) generate technology-integrated instructional projects and strategies to address their question, problems, and issues related to technology integration, (b) implement and evaluate their products to investigate in what kind of situations technology is really working effectively, and finally (c) share their experiences and findings with their peers. (p. 20)

According to Donovan and Green (2009), technology will inevitability become an essential part of the entire teacher education program. Rather than being separate, programs will combine elements of technology, pedagogy, content, assessment, and classroom management. Whether these changes have or will be successful at producing teachers that are ready to meet needs of their 21^{st} century students is yet to be seen. Nevertheless, it is apparent from the last two decades of research that many attempts have been made to improve the preparedness of preservice teachers when it comes to integrating technology. Hence, this study is designed to provide additional data on the level of preparedness of preservice teachers coming from teacher education programs today.

Technological, Pedagogical and Content Knowledge

Previous efforts to prepare teachers to utilize technology in the classroom focused on teaching teachers how to use technology. The belief was that after teachers learned to use technology, they would figure out how to use it effectively in their content area. Unfortunately, these efforts have been found to be largely ineffective (Thompson & Mishra, 2007). Rather than focusing on particular technologies and how to use them, attention in teacher education programs has shifted to the importance of a preservice teacher's ability to think strategically with respect to integrating technologies as learning tools (Niess, 2011). While teacher educators realize that changes are necessary to better prepare preservice teachers, how to effectively develop the necessary skills has yet to be determined. During the struggle to redesign teacher education programs that actively engage preservice teachers to integrate appropriate technology, a new framework for teacher knowledge in the 21st century emerged (Niess, 2011).

According to this new framework, teacher education programs should not consider technology, content and pedagogy as separate entities with regards to teacher knowledge. Teacher knowledge is better articulated as a blend of these domains (Abbitt, 2011). The new framework called "Technological Pedagogical and Content Knowledge (TPACK) is a framework for thinking about the knowledge teachers need for making instructional decisions with respect to integrating digital technology as learning tools" (Niess, 2011, p. 300). As defined by Koehler and Mishra (2009):

> Teacher knowledge is described in detail as, a complex interaction among three bodies of knowledge: content, pedagogy, and technology. The interaction of these bodies of knowledge, both theoretically and in practice, produces the types of flexible knowledge needed to successfully integrate technology use into teaching. (p. 60)

The TPACK framework is derived from Lee Shulman's 1986 descriptions of PCK (pedagogy and content knowledge). Shulman claimed that teachers' subject knowledge and pedagogy were being treated in isolation, and PCK represents the relationship between the two (Mishra & Koehler, 2006). "Shulman (1986) argued that having knowledge of subject matter and general pedagogical strategies, though necessary, was not sufficient, and teachers would have to confront both issues simultaneously" (Mishra & Koehler, p. 1021). Simultaneous treatment of distinct bodies of knowledge in teaching is where Koehler and Mishra constructed their idea of the TPACK model (see Figure 2) with three main components of teachers' knowledge: technological (TK), pedagogical (PK), and content knowledge (CK). "Equally important to the model are the interactions among these bodies of knowledge, represented as pedagogical content knowledge (PTK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPACK)" (Koehler & Mishra, 2008, p. 12).

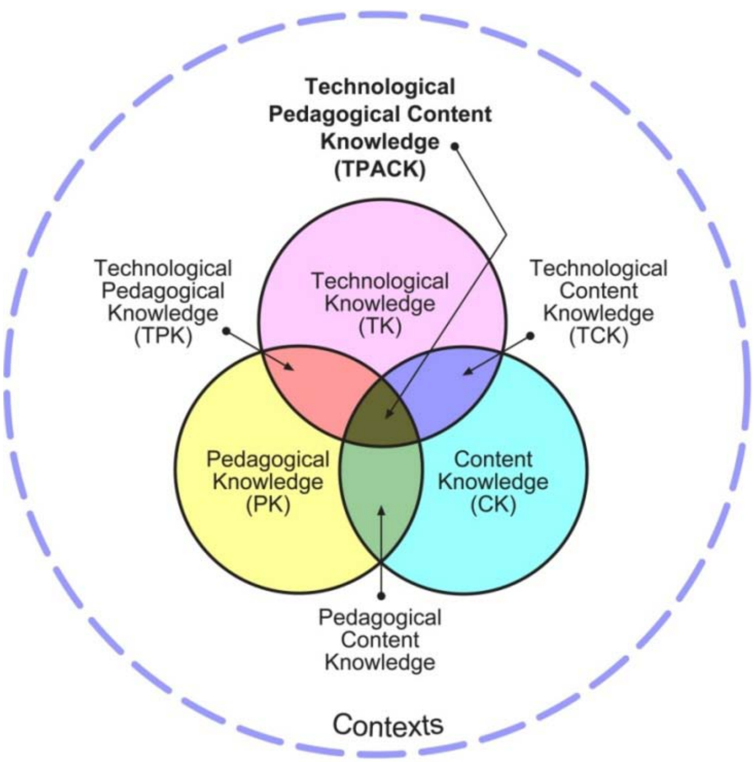

Figure 2. The TPACK Framework depicting the three main knowledge components, and the equally important knowledge components created by the intersection of the three. Rights-free image obtained from http://tpack.org.

As an overview of each component of the TPACK model, the seven bodies of knowledge described by Koehler and Mishra (2008) are as follows:

1. Content knowledge (CK) – actual knowledge of the subject matter that is to be taught or learned (e.g. math, science, art, etc.)
2. Pedagogical knowledge (PK) – knowledge of methods of teaching and learning, and the processes and practices of teaching, including classroom management, lesson plan development and student evaluation.
3. Technology knowledge (TK) – and open-ended interaction with technology or an evolving knowledge base of technology with the realization that technology and assist or impede the achievement of a goal.
4. Pedagogical content knowledge (PCK) – an understanding of the conditions that promote learning in a specific content including, an awareness of common misconceptions, and flexibility to develop alternative strategies to promote student learning.
5. Technological content knowledge (TCK) – knowledge of technological progress in a particular content area including, how technology is used in a field and what historical benefits technology has brought to a field.
6. Technological pedagogical knowledge (TPK) – an understanding that technology has a range of uses regardless of its intended purpose, and reconfigure it to meet pedagogical purposes.
7. Technological pedagogical content knowledge (TPCK) – knowledge of the interaction between the TPACK model (content, pedagogy, and technology), or the simultaneous integration of the components.

According to Koehler and Mishra (2008), “Ignoring the complexity inherent in each knowledge component, or the complexity of the relationships among these components, can lead to oversimplified solutions or failure” (p. 18). While teacher educators continued to accept the TPACK framework as a way to explain the intricacy of technology integration as a unique type of teacher knowledge (Polly & Brantley-Dias, 2009), “the framework is not yet fully understood” (Cox & Graham, 2009, p. 60).

In reference to teacher education programs implementing TPACK, Niess (2008) suggested:

> Structuring the curriculum and instruction of methods courses to prepare preservice teachers to teach with technology in their lesson designs requires attention to the pedagogical reasoning that integrates their knowledge about the students, of the content, of the instructional strategies, managing the classroom and assessing student learning along with a careful consideration of how technology impacts on how students interact with the subject matter. (Niess, 2008, p. 227)

Essentially, preservice teachers need to look at technology broadly enough to recognize how it can assist or impede the achievement, they need to be creative and flexible, and they need to reject the *functional fixedness* of technology. In other words, they need to *reconfigure* the technology for their own pedagogical purposes (Koehler & Mishra, 2008). Teachers themselves are the central part of the classroom environment. In essence, they are curriculum designers or active participants in implementing decisions on content, pedagogy and technology. “Teachers constantly negotiate a balance between technology, pedagogy, and content in ways that are appropriate to the specific parameters of an ever-changing educational context" (Koehler & Mishra, 2008, p. 21).

Research from TPACK theorists Koehler and Mishra suggested "developing TPCK is a multigenerational process, involving the development of deeper understandings of the complex web of relationships between content, pedagogy and technology and the contexts in which they function" (Koehler & Mishra, 2005b, p. 136). As a note to reader, "the TPCK framework acronym was renamed TPACK (pronounced 'tee-pack') for the purpose of making it easier to remember and to form a more integrated whole for the three kinds of knowledge addressed: technology, pedagogy, and content" (Schmidt et al., 2009, p. 123).

To explore these concepts, researchers began experiments on an approach to teaching technology integration to preservice teachers, specifically, *Learning Technology by Design*. The Learning Technology by Design approach emphasized "the value of authentic and engaging ill-structured problems that reflect the complexity of the real world" (Koehler & Mishra, 2005b, p. 135). While early efforts offered descriptive information on teacher knowledge and technology, the studies were primarily qualitative and were time consuming and difficult to replicate (Koehler & Mishra, 2005b). Consequently, developing a "fast, reliable, teacher-rated survey that [measured] teachers' understanding of each component of the TPACK framework" (Schmidt et al., 2009, p. 128) was necessary to extend research in the TPACK domains. Schmidt et al. (2009) developed a survey instrument that would be used to extend and support preservice teachers' development of TPACK. The *Survey of Preservice Teachers' Knowledge of Teaching and Technology* measured "preservice teachers' self-assessment of the seven knowledge domains included in TPACK" (Schmidt et al., 2009, p. 128). While there is a growing body of TPACK research, Table 1 provides an overview of the specific studies that were examined to guide this research.

Table 1

Selected TPACK Studies

Authors/Year	Participants	Grade	Design	Data Source(s)
Abbitt (2011a)	45 preservice teachers (enrolled in required course)	Pre K	Quantitative	Multiple regression analysis of pre-post survey
Archambault (2011)	596 online teachers	K-12	Quantitative	Survey
Hervey (2011)	91 veteran teachers (1:1 setting)	9-12	Sequential explanatory mixed method	Initial survey, observation and reflection
Jang and Chen (2011)	12 preservice science teachers (enrolled in required course)	9-12	Qualitative	Written assignments, journals and online discussions
Koehler, Mishra and Yahya (2007)	2 groups of faculty and students in a design seminar	Graduate	Mixed method	Observations, artifacts, self-progress surveys and emails
Koh and Divaharan (2011)	74 preservice teachers (first semester of teacher training)	Pre K	Mixed method	End of class reflections and pre-post survey
Nathan (2008)	197 preservice teachers	Pre K-6 and 4-8	Quantitative	Survey
Ozgun-Koca, Meagher, and Edwards (2010)	20 preservice math teachers (enrolled in methods course)	9-12	Mixed method	Surveys and open-ended questions
Schmidt et al. (2009)	124 preservice teachers (end of required technology course)	Pre K-6	Quantitative	Survey

Research relating to TPACK has varied in the last several years. The studies ranged in methods, participants, grade-levels and data types. However, since the *Survey of Preservice Teachers' Knowledge of Teaching and Technology* was developed for early childhood and elementary-level preservice teachers, quantitative research on preservice secondary teachers is limited. This gap in the research directed the course of this study.

