THE PERCEIVED TECHNOLOGY PROFICIENCY OF STUDENTS IN A TEACHER EDUCATION PROGRAM

A dissertation submitted to the Kent State University College of Education, Health, and Human Services in partial fulfillment of the requirements for the degree of Doctor of Philosophy

By

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The purpose of this study is to determine the perceived technology capabilities of different levels of undergraduate students of Kent State University in the College of Education, Health, and Human Services teacher education programs; to determine if the perceived technology capabilities of students beginning the teacher education program differ from those nearing completion of the program; and, if the perceived technology capabilities of students change from the start to the end of the Educational Technology course. Examining student perceptions may provide insight on whether preservice teachers think they can prepare students for the 21st century once they become inservice teachers. To determine whether preservice teachers perceive that they are being prepared to teach 21st century skills by integrating technology into teaching and learning, three groups of students were surveyed: incoming students, junior-level students at the beginning and end of the Educational Technology course, and students nearing graduation. The TPACK survey for preservice teachers (Schmidt, Baran, Thompson, Mishra, Koehler & Shin, 2009) was used to examine preservice teachers’ perceptions of their technology capabilities as related to teaching.

Teachers comprise an integral factor in the effective incorporation of technology into classroom activities, yet many current teachers remain unable or unwilling to employ
technology fully or effectively. The findings from this study led to several conclusions, including that the students perceived themselves to have better technological abilities after completing the Educational Technology course and as seniors near the end of the teacher education program, and the results of this study should challenge teacher education faculty to consider how their beliefs, attitudes, and use of technology in teaching and learning are transmitted to their students.
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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>ACKNOWLEDGEMENTS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>iv</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LIST OF FIGURES</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>vii</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LIST OF TABLES</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>viii</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td></td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td></td>
</tr>
<tr>
<td>Definition of Key Terms</td>
<td>1</td>
</tr>
<tr>
<td>Purpose</td>
<td>9</td>
</tr>
<tr>
<td>Research Questions</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>12</td>
</tr>
<tr>
<td>II.</td>
<td></td>
</tr>
<tr>
<td>REVIEW OF THE LITERATURE</td>
<td></td>
</tr>
<tr>
<td>Historic National Policy on 21st Century Skills</td>
<td>15</td>
</tr>
<tr>
<td>Current National Policy</td>
<td>19</td>
</tr>
<tr>
<td>State Policy</td>
<td>21</td>
</tr>
<tr>
<td>Technology Standards, NET Plan 2010</td>
<td>24</td>
</tr>
<tr>
<td>Current ISTE Standards</td>
<td>32</td>
</tr>
<tr>
<td>Current State Standards</td>
<td>37</td>
</tr>
<tr>
<td>Current Educational Technology Course Guiding Standards</td>
<td>44</td>
</tr>
<tr>
<td>The Changing K-12 Student</td>
<td>47</td>
</tr>
<tr>
<td>Technology as a Tool</td>
<td>56</td>
</tr>
<tr>
<td>Learning Environments</td>
<td>59</td>
</tr>
<tr>
<td>Technological, Pedagogical, and Content Knowledge</td>
<td>64</td>
</tr>
<tr>
<td>Frameworks for Integration</td>
<td>74</td>
</tr>
<tr>
<td>Core Elements</td>
<td>82</td>
</tr>
<tr>
<td>Conditions Necessary to Educate 21st Century Teachers</td>
<td>88</td>
</tr>
<tr>
<td>Rationale for Using Survey</td>
<td>92</td>
</tr>
<tr>
<td>Rationale for Using TPACK Survey for Preservice Teachers</td>
<td>100</td>
</tr>
<tr>
<td>III.</td>
<td></td>
</tr>
<tr>
<td>METHODS</td>
<td></td>
</tr>
<tr>
<td>Purpose</td>
<td>106</td>
</tr>
<tr>
<td>Participants and Research Context</td>
<td>106</td>
</tr>
<tr>
<td>Data Sources/Instrumentation</td>
<td>109</td>
</tr>
<tr>
<td>Procedures</td>
<td>113</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A Model of Learning, Powered by Technology</td>
<td>27</td>
</tr>
<tr>
<td>2</td>
<td>Connected Teaching Builds New Competencies and Expertise</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>Technological Pedagogical Content Knowledge (TPACK) Framework</td>
<td>73</td>
</tr>
<tr>
<td>4</td>
<td>The ICT-TPCK Framework</td>
<td>80</td>
</tr>
<tr>
<td>5</td>
<td>The Pedagogy, Social Interaction, and Technology (PST) Model</td>
<td>82</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table                                      Page
1  Participant involvement details                      .................................................................110
2  Frequency Counts for Demographic Variables (N=193) ........................................................................124
3  Cross Tabulation Counts for Class with Selected Variables (N=193) .................................................126
4  Characteristics for Scale Scores (N=193) ..........................................................................................127
5  Repeated Measures ANOVA Test Comparing the Scores for the Five Knowledge Areas (N=193) ..............130
6  One Way ANOVA Comparison of Scale Scores Based on Class Level (N=193) ....................................132
7  Cross Tabulation of the Five Technology-Related Knowledge Area Scale Score Ranges by Class level (Freshman, Sophomore, Junior, Senior) (N=193) ........................................133
8  Independent T-tests, Freshmen vs. Seniors (n=107) .........................................................................135
9  Dependent T-tests Comparing Pre/Post Survey Category Scores (n=45) ............................................137
10 Frequency Counts for Where Technology Skills were Predominantly Learned (N=193) ..................139
CHAPTER ONE

INTRODUCTION

"If we teach today as we taught yesterday, we rob our children of tomorrow."

~ John Dewey

The purpose of this study is to determine the perceived technology capabilities of different levels of undergraduate students of Kent State University in the College of Education, Health, and Human Services teacher education programs; to determine if the perceived technology capabilities of students beginning the teacher education program differ from those nearing completion of the program; and, if the perceived technology capabilities of students change from the start to the end of the Educational Technology course. This paper contains a discussion about the preparation of preservice teachers so that they can prepare students for the 21st century after they become inservice teachers. The preparation of preservice teachers is a contributing factor to why technology has yet to be effectively integrated into the teaching and learning process within the United State education system. Teachers are an integral factor in the effective incorporation of technology into classroom activities, and yet many remain unable or unwilling to employ technology fully or effectively. The reasons teachers do not effectively use technology in the classroom include: differences among generations (comfort-level with technology), lack of professional development (lack of knowledge on how to implement technology integration), and the lack of technology mandates within districts. To ensure
that future teachers are prepared, it is important to examine the technology capabilities of current preservice teachers in order to determine whether they are currently qualified or whether additional education will be necessary. The government and the American public have voiced concerns about the ability of schools to produce a competent future workforce (United State Department of Education, 1996; United States Department of Education, 2004; United States Department of Education, 2010b). In order to change this, the United States Department of Education and the Ohio Department of Education (ODE) are implementing standards and developing guidelines for integrating technology into K-12 education based on standards developed by the International Society for Technology in Education (ISTE), known as the Educational Technology Standards and Performance Indicators for All Teachers (better known as the National Educational Technology Standards for Teachers or NETS•T), and the Technology Foundation Standards for Students (better known as the National Educational Technology Standards for Students or NETS•S) (United States Department of Education, 2010b; Ohio Department of Education, 2011).

The documents released over the years by the United States Department of Education pertaining to integrating technology into the schools show that policy makers expect teachers to be qualified to educate 21st Century students by incorporating the skills necessary to succeed in the Information Age (United States Department of Education, 2004; United States Department of Education, 2010b). According to the Information Age Education Wiki, the Information Age first began in the late 1950s and refers to the idea
that individuals have the ability to transfer information freely through the manipulation of information by computers and computer networks, and have easy access to knowledge through publications. Other terms used to describe the 21st Century’s rapid growth and uses of technology include Digital Age, Information Era, and Computer Age, among others (Moursund, 2007).