Emerging from a series of design experiments, the TPACK framework investigates the ways teachers use knowledge to develop uses of technology in teaching. Many researchers examined this knowledge principal by looking at participants in required methods or technology courses from teacher education programs (Abbitt, 2011a; Jang & Chen, 2010; Ozgun-Koca, Meagher, & Edwards, 2010; Schmidt et al., 2009), by looking at in-service or current classroom teachers (Archambault, 2011; Hervey, 2011), or by looking at graduate students and faculty (Koehler, Mishra, & Yahya, 2007). While the studies varied in methods, many studies found positive results. According to Abbitt (2011a), "The TPACK framework provides a valuable structure for teacher preparation and the ways that technology creates new dynamics in the teaching and learning process" (p. 141). Ozgun-Koca, Meagher, and Edwards (2010) concluded:

> Preservice teachers can certainly develop their technological, pedagogical, and content knowledge separately, but integrating these types of knowledge through the development of their TPK, TCK and TPACK gives them a more holistic view of their teaching and helps them transition from learners of mathematics to teachers of mathematics. (p. 19)

In addition, from the study of a course design seminar, Koehler, Mishra and Yahya (2007) reported, "that given opportunities to thoughtfully engage around the design of an online course, faculty and students alike showed tremendous growth in their sensitivity to the complex interactions between content, pedagogy, and technology" (p. 259). The positive results from the aforementioned studies have strong implications for teaching preservice teachers to integrate technology. However, "there is still much work to do to fully understand the frameworks complexity" (Cox & Graham, 2009, p. 69).

TPACK researchers claim preservice and in-service teachers need to be able to develop a TPACK way of thinking in order to purposefully investigate content topics with technology (Niess, 2011). However, as stated by Graham (2011):

> A strong TPACK framework can also provide theoretical guidance for how teacher education programs might approach training candidates who can use technology in content-specific as well as general ways. However, in order for that potential to be realized, researchers must work together to shore up weaknesses in the clarity of TPACK construct definitions and in articulating ways that the constructs are related to each other. (p. 1959)

Even though many studies have resulted in positive outcomes, the TPACK framework is still questioned by some scholars. For example, while Cox (2008) found the framework beneficial, "the definition of the boundaries between the constructs in the framework have been 'fuzzy'" (Cox, 2008, p. 100). Angeli and Valanides (2008) questioned the uniqueness or newness of the TPACK knowledge and how teachers were supposed to develop this knowledge. Nevertheless, most TPACK researchers agree, additional research is needed to support or rebut claims from past studies.

This research study will attempt to extend the TPACK research on preservice secondary education teachers utilizing a quantitative method. While studies have been conducted utilizing the TPACK framework with regards to secondary education preservice teachers, they primarily utilize qualitative methods. "The *wickedness* [emphasis added] of the problem is contained in this question: How and when do teachers develop this TPACK strategic thinking ability if they have not learned the content with these technologies" (Niess, p. 308)? Examining the preparedness of the secondary preservice teachers at the end of their teacher preparation program was designed to provide insight on whether or not teacher education programs are any closer to solving the wicked problem.

Relationship between Teacher Self-efficacy and Technology Integration

Preparing teachers to use technology in an effective way has led to the development of a variety of approaches to utilize technology in teacher education programs. According to Ertmer and Ottenbreite-Leftwich (2010), "if teachers are going to prepare their students to be technologically capable, they need to have, at the very least, basic technology skills" (p. 259), which may explain the popularity of the required technology course. Eighty-five percent of 4-year degree-granting institutions offer computer skills training courses to their preservice teachers for initial licensure programs (Koh, 2011). "Although knowledge of technology is necessary, it is not enough if teachers do not also feel confident using that knowledge to facilitate student learning" (p. 261). Therefore, whether the approach to integrate technology is infused throughout the teacher education program or by offering a required technology course, the continual challenge is to understand what factors influence "future" teaching practices (Abbitt, 2011).

Albion (1999) suggested, “if teacher education programs are to be effective at increasing teachers’ capability for integrating technology, then decisions about the structure and content of those courses need to be based upon an understanding of factors which contribute to successful technology integration” (Albion, 1999, p. 1603). Various studies have identified factors that influence teachers’ successful technology integration. Ertmer, Ottenbreite-Leftwich, and York (2007) referred to these factors as extrinsic (first-order) and intrinsic (second-order) factors, whereas, Mueller, Wood, Willoughby, Ross, and Specht (2008) referred to these factors as environmental and teacher individual differences. Despite the differing terminology, external factors include access to technology, technical issues, time and support. Internal factors refer to the teachers’ beliefs about pedagogy, computer knowledge (skill level), or self-efficacy beliefs (confidence level). While research indicates that all factors have influenced successful technology integration, preservice teachers’ attitudes, teachers’ beliefs and more specifically, teachers’ self-efficacy have come to the forefront as possible predictors of future technology use in the classroom (Abbitt, 2011; Anderson & Maninger, 2007).

According to Bandura (1982), self-efficacy is “the relationship between knowledge and action” (p. 122). In other words, it is a person’s perception about his or her capability to carry out a course of action required in certain situations. He further explains that, “judgments of self-efficacy also determine how much effort people will expend and how long they will persist in the face of obstacles” (Bandura, 1982, p. 123). Self-efficacy theory suggests that regardless of the accuracy or inaccuracy of a person’s view of his or her ability, the perception will have an influence on future activities (Bandura, 1982). “In general, it is expected that higher self-efficacy beliefs will function as a positive support for action, whereas lower self-efficacy beliefs can have hindering effects on the decision to proceed with a particular course of action" (Abbitt, 2011, p. 136).

Bandura (1982) described four principal influences that are at the basis of self-efficacy judgments. These include (a) enactive [experience], based on authentic mastery experience; (b) vicarious experiences, seeing others perform successfully; (c) verbal persuasion, based on positive reinforcement from others; and (d) physiological state, based on gut feelings in stressful situations. While all four influences are important, Bandura (1982) suggested that authentic mastery experiences provide the most influential source of efficacy information, for "successes heighten perceived self-efficacy; repeated failures lower it, especially if failures occur early in the course of events" (Bandura, 1982, p. 126).

Self-efficacy researchers suggested, "self-efficacy beliefs relating to computer use as well as technology integration into teaching influence a teacher's ability to create learning environments that use technology in meaningful ways" (Abbitt, 2011, p. 137). The question requiring further examination: Are the instructional approaches used by teacher educators enhancing preservice teachers' ability to effectively integrate technology into the classroom?

In order to help teacher educators choose effective methods to prepare preservice teachers to integrate technology, Koh (2011) researched instructional approaches used during a computer skills class throughout one semester. Similar to Bandura's principal influences, results from the study revealed, "technology integration self-efficacy can be fostered as pre-service teachers are developing computer self-efficacy through behavioral modeling and enactive mastery" (Koh, 2011, p. 2398).

Additional studies have found a relationship between self-efficacy and computer use by preservice teachers. For example, Anderson and Maninger (2007) reported, "self-efficacy was the best predictor of intentions to use software" (p. 160). Ertmer and Ottenbreit-Leftwich (2010) stated, "Evidence suggests that self-efficacy may be more important than skills and knowledge among teachers who implement technology in their classrooms" (p. 261). If self-efficacy theory holds true with respect to teachers integrating technology, Bandura's principal sources of self-efficacy could provide an avenue for teacher educators to build programs or curricula. Interestingly, Albion (1999) declared:

> Teacher education [programs], enactive experience and resultant increases in self-efficacy might be achieved through successful experiences with the use of computers during field experience. In practice, variations in the experience and expectations of cooperating teachers and in the availability of equipment make it impossible to ensure that all students will experience the success that build self-efficacy beliefs. (p. 1605)

In other words, Albion concluded that it is the responsibility of teacher education programs to provide the necessary experience to build the self-efficacy required to be competent at integrating technology in the classroom.

Therefore, if preservice teachers' high self-efficacy relating to technology can predict future use of technology, then a possible relationship between preservice teachers' self-efficacy relating to TPACK could provide insight on effective use of technology.

While studies examining the relationship between perceived self-efficacy and TPACK are limited, the few available have revealed positive findings. For example, (Abbitt, 2011) “identified a possible relationship between TPACK and self-efficacy beliefs toward teaching, the study also revealed that the complex nature of this relationship requires further study” (Abbitt, p. 137). Abbitt (2011) concluded:

> In exploring the complex interplay between knowledge and self-efficacy beliefs, it is possible to better use these distinct constructs as both formative and summative measures for revealing the impact of teacher preparation experience on factors that lead to preservice teachers' effective technology integration. (p. 141)

Research indicates that both knowledge and self-efficacy beliefs are useful in understanding the process in developing teachers who make use of technology to create engaging and effective classroom environments (Abbitt, 2011). It is the premise of this study that efficacy beliefs with the TPACK framework could provide evidence on whether current teacher education programs are carrying out the task of better preparing today's teachers to effectively integrate technology.

Summary

Chapter Two provides support to the significance of this study, but also served to navigate the researcher toward an area with limited research. It is apparent from this review that teachers have historically been expected to embrace technology for use in the classroom. However, with the constant state of flux that technology brings, it is continually difficult for teachers to stay abreast on what is current. With growing evidence that technology can increase student achievement, teacher education programs have accepted that technology is an important facet of the preservice teachers' knowledge base. However, the rate of technology change to the teacher education program does not always parallel the rate of technology change in reality. By shifting focus from the technology itself, to the knowledge of the preservice teacher, teacher education programs may be able to successfully prepare teachers for any advancement in technology. "Teachers should come to understand that the various affordances and constraints of technology differ by curricular subject-matter content or pedagogical approach" (Koehler & Mishra, 2008, p. 22). Hence, technology is not one-size fits all. By utilizing TPACK as the theoretical framework in this study, preparedness will not be measured solely on the basis of the preservice teachers' ability to use technology. It allows the researcher to look deeper into the "understanding that emerges from an *interaction* of content, pedagogy, and technology knowledge" (Koehler & Mishra, p. 17).

While technology is not one-size-fits-all, neither are the preservice teachers expected to utilize technology in the classroom. This review describes compelling evidence that there is a dynamic connection between preservice teachers' knowledge and their self-efficacy beliefs with regards to technology integration (Abbitt, 2011). In fact, self-efficacy was found to be an excellent predictor of intentions or future use of technology (Anderson & Maninger, 2007). If preservice teachers' perception of themselves influences future activities, it is conceivable that it may reflect to some extent their level of TPACK preparedness. Consequently, this review indicates that combining the theories of TPACK and self-efficacy in this study will provide an effective measurement of the preparedness of today's preservice teachers to integrate technology into classroom instruction.

CHAPTER 3

METHODOLOGY

The methodology in this study derived from the results and conclusions uncovered in relevant literature. After reviewing the literature relating to levels of Technological, Pedagogical, and Content Knowledge (TPACK) two distinct areas warranted further investigation. First, TPACK studies have predominantly focused on early childhood and elementary preservice teachers, for those levels are what the original survey instrument was intended to measure. In fact, the researcher could not find any large-scale TPACK studies that used secondary preservice teachers as the sample population, and utilized a quantitative method. Secondly, even though studies pertaining to self-efficacy with regards to technology integration are common, studies that investigate the relationship between preservice teachers' self-efficacy and their level of TPACK are very limited. Therefore, it was the intentions of the researcher in this study to complete a larger-scale, quantitative study that investigated secondary preservice teachers' level of TPACK and their level of self-efficacy with regards to technology integration. Utilizing a quantitative method in this study allowed the researcher to gather a large amount of descriptive data to draw conclusions. In order to understand the research design in this study, Chapter Three is organized using the following topics: (1) Past Design Models, (2) Research Design and variables, (3) Participants, (4) Instrument, (5) Procedure, and (6) Data Analysis.

Past Design Models

Prior studies relating to the levels of TPACK were used to develop the research design of this study (e.g., Abbitt, 2011; Archambault & Crippen, 2009; Hervey, 2011;

Nathan, 2009). While these studies varied in method and population, each had similarities to the current study that helped guide the researcher in creating an effective research design. For example, Abbitt (2011) completed an investigation on the relationship between self-efficacy beliefs and TPACK among preservice teachers, but the preservice teachers in his study were early childhood majors enrolled in their student teaching practicum. The research employed quantitative methods, but used a pretest-posttest course design model to evaluate the relationship between research variables. Similar to this study, Abbitt (2011) used a combination of two existing surveys for data collection. In another study, Nathan (2009) also used a combination of two surveys for his research relating to TPACK and self-efficacy, but his conclusions were based on a population of elementary and middle level preservice teachers.

While the review of the literature uncovered two studies that included secondary level teachers, neither examined secondary "preservice" teachers. For instance, Archambault and Crippen (2009) completed a large-scale study that examined TPACK among online k-12 teachers. Similar to this study, the researchers used a modified TPACK survey that applied to the sample population, but modifications made to the survey had to include the online aspect of teaching. Hervey (2011) also made modifications to the TPACK survey to conduct her research. However, her investigation focused on the level of preparedness of secondary "veteran" teachers and employed a mixed-method research design model. In essence, the aforementioned studies helped to develop the model for this research study, for aspects of each were emulated to create the research design in this study.

Research Design and Variables

The purpose of this study was to examine secondary preservice teachers' perceptions of their preparedness to effectively integrate technology into classroom instruction. More specifically, the study examined the relationship between their level of technological, pedagogical and content knowledge (TPACK) and their level of self-efficacy (SE) with regards to technology integration. This descriptive study analyzed the research variables to determine the perceived level of technology preparedness of secondary preservice teachers and examine the relationship between the research variables. The following research questions were examined in this study:

1. What are the perceived levels of technology preparedness of secondary preservice teachers' as described by the TPACK framework?
2. What are the perceived levels of self-efficacy with regards to technology integration of secondary preservice teachers'?
3. What is the relationship between secondary preservice teachers' perceived level of technology preparedness (TPACK) and their perceived level of self-efficacy (SE) with regards to technology integration?

In order to address all of the research questions, this quantitative study employed a descriptive research methodology. The descriptive research design was chosen because it allowed the researcher to describe and depict relationships between variables (Thyer, 2001). The variables for this study were the preservice teachers' perceived level of TPACK and the preservice teachers' perceived level of self-efficacy with regards to technology integration.

Participants

In order to generate a pool of participants for this study, the researcher surveyed secondary preservice teachers from the 14 Pennsylvania State System of Higher Education (PASSHE) universities. These schools were chosen based their long history of training teachers in the Commonwealth of Pennsylvania. The schools include: Bloomsburg University of Pennsylvania, California University of Pennsylvania, Cheyney University of Pennsylvania, Clarion University of Pennsylvania, East Stroudsburg University of Pennsylvania, Edinboro University of Pennsylvania, Indiana University of Pennsylvania, Kutztown University of Pennsylvania, Lock Haven University of Pennsylvania, Mansfield University of Pennsylvania, Millersville University of Pennsylvania, Shippensburg University of Pennsylvania, Slippery Rock University of Pennsylvania, and West Chester University of Pennsylvania. While the names of individual PASSHE schools are public knowledge, the names of the universities that chose to participate in this study were purposely withheld in order to maintain confidentiality and anonymity.

After gaining approval to complete the study from the Institutional Review Board (IRB) at Indiana University of Pennsylvania, the researcher was able to begin the process of securing participants for the study. To obtain a list of potential participants, the researcher invited schools to participate in the study by contacting the Institutional Review Board from each school via US mail and email. Contact information for each school and required documentation was obtained by accessing the university website of each school. One school was immediately eliminated from the pool, for it only offered teacher preparation programs in elementary and early childhood education. Of the 13 remaining schools, nine schools agreed to participate in the study and provided email addresses to all secondary education preservice teachers currently completing their student teaching practicum. A total of 398 preservice teachers were invited to participate in the study. Each potential participant was emailed an invitation to voluntarily participate in the study. In addition to a description of the study, the letter of informed consent (email), contained a link to complete the online survey. Subsequent emails were sent to non-respondents one and two weeks following the initial request. The resulting sample size used in the research study was (n =79).

Instrument

Data collection for this study derived from two existing survey instruments: (a) *Survey of Teachers' Knowledge of Teaching and Technology*, used to measure the level of perceived knowledge in the area of TPACK (Schmidt et al., 2009); and (b) the *Technology Integration Confidence Scale (v2)*, used to measure the level of self-efficacy regarding technology integration (Browne, 2007). Both surveys were available for use under the public domain and were free to use as is or modified. In order to answer the research questions, it was necessary for the researcher to make modifications to both survey instruments. The following sections will describe each survey, scale validity and detail the modifications made by the researcher.

Survey 1. Schmidt et al. (2009) developed the *Survey of Teachers' Knowledge of Teaching and Technology*. Utilizing existing TPACK surveys, the researchers developed a survey that "would measure preservice teachers' self-assessments of the TPACK domains, not their attitudes toward TPACK" (Schmidt et al., 2009, p. 128). These knowledge domains include: technology knowledge (TK), content knowledge (CK), pedagogical knowledge (PK), pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and finally, technological pedagogical content knowledge (TPACK). Developed for use with PK-6 preservice teachers, the researchers created an instrument that would measure the TPACK domains in a less time-consuming, quantitative method. Based on initial research by Koehler and Mishra (2005), the instrument measured preservice teachers' TPACK knowledge by having them evaluate statements using a five-point Likert scale (strongly disagree, disagree, neither agree or disagree, agree, strongly agree). To ensure the development of a valid instrument, the researchers first utilized content-validity experts to analyze the questions. This validation procedure involves "the systematic examination of the test content to determine whether it covers a representative sample of the behavior domain to be measured" (Anastasi & Urbina, 1997, p. 71). The experts provided revisions that resulted in a 75 item survey with 7 subscales. To extend the validity and reliability the researchers tested each subscale for internal consistency using Cronbach's alpha reliability technique. The "Cronbach's alpha is an index of reliability associated with the variation accounted for by the true score of the 'underlying construct'" (Santos, 1999, para. 7). After the initial tests, the researchers eliminated problematic items and conducted Pearson product-moment correlations to examine the relationship between the 7 subscales. The correlations between the subscales were said to be significantly correlated. Final results from the researchers indicated that the survey was "a promising instrument for measuring preservice teachers' self-assessment of the TPACK knowledge domains" (Schmidt et al., 2009, p. 135). The researchers also asserted that it would be reasonable to have a similar survey designed specifically for secondary teachers, and suggested it would be valuable research in the future (Schmidt et al., 2009).

The above analyses indicated that the *Survey of Teachers' Knowledge of Teaching and Technology* was a reliable measure of the TPACK domains. However, since the survey was originally designed for PK-6 preservice teachers, it was necessary to adapt some of the statements to accommodate the representative sample in this study (secondary preservice teachers). For example, subscales from the original survey repeated the question dialog for the content areas of mathematics, literacy, science and social studies, to cover content taught by PK-6 teachers. It was necessary to change the wording of these questions to be less content specific, so secondary preservice teachers could answer the questions. These changes were made in the subscales of content knowledge (CK), pedagogical content knowledge (PCK), technological content knowledge (TCK), and technology, pedagogy and content knowledge (TPACK). Sample modifications made to the survey utilized in Schmidt et. al (2009) are described in Table 2.

According to the Schmidt et. al (2009), "using TPACK as a framework for measuring teaching knowledge could potentially have an impact on the type of training and professional development experiences that are designed for both preservice and in-service teachers" (p. 127). Hence, utilizing a modified *Survey of Teachers' Knowledge of Teaching and Technology* was essential in order to evaluate the research variable in the first research question.

Table 2

Sample modifications to the TPACK Survey utilized by Schmidt et al. (2009)

Original Survey Questions	Modified Survey Questions
CK (Content Knowledge)	*CK (Content Knowledge)*
Mathematics	
1. I have sufficient knowledge about mathematics.	
2. I can use a mathematical way of thinking.	
3. I have various ways and strategies of developing my understanding of mathematics.	1. I have sufficient knowledge about my content area (i.e. chemistry, math, physical education, etc.).
Social Studies	
4. I have sufficient knowledge about social studies.	2. I can use the knowledge of my content area in unique ways.
5. I can use a historical way of thinking.	
6. I have various ways and strategies of developing my understanding of social studies.	3. I have various ways and strategies of developing my understanding of my content area.
Science	
7. I have sufficient knowledge about science.	
8. I can use a scientific way of thinking.	
9. I have various ways and strategies of developing my understanding of science.	
Literacy	
10. I have sufficient knowledge about literacy.	
11. I can use a literary way of thinking.	
12. I have various ways and strategies of developing my understanding of literacy.	