The 2011 edition of Accenture’s Consumer Electronics Products and Services Usage Report (Accenture, 2011) indicates that American society is immersed in digital media, which is used for entertainment, communication, learning, and shopping. Around the world, today’s consumers view technology as an integral part of their lifestyle, much as they do fashion and transportation. In fact, consumer technology is ranked by the majority of consumers to be one of the top three priorities in spending (in Japan, it is number one). The Accenture 2011 report also reveals a great deal of interest in new technologies, a higher turnover in device usage, significant preference and usage differences among generations and global regions, and sustained spending levels despite an uncertain economy (Accenture, 2011). This growth of information and digital communication technologies, including capabilities for networking and shared environments, is changing the nature of business, education, and social interactions. Digital technology, in all its forms, allows information to be continuously available and adapted for different uses. Computers, on-line resources, networks, and smart mobile telephone systems allow us access to information and communication twenty-four hours a day (Kratcoski, Swan, & Campbell, 2006). Despite the prevalence of technology in
society however, classrooms have not changed much over the past fifty years (Swan & van ‘t Hooft, 2008). The ability to participate in this digital world is quickly becoming a prerequisite for successful integration into society; and, it is therefore imperative for schools to prepare students to enter this world through regular interaction with information and communication technologies such as computers, networking, and other digital and non-digital technologies, as well as audio, video and other media tools (United States Department of Education, 2004; United States Department of Education, 2010b).

According to the United States Department of Education, incorporating current technology into the education process may not only improve students’ satisfaction with school, but also enhance their opportunities to learn, to produce high quality projects, and to perform better (United States Department of Education, 2010b). One of the goals of the No Child Left Behind (NCLB) Act known as the Enhancing Education Through Technology Act of 2001 (E2T2) was to ensure that every student would be technologically literate by the time the student finished the eighth grade (U. S. House of Representatives, 2001). The United States Department of Education followed up on E2T2 by notifying states that, beginning in spring 2007, local districts would have to report the total number of students who could demonstrate a locally determined proficiency of technology literacy: No other data concerning technology literacy would be reported (United States Department of Education, 2006). The ODE website includes key literacies targeted by the Ohio Technology Academic Content Standards. The website explains that Ohio’s technology standards cover a broad range of technology
experiences, including literacy in computer and multimedia, information and technology. Ohio standards also define information literacy as the acquisition, interpretation and dissemination of information through the use of the Internet and other electronic information resources for research and knowledge building. Ohio standards consider technology literacy to encompass the ability to participate in a technological world (Ohio Department of Education, 2011).

The national push to incorporate technology into the American education system impacts educators, administrators, and policy makers at all levels, as well as information professionals. If students are expected to learn how to use technology to address 21st Century problems and to acquire 21st Century skills, it is only logical that teachers must be or become proficient in using technology effectively in the learning process. The focus for teachers, and those who train them, is educator proficiency and effective practice (Lemke, 2002).

According to an article published in 2008 in the Journal of Teacher Education, empirical evidence has shown that teachers tend to teach as they were taught (Struyven, Dochy, & Janssens, 2008). Thus it follows that, if teachers teach in the way they were taught, and what they were taught, preservice teachers need to experience a technology-enhanced, constructivist setting where their instructors act as a facilitators in the learning environment. Teacher education programs are essential to the effective integration of technology into Kindergarten through 12th grade (K-12) education, and to Pre-Kindergarten through 12 (P-12). The instructors of education courses need to be able to
incorporate the latest technology into teaching so that they may instill these methods in their students, the preservice teachers. Education programs at colleges and universities that recognize this need will adapt their education programs accordingly, while those institutions that ignore the importance of technology as a part of the teacher education program will be producing teachers poorly qualified to teach in technology-integrated classrooms (Banister & Vannatta, 2006).

The Educational Technology class at Kent State University (KSU) is required for all teacher education majors. The purpose of the class is to have students start an electronic portfolio to be used during their college years, which may be used later during job applications after graduation. Another course objective is to encourage the use of technology in the classroom once the education student graduates and secures a teaching position. The course covers only the common technology with which a student attending KSU must be fully conversant.

Since approximately 80 percent of students in the KSU College of Education have passed through the Ohio educational system (Research, Planning and Institutional Effectiveness office, 2011), it is important to examine the similarities and differences in technological proficiency as related to the teaching profession. Evidence indicates that student technology proficiency is directly affected by socioeconomic status (Banister & Fischer, 2010); research also shows that the technological skill level of the teacher affects the integration of technology into the classroom (Banister & Vannatta, 2006; Brown & Warschauer, 2006; Collier, Weinburgh, & Rivera, 2004; United States Department of
Education, 2004; Rosenfeld & Martinez-Pons, 2005 and Trotter, 1998). Additional research suggests that some high school students are more proficient with technology than their teachers (Kara-Soteriou, 2006). Determining technological skills and proficiency will be discussed later in the paper. Differences in technology proficiencies among students of the Educational Technology course are observable, regardless of the causes. What was once a wide variation in entry level knowledge among students (A. Ingram, personal communication, September, 2009), has narrowed in recent years to place most students at similar levels in the course (C. Kuo, personal communication, August, 2011). The recent trend of students displaying similar levels of proficiency in technology could possibly be a result of moving the course later in the program and exposing the students to several semesters’ experience with the common technology used while attending KSU.

According to discussions with several faculty members, when the course was first offered to freshmen, the course instructors often taught basic skills in Microsoft Word, Power Point and Excel (D. Robinson, personal communication, September 2009). Although many students were familiar with the Internet, many lacked familiarity with the word processing, presentation, and spreadsheet software used by students and faculty of KSU. Some students were not even familiar with e-mail (A. Ingram, personal communication, September, 2009). Variations in technology proficiency among first-year students in the College of Education at KSU may be attributed to the rapid advances in technology in society and the slow change of education in school systems throughout
the United States (Kara-Soteriou, 2006), especially for those students who can access technology only at school.

Currently, incoming students at the College of Education undergo no regular skill-level assessment, but are assessed through a series of assignments as they go through the Educational Technology course. The current requirements of the course include knowledge of the use of Microsoft Office products, Windows operating system, Macintosh operating system, an FTP client, and a digital imaging program. Students must write a five page paper on technology integration and complete the KSU library’s online modules on navigating education databases and American Psychological Association (APA) citation style. Each student must also present and/or teach a technology tool, software or hardware, which can be used in the classroom or be integrated into learning and teaching as well as complete exercises from the text, *Microsoft Office for Teachers*, on Word, PowerPoint, Excel, Publisher, and Integrating Office. All students observe technology integration in the AT & T classroom at KSU and must create an electronic portfolio on a six page website, posting it to their personal space on the KSU web server. In addition to the individual assignments, students also have to complete a group project consisting of creating a digital journal, a non-linear PowerPoint as a learning module, a WebQuest, and a movie. The group project must relate to a proposed teaching subject and grade level, an issue related to the use of technology, or a special journey that a student has experienced; the topic of which must be approved by
the course instructor. A syllabus used in the majority of the Educational Technology courses during fall 2011 is included as Appendix A.

Definition of Key Terms

For the purposes of this study, the following terms are defined.

Content Knowledge (CK). CK is knowledge about the subject matter that is to be taught or learned.

Digital immigrant. All generations before the digital natives who are not comfortable with technology (Prensky, 2001; Toledo, 2007).

Digital native. Defined by Prensky (2001) as the first generation to be immersed in technology or the first generation to experience technology as ubiquitous.

Digital technology. Digital technology, in all its forms, allows information to be continuously available and manipulated for different uses. (Kratcoski, Swan, & Campbell, 2006).

Pedagogical Knowledge (PK). PK refers to the methods and processes of teaching, including knowledge of classroom management, assessment, lesson plan development, and student learning.

Pedagogical Content Knowledge (PCK). PCK refers to teachers’ interpretations and transformations of subject-matter knowledge in the context of facilitating student learning, or a blend of content and pedagogy to facilitate student learning (Shulman, 1986).
Technological Content Knowledge (TCK). TCK refers to the knowledge of how technology can create new representations for content, and how teachers can use a specific technology to change the way learners practice and understand concepts within a content area.

Technological, Pedagogical, and Content Knowledge (TPACK). As a whole, TPACK refers to the knowledge required by teachers to integrate technology into their teaching in any content area, which means teachers must have an intuitive understanding of the dependent relationship between the three basic components of knowledge (CK, PK, and TK) by teaching content via the appropriate pedagogical methods and technologies (Koehler & Mishra, 2009). Also see TPACK framework.