Survey 2. Browne (2007) developed the *Technology Integration Confidence Scale (v2)* (TICS), in order to measure a preservice teachers' the level of self-efficacy with regards to technology integration. According to the researcher, "the survey was intended to measure preservice teachers self-efficacy regarding tasks described in the National Educational Technology Standards for Teachers (NETS-T)" (Browne, 2007, p. 3). Hence, the six subscales of the TICS corresponded to the NETS-T standards. The subscales included: (1) Technology Operations and Concepts, (2) Planning and Designing Learning Environments and Experiences, (3) Teaching, Learning, and the Curriculum, (4) Assessment and Evaluation, (5) Productivity and Professional Practice, (6) Social, Ethical, Legal, and Human Issues. As mentioned earlier in Chapter Two, the NETS-T are the technology standards that were accepted by the National Council for Accreditation of Teacher Education (NCATE). The current influence of the NETS-T on NCATE accreditation contributes to the decision to utilize this survey to evaluate the research variable in the second research question.

"Methods used to gather validity-supporting evidence [for the TICS] included repeated measures ANOVA, regressions analyses, and synthesis of self-efficacy research" (Browne, 2007, Abstract). In addition, in order to test the relevance and representativeness of the TICS, the researcher utilized content-validity experts to rate the relevance of each item to the field of teaching. Additionally, the item response theory (IRT) discovered estimates of item difficulty and established a scoring system. According to the survey creator, "validity is the property of the interpretation or inference drawn from data and not a property of a test, judgments of validity are not necessarily generalizable between purposes and uses of the same instrument or data" (Browne, 2007,

p. 71). Browne (2007) indicated positive validity results with varying purposes, and provided important evidence that supported the assumption that the TICS in fact measured self-efficacy regarding technology integration tasks. Even though the researcher indicated that it was difficult to create a NETS-T-aligned instrument that measured an overwhelming amount of tasks, positive validity assumptions were made based on the judgments of the content-validity experts.

The analysis of the *Technology Integration Confidence Scale* indicated that the survey will evaluate the research variable in research question two. However, the response format (e.g. not confident at all, slightly confident, somewhat confident, fairly confident, quite confident, and completely confident) did not correspond with the response format of the *Survey of Teachers' Knowledge of Teaching and Technology*. In order to create a combined survey with a consistent response matrix, it was necessary to make changes to the existing TICS. After considering the response formats of both survey, it was the decision of the researcher to utilize the five-point Likert response format from the original TPACK survey. While the six-point Likert format of the TICS forced the respondent to make a choice, it was the opinion of the researcher that it was too difficult for the respondent to distinguish between words such as slightly, somewhat and fairly from the original format. Therefore, changing the response format of the TICS to match the five-point Likert scale (strongly disagree, disagree, neither agree or disagree, agree, strongly agree) required the researcher to change from a question format to a statement format similar in the TPACK survey. Table 3 describes three examples of the new format.

Table 3

Modifications to the Technology Integration Confidence Scale utilized in Browne (2007)

Original Format	Modified Format
Your district is rolling out a new technology at each school. They invite representatives from each department to an in-service demonstration. *How confident are you* that you can that you can learn this new technology during the in-service?	Your district is rolling out a new technology at each school. They invite representatives from each department to an in-service demonstration. *You are confident* that you can learn this new technology during the in-service.
The news has recently featured a new on-line program that you think may be helpful in your classes. *How confident are you* that you can learn this new program on my own?	The news has recently featured a new on-line program that you think may be helpful in your classes. *You are confident* that you can learn this new program on my own.
Unfortunately, your school will not be able to afford a computer lab attendant this year. Instead, each teacher will be assigned two lab hours per week. *How confident are you* that you can manage your students' time and activities during these lab sessions?	Unfortunately, your school will not be able to afford a computer lab attendant this year. Instead, each teacher will be assigned two lab hours per week. *You are confident* that you can manage your students' time and activities during these lab sessions.

Combined Survey Validation. After modifications were made, the result was a 65-item survey that did not exceed the length of the original TPACK survey. Taking advantage of Qualtrics (online survey software), the researcher created an online survey that would be completed by the participants (Appendix A). In order to ensure the validity of the new survey, the researcher utilized content-validity experts to analyze each statement in the survey. The panel of experts consisted of eight secondary education teachers who commonly integrated technology in the classroom. The teachers were asked to analyze each statement for readability and how well the statement corresponded to real-world applications. Consistently the panel of experts suggested that two questions be changed to apply to more current technology. In turn, questions 23 and 42 were changed to include more current technology.

In order to ensure the internal consistency of the scale, the researcher used "one of the most common indicators of internal consistency…Cronbach's alpha coefficient" (Pallant, 2010, p. 97). Measures of internal consistency of the combined survey were found to be similar to those previously reported for Survey 1 and Survey 2. The Cronbach's alpha values for the combined survey are reported in Chapter 4.

Procedure

Once the researcher secured site approval through each university's Institutional Review Board, the email addresses of all possible participants were obtained. Via email, the researcher contacted all of the possible participants explaining the focus of the study and supplied a link to complete the online survey (Appendix A). In order to increase the number of participants, the researcher sent subsequent emails one and two weeks after the initial email to encourage participation. In order to complete the online survey hosted by Qualtrics, the participant had to agree to give consent on the form that appeared on the first screen of the survey (Appendix B). Those who did not give consent were automatically exited from the survey. Once the participant completed the survey, a thank you email was automatically generated and sent to the participant (Appendix C). Participants in the study (including universities) remained completely anonymous throughout the study, and no identifiable information was obtained or reported.

Data Analysis

In order to complete a descriptive study that utilized quantitative methods, the researcher prepared the data for analysis. Initial steps in the data analysis phase of this study involved assigning a value to each of the five-point Likert scale categories (1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree and 5=strongly agree). Once scale values were assigned, the data were imported to SPSS, a statistical analysis software package. The following paragraphs will describe the various phases of data analysis. A detailed explanation of each phase results can be found in Chapter 4.

Phase 1. The researcher analyzed the data for missing or incomplete data. This data was essentially removed from the database. Additional error checking techniques from the SPSS software were performed to screen data for mistakes or values that can distort the results of the correlation analysis. Once data were error free, Cronbach's alpha coefficient was conducted to further establish reliability and internal consistency of the combined survey instrument. A demographic profile was also used to familiarize the researcher with the sample. This profile detailed the gender, age and content area of the participants.

Phase 2. Descriptive statistics were used to test the variables in research questions one and two. Descriptive measures included calculating the mean, standard deviation and skewness of the data. Calculating mean values of each subscale of the survey allowed the research to compare the results of this study to relevant literature.

Phase 3. A correlation analysis was used to assist the researcher in identifying any relationships to answer research question three. The Pearson's product-moment correlation (r) was used to explore the relationship between variables from question one and question two. The correlation coefficient provided a numerical summary of the direction and strength of the linear relationship between the variables (Pallant, 2010).

Summary

The research design in this study allowed the researcher to collect valuable information relating to the research variables. Making use of a quantitative method allowed the researcher to gather data on a large number of participants. The descriptive statistics offered a clear picture of the sample population, and provided an avenue for the researcher to examine the relationship between research variables. Chapter 4 will detail the results obtained through the research design discussed in this chapter. The chapter is meant to summarize and analyze the data obtained throughout the study. It will only give minimal interpretation to allow the reader to draw conclusions from the data and match them against the researchers in Chapter 5.

CHAPTER 4

RESULTS

This study was designed to examine secondary preservice teachers' perceptions of their preparedness to effectively integrate technology into classroom instruction. More specifically, the study examined the relationship between their level of technological, pedagogical and content knowledge (TPACK) and their level of self-efficacy (SE) with regards to technology integration. This chapter presents quantitative findings that inform the following research questions:

1. What are the perceived levels of technology preparedness of secondary preservice teachers as described by the TPACK framework?
2. What are the perceived levels of self-efficacy with regards to technology integration of secondary preservice teachers?
3. What is the relationship between secondary preservice teachers' perceived level of technology preparedness (TPACK) and their perceived level of self-efficacy (SE) with regards to technology integration?

The following sections discuss: (1) a profile of the respondents including gender, age ranges, and certification level; (2) information regarding the reliability and validity of the survey instrument; (3) descriptive statistics used to analyze Research Question One; (4) descriptive statistics used to analyze Research Question Two; and (5) results from the Pearson Correlation used to analyze Research Question Three.

Respondent Demographic Data

The participants in this study included 79 secondary student teachers from nine of the Pennsylvania State System of Higher Education (PASSHE) universities. This sample population represented nearly 20% of the 398 enrolled secondary student teachers from the nine participating schools of education. Tables 3 and 4 describe the general characteristics of gender and age of the sample. The gender distribution for the participants was unevenly distributed with 71% females and 29% males. Not unexpected, 77% of the participants ranged from 18-26 years of age, or notably born after 1986.

Table 4
Summary Statistics of Participants by Gender

Response	Frequency	Percent
Female	56	70.9
Male	23	29.1
Total	79	100.0

Table 5
Summary Statistics of Participants' Age

Age Range	Frequency	Percent
18-22	34	43.0
23-26	27	34.2
27-32	9	11.4
33+	9	11.4
Total	79	100.0

While the distribution of respondents to the certification area question included all possible choices, nearly 56% of the participants were from the content areas of English (19%), Social Studies (14%), Math (13%), and Biology (10%).

Table 6

Summary Statistics of Participants' Secondary Education Content Area

Content Area	Frequency	Percent
None Selected	1	1.3
Art	3	3.8
Biology	8	10.1
Business/Computer	6	7.6
Chemistry	2	2.5
Earth Science	3	3.8
English	15	19.0
Family and Consumer Science	3	3.8
Foreign Language	2	2.5
Math	10	12.7
Music/Band	1	1.3
Physics	2	2.5
Physical Education	2	2.5
Social Studies/History/Geography	11	13.9
Special Education and additional content area	9	11.4
Total	79	100.0

TICS/TPACK Survey Reliability and Validity

To measure the participants' knowledge of the TPACK domains and self-efficacy with regards to technology integration, the researcher administered a web-based survey based on two established research scales. The modified TICS/TPACK survey (*Technology Integration Confidence Scale (v2)* and *Survey of Teachers' Knowledge of Teaching and Technology*) consisted of 65 items designed to solicit responses on a 5-point Likert Scale. Of the 65 items, 28 items were intended to measure the participants' confidence level with regards to technology integration, and 37 items measured the participants' knowledge of the TPACK domains. In order to determine the reliability and validity of the modified survey, the researcher utilized one of the most commonly used indicators of internal consistency, the Cronbach's alpha coefficient (Pallant, 2010). According to Pallant (2010), "values above .7 are considered acceptable; however, values above .8 are preferable" (p. 100). As shown in Table 6, Cronbach's alpha values for the TICS sub-scale, the TPACK sub-scale and the combined TICS/TPACK scale ranged from .952 to .967 suggesting adequate internal consistency and reliability for the scale.