TPACK framework. Technological Pedagogical Content Knowledge (TPACK) is a framework that identifies the knowledge teachers need to teach effectively with technology. The TPACK framework extends Shulman’s idea of Pedagogical Content Knowledge (1986). Also see Technological, Pedagogical, and Content Knowledge (TPACK).

TPACK modeling. TPACK modeling refers to the students’ perceptions of the use of TPACK by faculty at Kent State University, as observed during the teacher education program.

Technological Pedagogical Knowledge (TPK). TPK refers to the knowledge of how various technologies can be used in teaching and understanding that using technology may change how a teacher teaches.
Technology. For the purposes of this dissertation, technology will be defined as digital technology, such as computers, software, and handheld devices. See Digital Technology.

Technology Knowledge (TK). TK refers to the knowledge of various technologies, ranging from pencil and paper to the Internet, digital video and software programs. As related to the survey in this study, it referred to digital technologies.


21st century skills. Defined as the ability to problem-solve, think critically, and possess entrepreneurship and creativity, among other skills (United States Department of Education, 2010b). 21st century skills are considered to be defined by ISTE standards (ISTE, 2010; United States Department of Education, 2010b).

Purpose

The purpose of this study is to determine the perceived technology capabilities of different levels of undergraduate students of Kent State University in the College of Education, Health, and Human Services teacher education programs; to determine if the perceived technology capabilities of students beginning the teacher education program differ from those nearing completion of the program; and, if the perceived technology
capabilities of students change from the start to the end of the Educational Technology course.

Examining student perceptions may provide insight on whether preservice teachers think they can prepare students for the 21st century once they become inservice teachers. To determine whether preservice teachers perceive that they are being prepared to teach 21st century skills by integrating technology into teaching and learning, three groups of students will be surveyed: incoming students, junior-level students at the beginning and end of the Educational Technology course, and students nearing graduation. The survey will focus on students’ acquisition of the technology standards for teachers (NETS•T) technology skills, how they perceive their ability to effectively use technology as future teachers as measured by the Technology, Pedagogy and Content Knowledge (TPACK) framework, and how they predominantly acquire the knowledge to effectively use technology.

**Research Questions**

The primary research question:

What are the perceived academic technology capabilities of undergraduate students in the Kent State University College of Education, Health, and Human Services teacher education programs as measured by the TPACK survey for preservice teachers?

For the current study, volunteer participants included 78 freshmen, 86 students in their sophomore or junior year (58 of them enrolled in the Educational Technology course), and 29 seniors (18 of them during their student teaching semester). The
The instrument used was the TPACK survey for preservice teachers (Schmidt et al., 2009). The TPACK survey consists of 64 questions: 56 of the 64 questions use a five-level Likert scale to assess seven TPACK domains. Seven questions relate to demographic information, and one question concerns acquisition of technology knowledge. The survey was administered online once to all students, with the exception of students enrolled in the Educational Technology course, to whom it was administered at the beginning and at the end of the course.

The survey is intended to measure preservice teachers’ self-assessment of the TPACK knowledge domains—technology, pedagogy, and content, and there is also a question referring to the origin of learned technology skills. For the 56 questions using the Likert scale, each item response can be rated on a scale between 1 (strongly disagree) and 5 (strongly agree). The participant’s scores were averaged for each TPACK knowledge domain. For example, the 6 response scores under TK (Technology Knowledge) were averaged to produce one TK (Technology Knowledge) score for each student. Descriptive statistics were run on all quantitative data.

Secondary questions include:

1. Are there differences in the perceived technology capabilities as measured by the TPACK survey between students beginning the teacher education program and those finishing the teacher education program?

The participants for the current study consisted of 78 freshman volunteers and 29 senior volunteers (For details on participants, see Table 1 in Chapter 3, Participants and
Research Context section), and the instrument used was the TPACK survey for preservice teachers. Analyses included descriptive comparisons by TPACK category, and a point-biserial correlation as well as independent t-tests were carried out to explore any significant differences between the groups.

2. How do the perceived capabilities change during the mandatory College of Education Educational Technology course?

Participants used for this portion of the current study were 45 volunteers from the students enrolled in all spring 2012 sections of the Educational Technology course.

The instrument used was the TPACK survey for preservice teachers, and analyses included descriptive comparisons by TPACK category and dependent t-tests were carried out to explore any significant differences between pre- and post-test scores.
CHAPTER TWO

REVIEW OF THE LITERATURE

Historic National Policy on 21st Century Skills

Historically, there has been a gap between educational use of technology and the use of technology in society which means that students remain potentially unprepared to enter the workforce after graduation from high school. Society has been remarkably changed by milestones in science and technology, such as Gutenberg’s creation of moveable type in the 15th century –laying the foundation for universal literacy. The invention of the steam engine in the 18th century launched the Industrial Revolution. The invention of the telephone in the 19th century and the radio in the 20th century kicked off major steps towards the realization of global communications (United States Department of Education, 1996). The introduction of the IBM Personal Computer in 1982 may have marked the beginning of the digital revolution and as prices decreased, there was a marked increase of home computers. As early as 1996, the Government acknowledged this trend by acknowledging that computers and information technologies were transforming nearly every aspect of American life. Technology was changing how Americans worked and played, increasing productivity, and providing new ways of doing things. Major industries in the United States had started to rely on computers and telecommunications as part of the regular work day. The Government also acknowledged that America’s schools were not a part of the information revolution, with
students spending an average of a few minutes every day using the computer for learning. Only four percent of schools had a computer for every five students and only nine percent of classrooms had connections to the Internet (United States Department of Education, 1996).

The United States Department of Education considers technology to be an important component of education for two main reasons: first, due to the prevalence of technology throughout society, students must be proficient in its use; and second, it is believed that effective use of technology can improve student learning. As early as 1996, the United States Department of Education released a report stating that technological literacy was as fundamental as traditional skills like reading, writing, and arithmetic because technology was prevalent in every aspect of our lives (United States Department of Education, 1996). The importance of technology literacy in education was outlined in President Clinton’s January 1996 State of the Union address, which set goals for technology in schools: all teachers would have the training and support necessary to help students learn computers and the Internet; classrooms would be equipped with modern computers and be connected to the Internet; and lastly, software and online learning would be integrated into the school’s curriculum (United States Department of Education, 1996).

The United States Department of Education’s report, *Getting America’s Students Ready for the 21st Century: Meeting the Technology Literacy Challenge* (June 1996, p. 5), defines technological literacy to include “computer skills and the ability to use computers
and other technology to improve learning, productivity and other technology to improve learning, productivity, and performance.” The report also references the importance of teacher training as the key to integrating technology into the classroom to increase student learning. The report acknowledges also that computer equipment remained unused in classrooms at the time due to a lack of technology-proficient teachers (United States Department of Education, 1996).

However, despite the findings of the 1996 United States Department of Education report, progress toward the goal of producing tech-savvy students and trained teachers has remained undesirably slow (United States Department of Education, 2011a). The United States Department of Education determined educational technology integration status by involving and receiving input from students, educators, researchers, parents, higher education representatives, and industry leaders. The United States Department of Education has continued to push for technology in the education system by developing the National Education Technology (NET) plans, which set goals for the American education system. The National Education Technology (NET) Plan 2004 was developed by a collaboration of educators (current and future teachers, as well as teacher educators), representatives from leading educational associations, and industry leaders. The United States Department of Education based its claims on data collected from the report, *Young Children’s Access to Computers in the Home and at School in 1999 and 2000*, developed by the United States Department of Education, National Center for Education Statistics, published in 2003 (United States Department of Education, 2004, p. 63).
The Executive Summary of NET Plan 2004 explained how the technology-rich environment outside of the classroom was changing the way students learned and how teachers presented lessons. The summary depicted this trend as partially driven by the students, most of whom had access to technology and the Internet at home and were comfortable with it (United States Department of Education, 2011a). The NET Plan 2004 pointed out the gap between technology use in schools and the increasing use of technology in society by citing that students mastered technology and the Internet at home rather than at school, and were often more technologically literate than their teachers (United States Department of Education, 2004). The increased use of the Internet at home also affected the learning of school subject matter, as students preferred to access up-to-date, dynamic subject material on the Internet rather than outdated textbooks (United States Department of Education, 2004).

The NET Plan 2004 drew upon several sources for evidence of the need to meet technology literacy goals: *U.S. Department of Education FY 2000 Annual Plan, Volume 2*, addressed the need to increase student and teacher proficiency in technology (United States Department of Education, 1999); and, a report published in the *Education Week Technology Counts* section (Trotter, 1998), which claimed that student learning could be improved with technology based on a Milken Family Foundation study conducted by the Educational Testing Service (ETS) (United States Department of Education, 1999, p. 14). The Milken Family Foundation study quoted in the Technology Counts section mentioned earlier also included a survey of the 50 states’ policies on educational
technology and found that most states, while appropriating money for technology each year, lacked any technology standards or goals for the students or teachers. According to the study, policymakers and the public wanted to know if the billions of dollars spent on educational technology each year were effective. This study, conducted by Harold Wenglinsky of ETS, was also the first to document relationships between student use of technology and higher scores on a national standardized test (Trotter, 1998). This documented relationship is discussed further under the Technology as a Tool section of this chapter.

**Current National Policy**

Although the specific use of technology associated with higher scores was not clearly defined in Wenglinsky’s study (or the subsequent published government report) (Trotter, 1998), the push for technology proficiency in schools continued (United States Department of Education, 2010b) with the development and release of the National Education Technology Plan (NETP) 2010, which recognized that technology was integral to almost every aspect of our daily lives and work. The NETP 2010 was driven by two aggressive goals set by President Obama: first, to increase the number of U.S. citizens with a two-year or four-year degree by 2020; and second, to eliminate the achievement gap, thereby ensuring all high school graduates are ready to succeed in college and careers (United States Department of Education, 2011b).

The prevalence of technology in society was further underscored when Arne Duncan, U.S. Secretary of Education, released an online draft of the NETP 2010 in
March 2010 and invited the public to review it, comment on it, and provide examples of research and practice associated with it—all online. The Internet-using public had a period of sixty days after the release of the draft to provide feedback (United States Department of Education, 2011a). No alternate method of commenting on the NETP 2010 draft was offered, so feedback appears to have been limited to individuals who had access to and were comfortable with online technology. Duncan introduced the NETP to the public through a website presenting both text and a video in which he proclaimed how technology was going to improve student achievement (and learning) through effective learning experiences and better assessment (United States Department of Education, 2010a, video introduction). In the video, Duncan reiterates the advantages of technology in the classroom pertaining to student achievement and learning. However, he does not mention the impact of the teacher on technology integration in the classroom (United States Department of Education, 2010a, video introduction).

The NETP 2010 does reference the ongoing need for technology education for teachers by stating that technology would help facilitate collaborative teaching strategies to better prepare and enhance educators’ professional competencies and expertise over the course of their careers. The report suggested examining other enterprises, such as business and entertainment, that have used technology successfully to improve outcomes while increasing productivity, in order to shorten the learning curve for the education system. The United States Department of Education also offered suggestions for
implementation of the NETP 2010, some of which are discussed later in this paper (United States Department of Education, 2010b).

**State Policy**

The No Child Left Behind (NCLB) Act, which is also known as the Enhancing Education Through Technology Act of 2001 (E2T2), listed technology literacy for every student by the end of the eighth grade as one of its goals (U.S. House of Representatives, 2001). The E2T2 program provided federal funds to the states to enhance the use of educational technology to improve student achievement. The states used the funding to provide grants to school districts. The E2T2 program required recipients of the funds – at state and school district level – to evaluate the effectiveness of their E2T2 activities (U.S. House of Representatives, 2001). In 2006, the United States Department of Education followed up on E2T2 by notifying states that, beginning in the spring of 2007, local districts had to report the total number of eighth grade students and report the percentage of this population that demonstrated a locally-determined proficiency of technology literacy. No other data concerning technology literacy was required (United States Department of Education, 2010b).

In spite of the historical and current national push for technology, as late as October 2011, the ODE web site did not indicate that students in Ohio had been tested on technology literacy at any grade level. A review of the materials used in 2010 achievement tests (grades 3-8) revealed that the academic tests are conducted using a printed test booklet and a pencil; with the subject matter comprising reading, writing,
mathematics, science and social studies. The only integration of technology appeared to be in the analysis of the test results, and in the multiple choice portion of the tests, which may have been electronically scanned and scored (Ohio Department of Education, 2011).

The ODE website includes a printable document of key literacies targeted by the Ohio Technology Academic Content Standards. Ohio technology standards are based on the National Education Technology Standards (NETS), which are developed by the International Society for Technology in Education (ISTE). The document explains that Ohio’s technology standards cover a broad range of technology experiences including:

Computer and multimedia literacy is the ability to appropriately use hardware, software applications, multimedia tools and other electronic technology. It includes the usage of technology tools for productivity and communication.

Information literacy is the acquisition, interpretation and dissemination of information. Information literacy focuses on effective methods for locating, evaluating, using and generating information. Technology-based information literacy skills encompass the utilization of the Internet and other electronic information resources for research and knowledge building.

Technology literacy addresses the abilities needed to participate in a technological world. It is the intersection of mathematics, science and technology. It encompasses unique knowledge, devices and capabilities used to
solve problems. It identifies career connections between technology and the world of work. (Ohio Department of Education, 2011, “Key Literacies,” para. 1-4)

According to the ODE website, under the Assessment of Programs section, it is clearly stated that technology should be an integral part of the classroom, be it as the focus or as a learning aid to meet teaching and learning goals. However, it is pointed out that in order to make the most effective use of technology, it is necessary for all learning objectives to be clearly defined and aligned to the academic content standards (Ohio Department of Education, 2011a, p. 327).

In stark contrast to the ODE’s commitment to technology integration, since the beginning of his term in 2011, Ohio Governor John Kasich has altered State policy in a way that directly impacts education. House Bill 21 (H.B. 21), which was passed in March 2011 and signed by Governor Kasich in April 2011, mandates that the Ohio State Board of Education (BOE) make exceptions in the Ohio teacher licensure procedure. Non-education major college graduates could now participate in the Teach for America program to obtain full licensure in two years instead of going through Ohio’s five-year residency for other teachers, including college graduates of teacher education programs. Non-education major college graduates are not required to complete an educational technology course and most would not have completed any teaching methodology courses. However, the Teach for America program does offer a five-week training course for participants before they actually enter the classroom. The bill also allows for
the development of additional charter schools in Ohio without mandating that charter schools meet the same standards as public schools (OEA, 2011).

**Technology Standards, NET Plan 2010**

The ODE modeled the state technology standards after those of the International Society for Technology in Education (ISTE), a widely accepted set of technology-related national standards (Ohio Department of Education, 2011). The ISTE standards were developed to help make judgments about levels of performance and were in part, stimulated by linking federal legislation and funding to top student achievement (Taylor & Thomas, 1997). In 1989, the ISTE partnered with the National Council for Accreditation of Teacher Education (NCATE) on a project to develop standards for teacher education programs (Thomas, et al., 1994). The National Education Technology Standards (NETS) project was initiated by ISTE, the leading professional organization for educators involved with technology, and funded by the National Aeronautics and Space Administration (NASA). The NETS were originally developed by the International Society for Technology in Education in consultation with the U.S Department of Education, the National Aeronautics and Space Administration (NASA), the Milken Exchange on Educational Technology, and Apple Computer, Inc. which is now known as Apple Inc. (International Society for Technology in Education [ISTE], 1998). ISTE has continued to partner with other major organizations in the development of technology standards, including (but not limited to) the American Federation of Teachers (AFT), the Association for Supervision and Curriculum Development (ASCD),
the Council of Chief State School Officers (CCSSO), the National Association of Secondary School Principals (NASSP), the National School Boards Association (NSBA), the National Education Association (NEA) and the Software Publishers Association (SPA) (Taylor & Thomas, 1997).