Table 7
Cronbach's Reliability Alpha Values for Combined Survey and Subscales

Scale	Cronbach's Alpha	Cronbach's Alpha BSI	N
TICS Sub-scale	.952	.952	28
TPACK Sub-scale	.958	.965	34
TICS/TPACK Combined Scale	.967	.970	62

Note: BSI=Based on Standardized Items

Research Question One

What are the perceived levels of technology preparedness of secondary preservice teachers as described by the TPACK framework?

In order to measure the participants' perceived knowledge of the TPACK domains, the researcher first analyzed the mean scores, standard deviation, and skewness for each of the subscales. As reported in Table 7, the mean scores for each of the subscales ranged from 4.17 to 4.58. Skewness values were included to analyze the symmetry of the distribution. Negative skewness values for each subscale indicated a clustering of values near the high end of a skewness graph. In other words, when using a scale ranging from strongly disagree (1) to strongly agree (5), the respondent data was clustered toward strongly agree.

Table 8
Summary Statistics of TPACK Subscales (N=79)

Sub-Scale	Min.	Max.	Mean	SD	Skewness
Technology Knowledge	1.86	5.00	4.17	.770	-.963
Content Knowledge	3.00	5.00	4.58	.572	-1.095
Pedagogical Knowledge	3.00	5.00	4.42	.562	-.603
Technology Pedagogical Knowledge	2.40	5.00	4.26	.708	-.679
Technology Pedagogical Content Knowledge	2.00	5.00	4.35	.678	-.927
Pedagogical Content Knowledge	3.00	5.00	4.37	.626	-.472
Technology Content Knowledge	2.00	5.00	4.48	.754	-1.633

After the initial analysis of the mean scores, the researcher ran an independent t-test in order to compare the mean scores for groups of participants. T-test results compared each subscale with gender and age demographics. T-test results based on age showed no significant difference in the mean scores. Table 8 provides a summary of t-test results comparing TPACK subscales for males and females.

According to the t-test results, technology knowledge (TK) was the only TPACK subscale to have a significant difference in mean scores when comparing males and females. Technology knowledge t-test values were as follows: males (M = 4.50, SD = .48) and females (M = 4.03, SD = .83; t (77) = -2.549, p = .013, two-tailed). Eta squared effect size statistics were calculated to provide a magnitude of the differences between males and females. The magnitude of the differences in the means (mean difference = -.47, 95% *CI*: -.84 to -.103) was found to have a moderate effect (eta squared = .08).

Table 9
Summary of Means Grouped by Gender

Subscale	Gender	N	Mean	SD
Technology Content Knowledge	Female	55	4.40	.83
	Male	22	4.68	.48
Technology Knowledge	Female	56	4.03	.83
	Male	23	4.50	.48
Content Knowledge	Female	56	4.55	.59
	Male	23	4.63	.55
Pedagogical Knowledge	Female	56	4.47	.56
	Male	22	4.28	.54
Technology Pedagogical Knowledge	Female	56	4.25	.75
	Male	23	4.28	.61
Technology Pedagogical Content Knowledge	Female	56	4.33	.71
	Male	23	4.38	.59
Pedagogical Content Knowledge	Female	56	4.45	.63
	Male	22	4.18	.59

Figure 3 represents data obtained from questions 63-65 of the survey instrument. In this portion of the survey, participants were asked to choose the appropriate percentage that matched the following statements:

Question 63: In general, approximately what percentage of your teacher education professors have provided an effective model of combining content, technologies and teaching approaches in their teaching?

Question 64: In general, approximately what percentage of your professors outside of teacher education have provided an effective model of combining content, technologies and teaching approaches in their teaching?

Question 65: In general, approximately what percentage of the 9-12 cooperating teachers have provided an effective model of combining content, technologies and teaching approaches in their teaching?

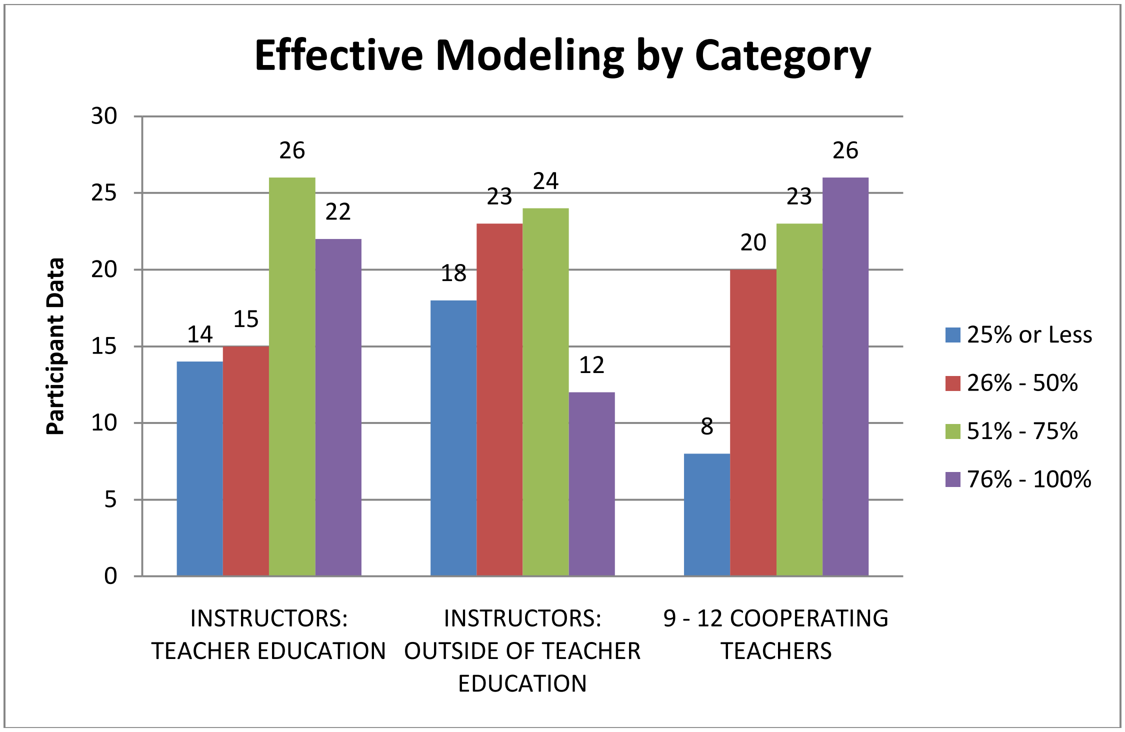

Figure 3. Graphical representation of the data obtained by participants for scale questions 63-65. Approximate percentage of effective modeling by professional groups.

Data from these questions reveal a high percentage of cooperating teachers and teacher education instructors provided effective modeling throughout the teacher educational program, but a large percentage of instructors outside of education did not provide effective modeling.

Summary of Research Question One

An analysis of Research Question One indicated that the preservice teachers in this study have a high-level of technology preparedness. Even though the t-test revealed a significant difference between males and females with regards to technology knowledge

(TK), mean scores for each group still reveal a high-level of technology preparedness. In addition, an examination of the Models of TPACK portion of the survey brings to light evidence relating more specifically to the teacher education program. Preservice teachers revealed that professors from their education program and cooperating teachers from their field work provided effective modeling of technology pedagogy. Implications from these results will be discussed in Chapter 5.

Research Question Two

What are the perceived levels of self-efficacy with regards to technology integration of secondary preservice teachers?

In order to answer Research Question Two, the researcher conducted tests comparable to those employed to inform Research Question One. To measure the participants' perceived self-efficacy, the researcher analyzed the mean scores, standard deviation, and skewness for the confidence scale. As reported in Table 9, the mean score for the confidence scale was (M=4.43). Skewness values were included to analyze the symmetry of the distribution. Negative skewness values for each subscale indicate a clustering of values near the high end of a skewness graph. In other words, when using a scale ranging from strongly disagree (1) to strongly agree (5), the respondent data was clustered toward strongly agree. These results indicate that the participants in this study have a high-level of technology confidence.

Table 10
Summary Statistics of the Technology Integration Confidence Scale (N=79)

Scale	MIN	MAX	Mean	SD	Skewness
Confidence Scale	2.61	5.00	4.43	.52	-1.21

A t-test was run to compare the confidence scale with gender and age demographics. Again, t-test results based on age showed no significant difference in the mean scores. However, t-test results comparing males and females were found to have a significant difference. Confidence scale t-test values for males was (*M* = 4.64, SD = .33) and females was (*M* = 4.35, SD = .56; *t* (77) = -2.302, *p* = .024, two-tailed). The magnitude of the differences in the means (mean difference = -.29, 95% *CI*: -.53 to -.039) was found to have a moderate effect (eta squared = .06).

Summary of Research Question Two

An analysis of Research Question Two indicated that the preservice teachers in this study have a high level of confidence with regard to technology integration. Similar to Research Question One, the t-test revealed a significant difference between males and females when comparing confidence levels of the group. However, these group results do not outweigh the overall high level of technology integration confidence the participants disclosed. Implications from these results will be discussed in Chapter 5.

Research Question Three

What is the relationship between secondary preservice teachers' perceived level of technology preparedness (TPACK) and their perceived level of self-efficacy (SE) with regards to technology integration?

In order to answer Research Question Three, the researcher conducted a correlation analysis to describe the strength and direction of the linear relationship between the variables (Pallant, 2010). To explore the relationship between the preservice teachers' perceived level of technology preparedness (TPACK) and their perceived level of self-efficacy (SE), the Pearson product-moment correlation coefficient (r) was calculated for each subscale. "A perfect correlation of 1 or -1 indicates that the value of one variable can be determined exactly by knowing the value on the other variable" (Pallant, 2010, p. 128). Table 10 provides a summary of the Pearson product-moment correlation coefficients.

Table 11
Summary of Correlation Values By TPACK and Confidence Scale

	Confidence Scale		
	Pearson Correlation (r)	Sig. (2-tailed)	N
Technology Content Knowledge	.53**	.000	77
Technology Knowledge	.47**	.000	79
Content Knowledge	.32**	.004	79
Pedagogical Knowledge	.30**	.008	78
Pedagogical Content Knowledge	.36**	.001	78
Technology Pedagogical Knowledge	.35**	.002	79
Technology Pedagogical Content Knowledge	.39**	.000	79

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

Pearson product-moment correlations between the confidence scale and subscales of the TPACK domains indicate a positive correlation between the variables ranging from .30 to .53. According to guidelines in Pallant (2010), interpretations on the strength of the relationship range from small (r = .10 to .29), to medium (r = .30 to .49) to large (r = .50 to 1.0). Hence, the r values indicate the strongest relationship between Technology Content Knowledge (TCK) and self-efficacy, and the weakest relationship between Pedagogical Knowledge (PK) and Self-efficacy. The investigation exposed a relationship between all levels of the TPACK and SE. More specifically, the correlation relationships between TPACK and SE are ranked (strongest to weakest) as follows: (1) Technology Content

Knowledge (TCK), (2) Technology Knowledge (TK), (3) Technology Pedagogical Content Knowledge (TPACK), (4) Pedagogical Content Knowledge (PCK), (5) Technology Pedagogical Knowledge (TPK), (6) Content Knowledge (CK) and (7) Pedagogical Knowledge (PK).