In an effort to improve education through the effective use of technology, the staff of ISTE has historically collaborated with educators, federal, state and local policy makers, businesses, and communities. In 2009, the United States Department of Education collaborated with ISTE to develop the NET Plan 2010 in order to ensure that the goal of the effective use of technology (to improve learning) would be a part of the plan and a fundamental part of daily classroom practice (ISTE, 2010). The ISTE National Education Technology Standards for Students (NETS•S) are referenced in the NET Plan 2010 as a complete definition of digitally literate learners (United States Department of Education, 2010b, P. 13).

The NET Plan 2010, entitled, *Transforming American Education: Learning Powered by Technology*, outlines the national perspective on technology in the classroom by recognizing both the prevalence of technology in society and the need to use technology not only to improve learning, but also to foster accurate assessments of student achievement that may be used to further improve instruction and learning (United States Department of Education, 2010b). The NET Plan 2010 presents five goals for the use of technology in education, and offers recommendations for states, school districts, the federal government and others. Expanding upon each goal, the plan addresses what
the United States Department of Education considers to be the five essential components of learning powered by technology.

The first goal of the NET Plan 2010 asserts that all learners will have effective learning experiences in and out of school which will prepare them to actively participate in a globally networked society (United States Department of Education, 2010b, p. 9). The NET Plan 2010 envisions creating a student-centered model of learning powered by technology. Rather than using teachers as knowledge delivery vessels, students and educators will be able to tailor individual activities based on a core set of standards (United States Department of Education, 2010b, p. 10). See Figure 1 for the graphic representation included in the NET Plan 2010 (United States Department of Education, 2010b, p. 11).

In the supporting documentation for this goal, the United States Department of Education acknowledges that the current education system is largely dependent on the classroom, textbooks, and educator/student relationships for learning. The plan also acknowledges that technology use in the classroom varies greatly from district to district, depending on funding, and that the effective integration of technology into the classroom is largely dependent on teachers’ understanding of how to effectively incorporate it (United States Department of Education, 2010b).

The NET Plan 2010 also cites a 2009 national survey by the Kaiser Family Foundation as evidence that 8- to 18- year-olds increasingly employ technology in their
Figure 1. A Model of Learning, Powered by Technology.

The model graphic shows the student as “connected” through technology to education resources, including tutoring, authoritative sources, learning communities, and peers; “connected” in school to teachers, peers, mentors and coaches; and connected to parents through school and at home. Adapted with permission from the “National Education Technology Plan 2010” by the United States Department of Education, 2010, p. 11.
personal lives outside the classroom. The 2009 study by the Kaiser Family Foundation used a random sample representative of 2,002 American school children, from grades 3 – 12, between the ages of 8 and 18. This was the third in a series of studies by the Kaiser Family Foundation on media use by this age group (Rideout, Foehr & Roberts, 2010). The studies were conducted at five year intervals – 1999, 2004, and 2009. The study from 2009 also included a comparison of all the studies to illustrate the increased use of technology in America. According to this study, on average, the subjects spent more than 53 hours a week using media for entertainment. The entertainment media included were television, music/audio, computer, video games, print media, and movies. The study did not include time spent using the computer for school work or time spent texting or talking on a cell phone (Rideout et al., 2010).

The second goal of the NET Plan 2010 is to use technology to improve evaluations and assessments (United States Department of Education, 2010b, p. 25). The NET Plan 2010 document summarized the second goal with a quote by President Obama, who implored education leaders to ensure accurate measurement of student abilities, particularly 21st century skills (United States Department of Education, 2010b). The vision for this goal also included assessing children’s thinking during learning so that educators could help them learn better. The NET Plan 2010 gave several real-life examples of technology used to improve evaluations and assessments (United States Department of Education, 2010b, p. 25, “Second Goal”). The examples illustrated the use of technology to enhance learning by engaging the students in problem-solving and
critical thinking, the use of formative assessment as a teaching and learning tool, as well as initiative shown by teachers who obtained grants to fund the use of the technology.

The third goal is to provide teachers with additional resources and information through technology (United States Department of Education, 2010b, p. 39). The goal envisions the use of technology to increase support for teachers through interaction with parents, students, other professionals, and experts outside of the school walls, and increased resources for professional development, data, and content. Figure 2 shows a diagram of “Connected Teaching” (United States Department of Education, 2010b, p. 40) included in the NET Plan 2010. This goal envisions increased professional development opportunities and to reduce the amount of time that educators work alone (United States Department of Education, 2010b, p. 39).

The fourth goal is to move learning beyond the boundaries of the classroom by creating an infrastructure for learning (United States Department of Education, 2010b, p. 51). This infrastructure was modeled on the National Science Foundation cyberinfrastructure, initially used to encourage collaboration between scientists and researchers, and later expanded to apply to learning in all domains (United States Department of Education, 2010b, p. 51).

The fifth and final goal of the NET Plan 2010 is to redesign the system so that technology may be used to improve learning outcomes while improving the effectiveness of staff and budgets (United States Department of Education, 2010b, p. 63). This goal is connected to the President’s goal of ensuring that 60 percent of US citizens hold degrees
Figure 2. Connected Teaching Builds New Competencies and Expertise.

Graphical representation of technology connecting teachers to other teachers for an exchange of ideas; to parents and students for feedback and timely communication; and to subject matter experts, subject content, and tutorials, as well as personal learning networks to improve subject knowledge and teaching skills. Adapted with permission from the “National Education Technology Plan 2010” by the United States Department of Education, 2010, p. 40.
to regain global leadership in college graduation rates by 2020. The rationale for including effective management of budgets is due to the anticipated reduction in federal and state funding for universities and colleges.

Also, over the past 30 years, the United States has increased K-12 education spending per student by more than 70 percent, but this increase has not been commensurate with an improvement in outcomes. College tuition has also steadily increased, even as completion rates remain the same (United States Department of Education, 2010b, p. 63).

The recommendations for implementing the NET Plan 2010 in school districts include suggestions for rethinking current educational practices and providing a technology-based education to increase the digital literacy of teachers so that they are capable of producing instructional materials that improve student learning, and accurately assess student ability (United States Department of Education, 2010b, p. 50). Based on the Kaiser Family Foundation study of 2009, the NET Plan encourages school districts to be creative in the incorporation of technology by making use of students’ home computers if the district cannot provide enough computers for every student. The United States Department of Education also offers funding for implementation of some of the suggestions and offers technical support and expertise in establishing a working, effective infrastructure to enhance education within districts (United States Department of Education, 2010b).
Current ISTE Standards

The ISTE National Education Technology Standards for Students (NETS•S) and the National Education Technology Standards for Teachers (NETS•T) are referenced in the NET Plan 2010 and constitute widely accepted national standards. The most recent NETS•T were released in 2008 (Appendix B). In 2011, the ISTE website stated that the 2008 standards enabled schools to transition from the Industrial Age to the Digital Age (ISTE, 2008a, “nets-for-teachers”). The NETS•T include five standards that teachers should meet to effectively integrate technology into education so that learning is enhanced (ISTE, 2008a). These standards are listed and explained in the following paragraphs.

The first standard is “Facilitate and inspire student learning and creativity” (ISTE, 2008a, “Facilitate,” para. 1), which means that teachers need to use their knowledge of subject matter, teaching, learning, and technology to facilitate student experiences that advance learning, creativity and innovation in face-to-face and virtual environments. To attain this standard, teachers must model, promote, and support creative thinking while engaging students in real-world scenarios with real-world problems and issue through the use of technology. Teachers should also use technology for collaboration with students, colleagues, and subject matter experts and facilitate a collaborative environment for students in and out of school (ISTE, 2008a).

The second standard is that teachers need to “design, develop, and evaluate digital-age, 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” (ISTE, 2008a, “Design,” para.
1). To attain this standard, teachers must design relevant learning experiences, or adapt
existing learning experiences, using technology to promote student learning and
creativity. The learning experiences must be student-centered, so that all students may
pursue individual interests and participate in setting their own educational goals, manage
their own learning, and assess their own progress. The learning environments must be
adaptable to all learning styles, working strategies, and individual levels of technology
skills. Students must be provided with formative and summative assessments aligned
with content and technology standards; teachers will use the assessment data to tweak the
environment to enhance individual teaching methods and student learning (ISTE, 2008a).

ISTE’s third standard in the NETS•T is that teachers should demonstrate the
“knowledge, skills, and work processes representative of an innovative professional in a
global and digital society” (ISTE, 2008a, “Model,” para. 1). To successfully attain this
standard, teachers must demonstrate fluency in technology and be able to apply this
knowledge to new technologies and situations; teachers must also promote professional
growth and student success using technology to collaborate with students, peers, parents,
and community members. Teachers must be able to effectively communicate information
and ideas within this collaborative environment and model effective use of technology by
locating, analyzing, evaluating, and drawing upon credible information resources to
support learning (ISTE, 2008a).
The fourth standard involves teachers’ understanding of “local and global societal issues and responsibilities in an evolving digital culture” (ISTE, 2008a, “Promote,” para. 1) and maintenance of legal and ethical behavior. Teachers must model and teach safe, legal, and ethical use of digital information. Students need to learn about copyright, intellectual property, and how to appropriately document sources as well as observance of digital etiquette, or ‘netiquette,’ and responsible social interactions relating to the use of digital information and technology. This standard also states that teachers must address the diverse needs of students with learner-centered instruction and equitable access to resources (ISTE, 2008a, “Promote,” para. 3). Teachers should also use technology to foster connections with colleagues and students of other cultures to promote cultural understanding and global awareness (ISTE, 2008a).

According to ISTE’s NETS•T fifth standard, teachers must continually improve their professional skills, “model lifelong learning, and exhibit leadership in their school and professional community by promoting and demonstrating the effective use of digital tools and resources” (ISTE, 2008a, “Engage,” para. 1). To attain this standard, ISTE recommends that teachers participate in local and global learning communities in order to exchange ideas on the creative use of technology to improve student learning, that they likewise assume a leadership role in technology infusion and decision-making, and help to develop the technology skills of their peers. To participate effectively in learning communities and assume leadership roles, teachers must keep up with current research and professional practices concerning technology in the classroom to ensure that they can
tap into emerging technologies and technological support which improves student learning (ISTE, 2008a).

The NETS•T standards overview states that “Effective teachers …” (ISTE, 2008a, “NETS•T standards overview”, para. 1) utilize the NETS•S while they are designing and implementing learning environments that engage students and improve their learning (ISTE, 2008a). The NETS•S currently in effect were released in 2007 (Appendix C). The ISTE website offers the opportunity to join a wiki to discuss the implementation of the NETS•S; however, from its inception in January 2008 to November of 2011, the wiki showed only 49 messages by eight participants and a moderator. This low participation may be an indication of a shortage of teachers who are able to design and implement technology-based, engaging learning environments. According to ISTE, because technology is so prevalent in society, students will be expected to creatively use basic technology skills for problem-solving and successful completion of projects (ISTE, 2011, “Nets-for-students”). NETS•S are intended to help prepare students to be able to effectively live, work and contribute in society.

To successfully master all six of the NETS•S, students must demonstrate creativity and innovation by demonstrating the ability to apply existing knowledge to new situations (ISTE, 2007, “Creativity,” para. 1); create original work to express ideas; utilize models and simulations for complex concepts (ISTE, 2007, “Creativity,”, para. 1); and, draw inferences from identified trends (ISTE, 2007, “Creativity,”, para. 1). Students must be able to use digital media to communicate and collaborate with peers and
others, including learners of other cultures, and effectively participate as a member of a team, whether in face-to-face or virtual environments. Students must be able to use technology to gather, evaluate, and use information by developing strategies to guide their inquiry and to locate, organize, analyze, synthesize, and use appropriate, pertinent information from a variety of sources, as well as to effectively process data to report findings. Students should be able to demonstrate an understanding of all issues relating to technology and practice safe, legal, and ethical behavior surrounding technology as well as demonstrate enthusiasm for lifelong learning. The final standard states that students should demonstrate a good understanding of technology concepts by effectively selecting and using applications productively; they should also be able to troubleshoot systems and applications and transfer current technology knowledge to learning of new technologies (ISTE, 2007).

The ISTE website also contains information about conditions essential to effectively leverage technology for learning. The conditions articulated include a shared vision for educational technology by empowered stakeholders; an implementation plan aligned with the shared vision; adequate and ongoing funding, including community partnerships; reliable access for all with skilled personnel assisting with selection of information and communication technology (ICT) materials and professional development; consistent technical support; student-centered learning with continuous assessment and evaluation; incentive plans and accountability measures for the use of technology in the classroom; and, the assurance that all levels of government will support
schools and teacher education programs so that the successful attainment of curriculum and learning technology standards may be achieved (ISTE, 2008b, “Supportive External Context”).

Because ISTE standards are widely accepted from federal- to state-level policies (United States Department of Education, 2010b; Ohio Department of Education, 2011a), the ISTE standards are also included in teacher education programs in Ohio, including the required Educational Technology course at KSU.

**Current State Standards**

The ODE has modeled the Ohio state standards after the ISTE standards. The ODE website offers the Academic Content Standards for K-12 Technology as a downloadable PDF file (http://www.ode.state.oh.us/GD/Templates/Pages/ODE/ODEDetail.aspx?page=3&TopicRelationID=1707&ContentID=1279&Content=109741). While the state standards were originally adopted in December 2003, the alignment of Ohio standards to ISTE standards can be further defined by observing grade-specific benchmarks. The ODE standards document is aligned to the 2007 NET•S (the latest version available); however, that alignment is not documented. The ODE website features a link to the Technology Standards Current Update; which informs visitors that the standards are not being replaced but will be presented in a different format (Ohio Department of Education, 2011, “Integrating,” para. 1). The most recent modification data on the page is Aug. 5, 2011. As mentioned earlier, the ODE also offers Key
Literacies Targeted by Ohio Technology Academic Content Standards, this key literacies

Ohio has established seven technology standards, which include the nature of
technology, technology and society interaction, technology for productivity applications,
technology and communication applications, technology and information literacy, design,
and designed world. The term “Nature of technology” refers to students’ ability to
“develop an understanding of technology, its characteristics, scope, core concepts and
relationships between technologies and other fields” (Ohio Department of Education,
2011, p. 58, para. 1). Students must recognize the role and effects of technology in
interactions in society (Ohio Department of Education, 2011, p. 70, para. 1). Students
should develop ethical technology practices to support life-long learning (Ohio
Department of Education, 2011, p. 58, para. 1). Students should be able to use
technology, computer, and multimedia resources to support their learning; students need
to facilitate support of their learning with the ability to use appropriate terminology when
communicating, to select the appropriate technology tool based on their needs, and to
practice collaborating, experimenting, investigating, collecting, analyzing and problem-
solving. Students may communicate via technology in or out of the classroom, as a
group or individually with students from other schools, communities, states or countries.
Students must also demonstrate technology and information literacy by developing
strategies to guide their inquiry and locating, organizing, analyzing, synthesizing, and
using appropriate, pertinent information from a variety of sources and effectively process the data to report findings.

The last two standards, design and designed world, refer to a student’s ability to demonstrate recognition of the attributes of design, explain the critical design factors, and apply technology tools in the problem-solving process within the designed world, which is defined as a technology-based reflection of human-made modifications to the natural world (Ohio Department of Education, 2011, p. 148, para. 1). Students acquire understanding of the impacts of technological systems on history, culture, environment, government, and future careers, as well as an understanding of the services available through technology (Ohio Department of Education, 2011).