Summary of Research Question Three

An analysis of Research Question Three indicated a positive relationship between self-efficacy and all of the subscales of the TPACK domain. Values from the Pearson product-moment correlation indicated a medium level of strength for all of the values, but domains that included technology were predominantly ranked at a higher strength level. Implications from these results will be discussed in Chapter 5.

Summary of Findings

This chapter presented a summary and analysis of quantitative data obtained throughout this study. Collected from 97 survey respondents (student teachers) from any of the nine participating Pennsylvania State System of Higher Education universities, this data was used to better understand the preparedness of preservice teachers to integrate technology into the secondary classroom. After careful statistical analysis of the three research questions, the following results stand out to be the most significant:

1. Preservice teachers from this sample have a high perceived level of knowledge in each of the subscales of the domains.
2. Age of the participants had no significance in relationship to TPACK domains.
3. Gender had a moderate significance in the TK domain, with males rating higher than females.

4. Participants revealed that a higher percentage of teacher education instructors and cooperating teachers use effective modeling than teachers outside of teacher education.
5. Preservice teachers from this sample had high-levels of perceived self-efficacy.
6. Age of the participants had no significance in relationship to self-efficacy.
7. Gender had a moderate significance when comparing group mean scores, with males rating higher than females in confidence levels.
8. Statistics revealed that there is a relationship between self-efficacy and all of the TPACK domains.
9. The r values indicated that self-efficacy had the strongest relationship with TCK and the weakest relationship with PK.
10. When ranking r values, subscales that blend with technology (TCK, TPK, and TPACK) were among those having the highest correlation with self-efficacy.

The analysis of data from each section was meant to provide enough information to answer the research questions. This information will be used in Chapter 5 to draw conclusions and match them against prior studies.

CHAPTER 5

IMPLICATIONS AND RECOMMENDATIONS

"The ever-changing nature of technology has made the knowledge-base for technology a moving target in terms of its relationship with teachers' ability to successfully integrate technology into classroom practices" (Abbitt, 2011a, p. 134). The continued need for better-prepared preservice teachers has created an ongoing challenge for colleges of education to increase the technology skills of teacher candidates. While research indicates that teachers who are more prepared to use technology are more likely to integrate technology in the classroom (Franklin, 2008), effective use of technology is not always the case. Hence, this finding supports important questions that form the foundation of this study. Are teacher education programs preparing teachers to become familiar with today's emerging technologies, and are they helping these preservice teachers develop strategies that will enable them to effectively integrate these technologies in the classroom? In an attempt to answer these questions, this chapter will provide: (1) a summary of the study, (2) a discussion of each of the research questions, and (3) implications and recommendations.

Summary of the Study

The purpose of this study was to examine secondary preservice teachers' perceptions of their preparedness to effectively integrate technology into classroom instruction. More specifically, the study examined the relationship between their level of technological, pedagogical and content knowledge (TPACK) and their level of self-efficacy (SE) with regards to technology integration. While it is often thought that today's teacher education graduates (digital natives) are more prepared to teach in the 21st century, assumptions cannot be made on their confidence level and capabilities to effectively integrate technology into the classroom (Albion, Finger & Jamieson-Proctor, 2010). This study was rooted on the premise that preservice teachers "being able to use technology does not necessarily mean being able to use technology critically, wisely, or meaningfully" (Lie, 2009, p. 88).

Two theories formed the theoretical base of this study: (1) technological, pedagogical and content knowledge (TPACK), and (2) self-efficacy (SE). Utilizing these theories enabled the researcher to study the preparedness of secondary preservice teachers to effectively integrate technology into the classroom. In order to examine this preparedness, the researcher first measured the preservice teachers' level of TPACK and their level of SE with regards to technology and then looked for a possible relationship between the components.

To analyze each component and its possible relationship, a quantitative methodology was used to answer the following research questions: (1) What are the perceived levels of technology preparedness of secondary preservice teachers' as described by the TPACK framework?; (2) What are the perceived levels of self-efficacy with regards to technology integration of secondary preservice teachers?; and (3) What is the relationship between secondary preservice teachers' perceived level of technology preparedness (TPACK) and their perceived level of self-efficacy (SE) with regards to technology integration? Quantitative data was collected from 79 of the 398 preservice (student) teachers attending one of the nine PASSHE universities participating in the study. The online survey derived from two existing survey instruments: (a) *Survey of Teachers' Knowledge of Teaching and Technology*, used to measure the level of perceived knowledge in the area of TPACK (Schmidt et al., 2009); and (b) the *Technology Integration Confidence Scale (v2)*, used to measure the level of self-efficacy regarding technology integration (Browne, 2007). These surveys were modified by the researcher to be geared specifically toward secondary education student teachers. Cronbach's reliability alphas were calculated for the modified instrument in order to ensure internal consistency and reliability for the scale. Descriptive statistics were used to analyze Research Questions One and Two, and a Pearson Correlation analysis was used to examine Research Question Three. Quantitative results for each research question were detailed in Chapter 4 and are discussed fully in the following sections. In addition, the survey instrument provided an option for participants to offer comments. While this study is primarily quantitative, the following synopsis will include comments that support or explain the outcomes of the research questions.

Discussion of Research Questions

Research question one. *What are the perceived levels of technology preparedness of secondary preservice teachers as described by the TPACK framework?* The first research question examined the perceived levels of technology preparedness of secondary preservice teachers as described by the TPACK framework. As discussed in Chapter 2, the seven domains of the TPACK framework include: (1) CK - Content Knowledge; (2) PK – Pedagogical Knowledge; (3) TK – Technology Knowledge; (4) PCK – Pedagogical Content Knowledge; (5) TCK – Technological Content Knowledge; (6) TPK – Technological Pedagogical Knowledge; and (7) TPACK – Technological Pedagogical Content Knowledge. Analysis of these domains was used to evaluate the preservice teachers' ability to effectively integrate technology. Initial descriptive statistics revealed negative skewness values, with mean scores for each subscale ranging from 4.17 to 4.48. Overall, these mean score values indicate that preservice teachers have a high-level of knowledge in each of the subscales of the TPACK domain.

A t-test analysis was completed in order to compare the mean scores for groups of participants. The t-test showed no significant difference in the mean scores based on age. However, when comparing gender, the t-test revealed technology knowledge (TK) for males was significantly higher than females. The mean scores for males was (M = 4.50) and females was (M = 4.03). Eta squared effect size statistics indicated this difference was moderate in magnitude.

Questions 63-65 of the survey instrument asked participants to choose what percentage of their teacher education professors, professors outside of teacher education, and cooperating teachers in grades 9-12 provided effective modeling. Teachers who provided effective modeling were described as those who combine content, technologies and teaching approaches in their teaching. Results for participants who chose ranges above 51% were ranked as follows: (1) 64%, cooperating teachers; (2) 62%, teacher education; and (3) 47% outside instructors. Therefore, a high percentage of participants believe that both teacher education instructors and cooperating teachers' practice effective modeling. While effective modeling was not one of the seven TPACK domains measured in this study, it was included in the survey because it is found to be a significant factor in predicting future technology use by preservice teachers. For example, Gong and Lambert (2010) found that "preservice teachers need to see models of technology integration throughout their schooling" (p. 67). Also, Angeli (2004) found that "student teachers will be able to effectively develop the competencies needed to teach with technology only when teacher educators systematically infuse technology throughout the teacher education curriculum" (p. 395).

Results from the statistical analysis of Research Question One indicate that a large percentage of the participants rate their knowledge of the TPACK domains as high. These high values indicate a large percentage of the preservice teachers in this sample are prepared to effectively integrate technology. While all levels of the subscale are rated highly, it is worth noting that TK was the subscale with the lowest mean score. In addition, analysis of the mean scores by gender indicated a significant difference between male and female preservice teachers with respect to TK. This finding mirrors that of a previous study by Albion, Finger and Jamieson-Proctor (2010).

"Furthermore, when teachers witness how technology facilitates student success, confidence also increases" (Ertmer & Ottenbreit-Leftwich, 2010, p. 261). This notion highlights the positive findings relating to effective modeling. Preservice teachers in this study rated their teacher education professors and their cooperating teachers much higher than their professors outside of education. Hence, the statistical analysis revealed that preservice teachers are prepared for effective technology integration, and teacher education programs are taking an active role in better preparing preservice teachers to integrate technology into the classroom.

Research question two. *What are the perceived levels of self-efficacy with regards to technology integration of secondary preservice teachers?* The second research question examined the perceived levels of self-efficacy with regards to technology integration of secondary preservice teachers. Initial statistical analysis resulted in a high mean score (M = 4.43) and a negative skewness value (-1.21). These values provide evidence for the perceived high self-efficacy levels among participants. Corresponding to Research Question One, a t-test analysis was compiled in order to compare the mean score for groups of participants. T-test results comparing gender found a significant difference in mean scores for males at (M = 4.64) and females at (M = 4.35). Eta squared effect size statistics indicated this difference was moderate in magnitude.

Consequently, descriptive statistics for question two indicate a high-level of self-efficacy among participants, yet males in this sample have moderately higher perceived self-efficacy levels than females. Interestingly, Research Question Two again showed t-test results for age as having no significant difference when analyzing the mean scores. The high percentage of participants (77%) born after 1986 may support the notion that "digital natives" are likely to be more prepared to utilize technology in the classroom. Several comments submitted by the participants confirm the digital native notion. For example, one participant stated:

> Because my age group has grown-up hand in hand with the Internet, I believe that I am plenty more aware of the technologies that are out there compared to anyone older than me; and that is without taking seminars or trainings. We are able to pick up software whether it's ActiveInspire, Excel, YouTube, Adobe, and Word, and master it in maybe an hour with just self-discovery.

Another participant stated:

> The only reason I feel capable of using technologies is that my generation grew up with computers, phones, etc. While I do not have direct knowledge about a large variety of different technologies, I know that I will be able to learn the

programs quickly. One of my professors taught us about SMARTboards, Photoshop or any other art related technological program.