In Ohio, the licensing requirements for teachers do not specify any particular technological knowledge; instead the requirements focus on teacher education programs. All teachers are required to complete a qualified education program at an accredited four-year university. In Ohio, the Chancellor of the Ohio Board of Regents approves institutions of higher education and educator licensure programs for the preparation of pre-K-12 educators and other school personnel. The State Board of Education for Ohio develops and approves the standards and requirements for educator licensure preparation programs. The Ohio Teacher Education and Licensure standards establish requirements for educator licensing; including teaching credentials, administrator and pupil services credentials, permits, alternative credentials, and substitute and temporary credentials, and comprise a part of the Ohio Administrative Code and Ohio Revised Code (Ohio
Department of Education, 2011). House Bill 1, which was passed in 2009, established a new licensure structure for Ohio educators, and became effective in 2011. The ODE website offers a downloadable chart outlining the new structure and existing licenses, certificates and permits. House Bill 1 also transferred the responsibility for developing a state education technology plan from the ODE to the eTech Ohio Commission. In addition, House Bill 1 changed the purpose of the state education technology plan from promoting the use of technology, to compliance with federal mandates pertaining to preschool through postsecondary education. Lastly, House Bill 1 required the eTech Ohio Commission to implement the plan without any apparent power, and with a budget controlled by ODE (Ohio Department of Education, 2011).

The ODE website features a link to the Ohio standards for the teaching profession, which makes no mention of any technology requirements. The office of educator licensing allows the website visitor to select a specific subject in order to view the certificate type required to teach that subject in Ohio. Educational Testing Service (ETS) administers the pre-certification tests, also known as The Praxis Series (Educational Testing Service, 2012; Ohio Department of Education, 2011). ETS is a well-known, nonprofit organization that promotes quality education worldwide by creating assessments based on research and administering those assessments in a controlled environment (Educational Testing Service, 2012). A review of this website and the ETS website confirms there are no tests for technology with the exception of technology education certification, which is only required of individuals who will be

As mentioned earlier, teacher preparation includes the completion of an accredited teacher education program. Graduates of accredited colleges or universities whose bachelor’s degree was not in education, and who have not yet earned a traditional teaching certificate, can still receive an alternative teaching certificate by satisfying certain requirements. Typically, teacher education programs consist of a combination of curricula and fieldwork. The curricula often include instruction on foundational knowledge and skills, pedagogy, and preparation for future teachers to research, design, and implement learning experiences in their field of study. The fieldwork component can include field observations, student teaching, and/or an internship (Ohio Department of Education, 2011). The ODE publishes a list of state-approved teacher preparation programs, which may be downloaded from the ODE website.

In 1964, the Higher Education Act was developed to provide financial support for low-income youth for the purpose of pursuing postsecondary education. Reviewed, amended, and reauthorized by Congress about every five years, the Higher Education Act was amended to include a Teacher Quality section known as Title II, which, among other things, established grants with new accountability requirements for states and institutions that prepare teachers (Early, 2001). The state requirements mandated the collection of certain information about the teacher education program and the subsequent ranking of institutions; every year, the institutions are required to report the pass rates of teacher
education program graduates on state licensure examinations; the number of teacher education program enrollees; the required number of hours and faculty-student ratio during student teaching; whether the teacher education program is accredited by the state; and, whether the teacher education program has been identified as low-performing (Early, 2001, Higher Education Reporting Requirements section, para. 2). Low-performing institutions that fail to improve after receiving state intervention may lose eligibility for federal grants and may not enroll in its teacher education program any student who receives student financial aid under Title IV of the Higher Education Act. Each state receiving funding under the Higher Education Act is required to submit an annual report on the quality of teacher education programs to the United States Department of Education, to be cited by the Secretary of Education in a report to Congress on teacher quality (Early, 2001). The annual report requires information about teacher education programs, including: the quality of teacher preparation in the state and how it is measured; admissions requirements; enrollment; standards for teachers and their alignment with standards for students; requirements for each teaching certificate or license; pass rates on each assessment used by states in certifying or licensing teachers as well as the reliability and validity of these assessments; descriptions of alternative routes to teacher certification or licensure; descriptions of how the programs address shortages of highly qualified teachers; preparing teachers to teach students with disabilities or who are limited in English proficiency; and preparing teachers to use technology; and lastly,
the state’s efforts to improve the quality of teaching (United States Department of Education, 2011b).

For 2010, the Center for the Teaching Profession (a department within the ODE) submitted the report, which was based on the 2008 reauthorization of the Higher Education Act (Kastner, 2010). Under section XI of the report, labeled “Technology,” the federal government requires the states to describe activities that prepare teachers to effectively integrate technology into the classroom, including the use of technology to improve teaching and learning resulting in improved student academic achievement (United States Department of Education, 2011b, Section IX Technology, ¶ 1). The report, based on data collected from institutions offering teacher education programs, described Ohio’s institutions as offering a variety of approaches, from stand-alone technology-pedagogy courses, to an integration of technology throughout the teacher education program utilizing “up-to-date media-rich equipment and services” and technology-based assignments. According to institution data, all preservice teachers learn to use technology to enhance the learning experience of students and accurately assess the effectiveness of the learning experience (Kastner, 2010, Section IX Technology, para. 2)

Although Kastner (2010) states that technology instruction is integrated into the teacher education programs at institutions of higher learning, no assessment for technology capabilities exists at the state level for teacher certification. For annual reports, the state gathers data from teacher education institutions, which are required only
to verbally describe how preservice teachers are prepared to use technology (United States Department of Education, 2011b); there is no statistical evidence, such as assessments which measure outcomes, of preservice teachers’ preparedness required by the state or federal government. In Ohio, the education system assumes that teacher education programs are adequately preparing preservice teachers with the competencies to meet ISTE standards, but no state-wide assessment measures whether students (preservice teachers) satisfy that assumption.

**Current Educational Technology Course Guiding Standards**

The Ohio Board of Regents developed the Ohio Articulation and Transfer Policy in response to concerns over the ability of students to transfer effectively among Ohio’s public post-secondary institutions of higher education (Ohio Department of Education, 2011a). Data collected from Ohio’s public post-secondary institutions of higher education showed that almost 25 percent of freshmen students transfer between institutions. National data suggests that sixty percent of Bachelor of Arts recipients attend multiple colleges. In 2009, a total of 36,295 students transferred between 2-year colleges, 4-year universities and 4-year regional campuses to institutions within the University System of Ohio (Mustafa, Glenn, & Compton, 2010). The Ohio Board of Regents created the Articulation and Transfer Advisory Council to facilitate and guide efforts to ease credit transfer among Ohio's institutions of higher education.

Developed by the Council, The Ohio Transfer Module (OTM) describes a transferable, common body of knowledge and academic skills, comprised of 36-40
semester hours, that constitutes a subset or complete set of higher education general education courses for Ohio public post-secondary institutions. Credits received from courses in the OTM, transfer and apply toward general education requirements in destination campuses across the University System of Ohio (Ohio Department of Education, 2011a). The Transfer Assurance Guides were developed to facilitate transfer of credits beyond the general education requirements. The Transfer Assurance Guides (TAGs) include the OTM and additional hours in pre-major and major courses.

Courses in a TAGs are guaranteed to transfer and apply directly to the major. In its totality, the TAGs become a guaranteed pathway for students and is [sic] a very powerful advising tool for faculty and other advisors. There are 39 TAGs in 8 specific discipline areas presently involving 3,500 plus approved matches. The TAGs are developed, approved, and monitored by Ohio's public institutions for higher education. (Ohio Board of Regents, 2011, “Transfer,” para. 1)

TAGs specify equivalency of courses across the University System of Ohio. Credits received in approved equivalent courses transfer and satisfy prerequisite and beginning major requirements across the University System of Ohio (Mustafa et al., 2010).