Results from Research Question Two indicated a high-level of perceived self-efficacy with regards to technology integration for the participants. "Evidence suggests that self-efficacy may be more important than skills and knowledge among teachers who implement technology in their classroom" (Ertmer & Ottenbreit-Leftwich, 2010, p. 262). Therefore, while males rate their confidence level higher than females in this sample, the overall analysis indicated positive findings for future technology use by the participants.

Research question three. *What is the relationship between secondary preservice teachers' perceived level of technology preparedness (TPACK) and their perceived level of self-efficacy (SE) with regards to technology integration?* The third research question examined a possible relationship between secondary preservice teachers' perceived level of technology preparedness (TPACK) and their perceived level of self-efficacy (SE) with regards to technology integration. Pearson product-moment correlations between the confidence scale and subscales of the TPACK domains provide evidence of a positive correlation between all research variables. The r values indicated the strongest relationship between Technology Content Knowledge (TCK) and self-efficacy, and the weakest relationship between Pedagogical Knowledge (PK) and self-efficacy. Nevertheless, ranking the r values in order indicated subscales that were blended with technology (TCK, TPK, and TPACK) were among those having the highest correlations with self-efficacy. Similar results were reported in prior studies. Abbitt (2011) suggested, "Specific knowledge of the intersections between knowledge of technology and the other two knowledge domains support higher self-efficacy beliefs about technology integration" (Abbitt, 2011, p. 140). While finding a weaker relationship, Nathan (2009) also reported "a moderate relationship between the respondents' levels of technology integration self-efficacy…and their levels of technology integration knowledge [TPACK domains]" (p. 64).

Results from Research Question Three provide evidence that there is a positive relationship between preservice teachers' perceived self-efficacy and their perceived level of technology preparedness. Hence, both knowledge of the TPACK domains and self-efficacy are likely to influence the success of preservice teachers' ability to effectively integrate technology into the classroom.

Overall, the results indicate that preservice teachers from this sample are prepared to integrate technology into the classroom. The first indicator was the high self-efficacy levels, which are believed to be a predictor of future technology use. The second indicator was the high levels of knowledge of the TPACK domains, a framework for effective technology integration. However, it is not as readily apparent whether the preparedness of the teachers was directly related to the teacher education programs, or the age of the participants (digital natives). It is possible that the effective modeling from the teacher educators and cooperating teachers played a part in the positive results. In essence, the positive results indicated that the secondary teachers from this study are prepared to effectively integrate technology in the classroom. Nevertheless, before making conclusions based on the data presented in this study one must consider the limitations that are discussed in the next section.

Limitations

Several limitations to this study should to be acknowledged. First and foremost, the sample size of this study was relatively small (n=79). Therefore, making generalizations based on this group is limited. Second, this study was limited to secondary preservice teachers from nine participating PASSHE universities in Pennsylvania. It cannot be assumed that the results of this study will coincide with results from universities in different parts of the country. Third, in order to protect the identity of universities and individual participants, the researcher could not identify where the preservice teachers were enrolled. Hence, there is no way of knowing if the sample population was predominately from one university or evenly distributed throughout the nine universities. Fourth, the information gathered from the participants was based on their perceptions. Therefore, the self-reported data is limited to the respondents' ability to formulate an accurate evaluation of themselves. Lastly, this study is primarily descriptive in nature, and the quantitative data does not measure actual technology use, or can it fully predict future technology use by the participants.

While there were several limitations to consider in this study, they should not take away from the positive outcomes determined by this sample of participants. That being the case, the following section will provide suggestions on how these results can be utilized in the future.

Implications and Recommendations

The research questions were intended to present evidence on whether teacher education programs are preparing preservice teachers to effectively integrate technology into the secondary classroom. In addition, it was the intention of the researcher to provide a unique body of research with respect to TPACK framework. Findings from this investigation have implications for teacher education programs, and recommendations for future research in the area of technology integration.

Teacher education programs. "Technology integration (the act of including technology in teaching) is not a new phenomenon" (Koehler & Mishra, 2008, p. 6). However, teacher education programs have faced continuous challenges preparing preservice teachers to integrate technology into the classroom. Early attempts to prepare preservice teachers focused primarily on preparing teachers to use technology, with the premise that they would in-turn utilize the technology in the classroom. However, rapid developments in technology make it difficult for colleges of education to keep up with all of the modern technology. The spiral-like development of the TPACK framework deviates from specific technologies and requires that teachers be open to all technology and aware that these technologies come with pedagogical benefits and restrictions (Koehler & Mishra, 2008). Preservice teachers who have an understanding of the TPACK framework are able to differentiate between technologies that will enhance student learning.

Finding that participants revealed high knowledge levels of the TPACK framework is a good indicator that this group of preservice teachers are better prepared to integrate technology in the classroom. Hence, if teacher education programs are not designed to enhance experiences that allow preservice teachers to develop strategic thinking about technology, changes should be made to improve preservice teacher development. "[Preservice teachers] need to be given sufficient opportunities during their training to develop adequate pedagogical reasoning and to become more confident and competent in infusing technology in their teaching" (Angeli, 2004, p. 396).

Research indicates that preservice teachers who have opportunities to use technology as an instructional tool are more likely to use technology to facilitate learning in their future classrooms (Ertmer & Ottenbreit-Leftwich, 2010). However, providing experience and opportunities to teacher candidates is not only accomplished in the college classroom. Consider the following comments from the participants in this study:

1. I did not have any classes on instructional technology and learned about smart board technologies from my student teaching cooperative teachers.
2. SMARTboards are becoming more and more common in the general classroom. They are great tools for any classroom and the students seem to enjoy them because they offer interaction that is different than the basic PowerPoint. My university does not have any SMARTboards and I had to learn this during one of my field experiences.
3. I was not that prepared with using a smart board but once I got into the classroom I learned it very quickly and I am learning new tools every day for it.

The teacher education field experiences and student teaching experience play a major role in the preservice teachers' ability and willingness to use technology. However, technology use in schools varies because of availability of technology and willingness of the cooperating teacher to use technology. Universities need to be proactive when selecting schools that provide field experiences to ensure the cooperating teachers are providing the kind of experience that improves the technology integration abilities of its candidates. Effective collaboration between K-12 schools and universities would be essential to accomplish this task.

Other positive results from this study are the high levels of perceived self-efficacy by the participants. As mentioned earlier, self-efficacy is said to be one of the most important variables in predicting future technology use (Ertmer & Ottenbreit-Leftwich, 2010), and personal mastery and vicarious experiences is the most powerful source of improving the confidence level (Bandura, 1977). By ensuring effective field experiences in the teacher education program, the university would play a major role in increasing the self-efficacy levels of the students with regard to technology integration.

Teacher education programs face an upward climb trying to keep up with the constant changes in technology. However, by focusing on how technology is infused into the university program, and what hands-on experiences the preservice teachers are provided, universities will create a program that will withstand technology advancements.

Recommendations for future research. One purpose of this study was to provide a unique body of research measuring the development of TPACK in preservice teachers. Hence, the researcher modified the original TPACK survey instrument to complete a study specifically pertaining to secondary preservice teachers and investigate the relationship between self-efficacy and TPACK among preservice teachers. Findings from this study indicate that preservice teachers are prepared to effectively integrate technology in the classroom. However, a mixed-method or longitudinal study would provide more evidence to support these results. Also, future studies relating to secondary preservice teachers and TPACK would benefit from quantitative survey results that are blended with an assessment rubric that would evaluate actual technology use by the participants. For example, while designed for elementary and early childhood, the Technology Integration Assessment Rubric could complement the modified survey from this study (Abbitt, 2011). In any case, it is necessary to observe preservice teachers and evaluate if these teachers are actually using technology effectively in the classroom. Not only would this type of study provide evidence on technology preparedness, but also validate the results obtained through the use of the modified TPACK survey.

Summary

Integrating technology into the classroom has been an enduring topic in the field of education for decades. While the technology types may have changed from slide projectors and calculators to laptops and smart phones, preparing preservice teachers to integrate technology in the classroom is a constant in teacher education programs. The pace at which technology advances has forced teacher educators to reconsider how to better prepare future teachers. Attention has shifted from preservice teacher awareness of specific technologies to preparing teachers who can effectively evaluate technologies for use in the classroom. In spite of reports that today's preservice teachers are not prepared to effectively integrate technology into the classroom, evidence from this study revealed the opposite.

First, the quantitative data from Research Question One indicated that preservice teachers have extensive knowledge of all the TPACK domains. If the TPACK framework is considered the knowledge that preservice teachers need to effectively utilize technology, then the participants in this study are prepared to combine technology, pedagogy, and content knowledge to advance student achievement. Many teacher education programs have supported the use of the TPACK framework as a necessity in preparing future teachers. However, this research did not investigate specific educational technology models utilized at each university.

Second, even though the descriptive data does not provide evidence specifically relating to the teacher education programs and the TPACK model, it is clear that the preservice teachers from these programs are effectively prepared to integrate technology into the classroom. However, descriptive results from the survey relating to effective modeling do provide evidence that teacher education programs may play a part in the preparedness of these preservice teachers. Survey results revealed that the teacher educators throughout their program, and cooperating teachers during student teaching, were highly effective at modeling the use of technology in the classroom. In essence, the modeling of technology use throughout the teacher education program increases the confidence level of the student to utilize technology in the future. In turn, preservice teachers from these programs are effectively prepared to integrate technology.

Third, quantitative data from Research Question Two indicated that the sample population is not only prepared to effectively integrate technology, but also has high levels of self-efficacy with regards to technology integration. While modeling may play a role in the confidence level of the participants, so could the age of the participants who were predominately considered digital natives. Regardless of the origin, high self-efficacy levels of the participants indicated that these preservice teachers are confident with regards to integrating technology.

Lastly, the investigation of Research Question Three revealed a correlation between all levels of the TPACK framework and self-efficacy. However, specific TPACK domains that were blended with technology (TCK, TPK, and TPACK) were ranked higher. These results provide evidence that there is a positive correlation between the participants' level of technology preparedness (TPACK) and their level of self-efficacy (SE) with regards to technology integration. Although knowing how to use technology does not ensure effective technology integration by preservice teachers, not know how to use technology my diminish confidence levels and the actual use of technology in the classroom.

While the source of the high levels of knowledge in the TPACK domains or the high levels of self-efficacy is not clear from this research, the correlation between the two is more evident. More importantly, the overall results from this study revealed that teachers from these teacher education programs are familiar with today's emerging technologies, and have gained the knowledge to effectively integrate technology in the classroom.

While one could argue whether the preparedness of these preservice teachers is directly related to improvements in teacher education programs or the prior technology experience of the participants, the outcomes are optimistic. These positive results provide a picture of what could be an upward trend in the future. Additional research with varying methods will validate this trend. However, more important than the encouraging outcomes from the study are the positive increases in student achievement that can result from these better-prepared teachers.

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Appendix A
Survey Instrument

Preservice Teacher Technology Survey

Link to Online Survey:
https://iup.qualtrics.com/SE/?SID=SV_3CWK1gQFGj46okc

Note: The following pages are a preview of the questions on the survey. To better understand the constructs of the survey, use the link above to preview the survey.

Instructions:

Thank you for taking time to complete this questionnaire. Please answer each question to the best of your knowledge. Your thoughtfulness and candid responses will be greatly appreciated. Your identity will not at any time be associated with your responses or your university. Your anonymous responses will be kept completely confidential and will not influence your academic standing in any way.

What is your secondary education content area?

- ❍ None Selected
- ❍ Art
- ❍ Biology
- ❍ Business/Computer
- ❍ Chemistry
- ❍ Earth Science
- ❍ English
- ❍ Family and Consumer Science
- ❍ Foreign Language
- ❍ Math
- ❍ Music/Band
- ❍ Physics
- ❍ Physical Education
- ❍ Social Studies/History/Geography
- ❍ Special Education and additional content area
- ❍ Speech/Theater
- ❍ Technology Education

Gender

- ❍ Female
- ❍ Male

Age Range

- ❍ 18-22
- ❍ 23-26
- ❍ 27-32
- ❍ 33+

Items 1 through 6 refer to the image (Window A).

Window A

Read each statement. Using the scale* from strongly disagree to strongly agree, rate your confidence level at this moment and without any further instruction or practice to accomplish the tasks they propose.

1. **I am confident that I can identify the sound file in Window A.**
2. **I am confident that I can identify the graphic/image files in Window A.**
3. **I am confident that I can identify the word processing document in Window A.**
4. **I am confident that I can open, edit, and save the file named "grades.xls" in Window A.**
5. **I am confident that I can delete the file named "refs.doc" in Window A.**
6. **I am confident that I can rename the document "index.html" in Window A.**

* Participants will respond to each statement using a Likert-Type scale. The scale includes: Strongly Disagree, Disagree, Neither Agree or Disagree, Agree, and Strongly Agree

Directions: Read each statement. Using the scale* from strongly disagree to strongly agree, rate your confidence level at this moment and without any further instruction or practice to accomplish the tasks they propose. (Although the statements are worded as if you were already teaching, rate your confidence regarding each as it is at this moment. Project your beliefs based on your current knowledge or confidence level.)

7. Your district is rolling out a new technology at each school. They invite representatives from each department to an in-service demonstration. You are confident that you can learn this new technology during the in-service.

8. The news has recently featured a new on-line program that you think may be helpful in your classes. You are confident that you can learn this new program on my own.

9. Unfortunately, your school will not be able to afford a computer lab attendant this year. Instead, each teacher will be assigned two lab hours per week. You are confident that you can manage your students' time and activities during these lab sessions.

10. A member of the PTA believes there is too much technology in the school and states that not all technologies are equally applicable to your classroom and not all student learning goals are well suited for technology. You are confident that you can effectively judge when and how to use technology to support your students' learning.

11. Your school assigns each class one computer lab period every two weeks. You are confident that you can create lesson plans that effectively use the lab time for student learning.

12. A teacher in another subject has found an article that claims students learn more when they use a certain computer program. You are confident that you can identify the information in the article that applies to my classes.

* Participants will respond to each statement using a Likert-Type scale. The scale includes: Strongly Disagree, Disagree, Neither Agree or Disagree, Agree, and Strongly Agree

Please rate the following statements by choosing strongly disagree to strongly agree:

13. An educational software vendor gives a sales pitch to your department. You are confident that you can evaluate their products for its suitability to your teaching environment.

14. A vice principal is upset that the new equipment that was donated to the school is not being used. She asks if you can demonstrate how to use it at the next in-service meeting. You are confident that you can accomplish this task.

15. Your district has allocated money to purchase educational technology products for your subject/grade. The board has asked for input to help them decide between two competing products. You are confident that you can advise them on this purchase by evaluating the products for its suitability to your teaching situation.

16. Your principal promises full support for any technology that can be linked to the state's core curriculum standards. You are confident that you can find technologies that will help meet these standards in your subject.

17. Current educational practice stresses 'higher order' thinking skills such as analysis, synthesis, and evaluation. You are confident that you can use technology to improve these skills in your students.

Please rate the following statements by choosing strongly disagree to strongly agree:

18. Thanks to a grant from the state, your classroom now has three computers, a video camera, and a digital camera. You are confident that you can integrate some or all of these technologies into your teaching.

19. Your students are using the Internet to research a topic. You are confident that you can provide them with a list of high quality, trustworthy websites to get them started.

20. The state has created a website where teachers can download test questions that have been written to the state's core curriculum in every subject. You are confident that you can use these questions to track your students' learning.

21. Your students use computers to complete several assignments during the year. You are confident that you can grade both the final product of these assignments and the students' use of the technology.

22. In preparation for a performance review with an administrator, you are asked to critically evaluate several aspects of your teaching, including your use of technology in class. I am confident that I can accurately do so.

Please rate the following statements by choosing strongly disagree to strongly agree:

23. A speaker from the state Department of Education declares that effective teachers are also life-long learners, and that the Internet is a great source of information. You are confident that you can use the Internet and other technology resources as part of your own lifelong learning.

24. The parents of several students have asked to be kept informed of class assignments and activities via regular emails or a class website. You are confident that you can accommodate this request.

25. Not all of your students will have equal access to technology at home. You are confident that you can identify situations where access to technology might be an issue for one or more of your students.

26. The district is purchasing an active board (Smart-board, Promethean, Poly-vision, etc.) for all classrooms. You are confident that you can use this technology to create effective lesson that increase student learning.

27. Because students are using the Internet and other technologies in school, they must be instructed how to stay safe while getting the most from these resources. You are confident that you can model, monitor, and teach safe usage of technology, including Internet safety?

28. Your district received a grant that supplied your classroom with enough laptop computers for every student. You are confident that you will be able to monitor, maintain and utilize the laptops to enhance student learning.

Please rate the following statements by choosing strongly disagree to strongly agree:

29. I know how to solve my own technical problems.

30. I can learn technology easily.

31. I keep up with important new technologies.

32. I frequently play around with technology.

33. I know about a lot of different technologies.

34. I have the technical skills I need to use technology.

35. I have sufficient knowledge about my content area (i.e. chemistry, math, physical education, etc.).

36. I can use the knowledge of my content area in unique ways.

37. I have various ways and strategies of developing my understanding of my content area.

Please rate the following statements by choosing strongly disagree to strongly agree:

38. I know how to assess student performance in a classroom.

39. I can adapt my teaching based upon what students currently understand or do not understand.

40. I can adapt my teaching style to different learners.

41. I can assess student learning in multiple ways.

42. I can use a wide range of teaching approaches in a classroom setting.

43. I am familiar with common student understandings and misconceptions.

44. I know how to organize and maintain classroom management.

45. I can select effective teaching approaches that guide student thinking and learning in my content area.

46. I know about technologies that I can use for understanding and doing tasks in my content area.

Please rate the following statements by choosing strongly disagree to strongly agree:

47. I can choose technologies that enhance the teaching approaches for a lesson.

48. I can choose technologies that enhance students' learning for a lesson.

49. My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.

50. I am thinking critically about how to use technology in my classroom.

51. I can adapt the use of technologies that I am learning about to different teaching activities.

52. I can select technologies to use in my classroom that enhance what I teach and what students learn.

53. I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.

54. I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.

55. I can choose technologies that enhance the content for a lesson.

56. I can teach lessons that appropriately combine my content area, technologies and teaching approaches.

Please rate the following statements by choosing strongly disagree to strongly agree:

57. My content area education professors appropriately model combining content, technologies and teaching approaches in their teaching.
58. My instructional technology professors appropriately model combining content technologies and teaching approaches in their teaching.
59. My educational foundation professors appropriately model combining content technologies and teaching approaches in their teaching.
60. My professors outside of education appropriately model combining content, technologies and teaching approaches in their teaching.
61. My 9-12 cooperating teachers appropriately model combining content, technologies and teaching approaches in their teaching.
62. Overall, my teacher education program has effectively prepared me to integrate current technology in the classroom to increase student learning.

Modeling: Please choose the percentage that matches the statement.

	25% or less	26% - 50%	51%-75%	76%-100%
63. In general, approximately what percentage of your teacher education professors have provided an effective model of combining content, technologies and teaching approaches in their teaching.				
64. In general, approximately what percentage of your professors outside of teacher education have provided an effective model of combining content, technologies and teaching approaches in their teaching?				
65. In general, approximately what percentage of the 9-12 cooperating teachers have provided an effective model of combining content, technologies and teaching approaches in their teaching?				

Please add any comments/remarks you may have about your preparedness to effectively integrate technology in the classroom. (Optional)

Appendix B
Informed Consent Form

School of Professional Studies in Education

Secondary Preservice Teachers' Preparedness to Integrate Technology in the Classroom

VOLUNTARY CONSENT FORM:

I have read and understand the information on letter of consent, and I consent to volunteer to be a subject in this study. I understand that my responses are completely confidential, and that I have the right to withdraw at any time by emailing Leanne Spazak the principal investigator at L.Spazak@iup.edu. Also, if I have any questions in the future about this study, I can contact the principal investigator. I hereby agree to participate in this research study. Click on the appropriate consent link below to continue.

I GIVE CONSENT **I DO NOT GIVE CONSENT**

I certify that I have explained to the above individual the nature and purpose, the potential benefits, and possible risks associated with participating in this research study, and have answered any questions that have been raised.

Leanne Spazak, Principal Investigator
Indiana University of Pennsylvania
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171 State Street
Charleroi, PA 15022
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323 Davis Hall
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Appendix C
Thank You Email

School of Professional Studies in Education

Dear Aspiring Educator,

Thank you for agreeing to participate in the study, *Secondary Preservice Teachers' Preparedness to Effectively Integrate Technology in the Classroom*. Your involvement in this study will provide valuable information about the technological preparedness of today's preservice teachers. Your contribution will provide the higher education community information that will assist them in their continued effort to prepare excellent teachers. By completing the survey, you have already shown your dedication to the field of education. I wish you great success in your future endeavors as an educator.

In accordance with federal regulations, data from survey will be stored on a flash drive, and locked in the researcher's home office and maintained for 3 years.

Please feel free to call me at (724) 787-5846 or email me at L.Spazak@iup.edu if you have any questions or concerns regarding the study.

Sincerely,

Leanne Spazak, Principal Investigator
Indiana University of Pennsylvania
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Charleroi, PA 15022
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