The Educational Technology course at KSU is a TAGs course. As a TAGs course, it meets the required outcomes established by the Ohio Board of Regents, which must be taught by all Ohio public institutions of higher education. According to the Ohio Board of Regents’ general course description,
This is a required course for all preservice teachers. It encompasses effectively identifying, locating, evaluating, designing, preparing and efficiently using educational technology as an instructional resource in the classroom as related to principles of learning and teaching. Candidates will develop increased classroom communication abilities through lectures, discussions, modeling, laboratory experiences and completion of a comprehensive project. (Ohio Board of Regents, 2011, “General Course Description”)

The required student expectations are to:

1. Develop basic technology competencies through effective use of multiple operating systems in this unit (This set of knowledge and skills is the first of two sets of foundations for the rest of the semester’s activities.)
2. Develop the basic understanding of productivity and utility software capabilities and to be able to use a variety of applications. (This set of knowledge and skills is the second of two sets of foundations for the rest of the semester’s activities.)
3. Develop the basic understanding of using existing and emergent educational technologies in achieving curricular goals including classroom management, curriculum design, and instructional strategies.
4. Develop an understanding of copyright law, use of copyrighted materials, software licensing, and other ethical issues.
5. Develop the ability to align curricular goals, instructional objectives, and the capabilities of electronic media through the principles of effective visual design, specification of clear instructional objectives and the production of electronic media in various digital and non-digital formats. (Ohio Board of Regents, 2011, “Candidates”)

The Educational Technology course at KSU, course number ITEC 19525, lists the TAGs outcomes, the National Council for Accreditation of Teacher Education (NCATE), and the NETS•T standards in a syllabus developed largely by Dr. Chia-Ling Kuo, Ph.D. Assistant Professor in the College of Education. Dr. Kuo also teaches the majority of the Educational Technology courses (J. Piatt, personal communication, August 2011). The course features seven complex assignments, including some involving group work, that satisfy the ISTE NETS•T standards and the TAGs outcomes. The fall 2011 semester syllabus for the ITEC 19525 Educational Technology course is included as Appendix A.

As mentioned in the closing paragraph under the Current State Standards section earlier, no technology assessment has been established at the state or federal level. The only measure of whether preservice teachers possess the technical ability to satisfy the ISTE NETS•T standards therefore comes down to whether or not they successfully complete the Educational Technology course assignments.

The Changing K-12 Student

Jason Piatt, an instructor of an Educational Technology course, remarked that in the previous semester, many students expressed the opinion that they did not need the
required Educational Technology course, though their assignments and assessments instruments indicated otherwise. While their assignments and assessments may have indicated low technology proficiency for other reasons, including a lack of time invested in the assignment, or a lack of understanding of the assignment requirements, some research suggests that students overestimate their ability in some areas of technology, including word processing and spreadsheet use (Grant, Malloy, & Murphy, 2009).

Many of today’s college students have grown up immersed in digital media which they have used for entertainment, communication, learning, and shopping (Brooks-Young, 2005). According to the Kaiser Family Foundation report detailed earlier, more than 93% of school children ages 8-18 surveyed have a computer at home, and 84% of them have high-speed Internet access. Within this population, 70% of them go online every day – usually when at home (57%) rather than other locations. Online access from home has increased by 12 percentage points over the past five years (Rideout et al., 2010, p. 20). The report also shows that 40% of 8- to 18 year-olds primarily use the computer to visit social networking sites such as Facebook, spending an average of 54 minutes a day there. The percentages increased with the ages within the population (Rideout et al., 2010, p. 21).

Although the report was unable to define electronic reading well enough to track it during this study, the study did note a decline of seven minutes a day in the amount of time students spend reading printed newspapers and magazines. The study findings also reflected a gender difference in computer use, with boys using the computer, on average,
15 minutes more per day than girls. The time difference is attributed to the fact that boys played more games and watched more videos (YouTube) than girls; however, girls spent more time on social networking than boys. The gender difference in time spent on the computer only appears among teenagers and the report cites the “clear reason” (Rideout et al., 2010, p. 22) for the difference as the loss of interest in computer games by girls during their teenage years (15- to 18-years of age) (Rideout et al., 2010).

In 2001, Marc Prensky popularized the terms “digital natives” and “digital immigrants” to describe the differences between those who are comfortable with technology and those who are not (Prensky, 2001; Toledo, 2007). Prensky equated digital natives with the Net-generation, also known as N-Gen, the Millennials, or the Millennial Generation. The date for the onset of N-Gen varies depending on the source, ranging from the mid-1970s to 1982 (Koeller, 2012). A review of several educational research articles revealed N-Gen refers to anyone born after 1981; therefore, for the purposes of this document, a start date of 1982 will be assumed.

Prensky (2001) defines digital natives as the first generation to be immersed in technology or the first generation to experience technology as ubiquitous. According to Prensky, the average college graduate of today has spent less than 5,000 hours reading, but over 10,000 hours playing video games, and over 20,000 hours watching TV. And this media environment has contributed to today’s students thinking and processing “…information fundamentally differently from their predecessors” (Prensky, 2001, p. 1).
The National Commission on Teaching and America’s Future (NCTAF) analyzed data from the United States Department of Education Schools and Staffing Survey which is administered every four years. The data from the 2003-2004 survey shows the median age of Ohio teachers to be 43 years (Ingersoll, 2009), while the data from the 2007-2008 survey shows the median age of Ohio teachers to be 39.8 years, and the average age to be 41.2 years (United States Department of Education, 2011c), which means an “average” birth year of 1970. The 2007-2008 data shows that only 18.4 percent of public school teachers are less than 30 years old and that 73.5 percent of teachers are female. Since N-Gen started around 1982, the oldest digital native would be 26 years old in 2008 (the latest survey year), which means they represent only a portion of the 18.4 percent of public school teachers in Ohio younger than thirty.

An article appearing in *T.H.E. (Technological Horizons in Education) Journal* (Gordon, 2011) featured the 2007 report, *Maximizing the Impact: The Pivotal Role of Technology in a 21st Century Education System*, developed by “a task force of leading employers, ed tech advocates, and educators [who] concluded that schools were barely using technology, much less developing the tech skills needed of those entering the workplace” (Gordon, 2011, p. 31). The report was developed through the collaboration of ISTE, Partnership for 21st Century Skills, and SETDA (2007). To produce this report, task force members drew conclusions from 51 sources, including several independent studies from various states. Task force members lamented that, despite the United States being a nation that relies on technology, technology is minimally used in education,
which leaves students unsuited for the current work environment; “In fact, education is
the least [italics in original] technology-intensive enterprise in a ranking of technology
use among 55 U.S. industry sectors, according to the U.S. Department of Commerce”
(ISTE, Partnership for 21st Century Skills, & SETDA, 2007, p. 2). The report stated that
even if all students mastered all core academic subjects, they would still be
underprepared because postsecondary institutions and workplaces want people who
possess 21st century skills (ISTE et al., 2007, p. 3). In an updated report in 2011,
published in T.H.E. Journal, Dan Gordon notes that there has not been much progress
since the release of the 2007 report. Gordon, referring to the current generation of
students entering the job market, stated that the students do not possess the 21st century
skills needed by companies (Gordon, 2011, p. 32).

In 2003, Project Tomorrow, an “education nonprofit organization dedicated to
ensuring that today’s students are prepared to be tomorrow’s innovators, leaders, and
engaged citizens” (Smith & Evans, 2010, p. 21), developed a national research project
called Speak Up. Since 2003, the Speak Up research project has “annually collected and
reported the views of more than 1.85 million K-12 students, teachers, administrators, and
parents representing more than 23,000 schools in all 50 states” (Smith & Evans, 2010, p.
21). The data collection covers a fairly equal number of urban, suburban, and rural
communities across America, with more than half of these being Title I eligible (an
indicator of poverty level) and 42 percent of the included schools having a minority
population of more than 50 percent. In 2009, “Project Tomorrow surveyed 299,677 K-12
students, 26,312 parents, 38,642 teachers, 1,987 pre-service teachers, and 3,947 administrators, representing 5,757 schools and 1,215 districts including public (97 percent) and private (3 percent) schools” (Smith & Evans, 2010, p. 21). The school locations percentages were about the same for urban, suburban, and rural communities (Smith & Evans, 2010, p. 21).

The authors of the article summarized the national findings based on the 2009 Speak Up survey as compelling evidence that K-12 students were taking responsibility for their own learning outside of the traditional school setting. These “Free Agent Learners” leveraged a wide range of learning resources, tools, applications, outside experts, and each other to create learning experiences that met their educational goals. The 2009 Speak Up survey revealed that students seek out other students for collaboration; they not only share information and give/get tutoring via Facebook, but also engage in online assessments to test their understanding of content. Students use cell phone applications to manage their time and take online classes that interest them (Smith & Evans, 2010, p. 22). In other words, the current generation of students are not waiting for school-based classes to catch up with current technology; instead, they are adapting the technology in their personal lives to enhance learning that occurs in the traditional classroom.

The Speak Up project data identifies three essential elements in students’ vision for learning; at the base of each element lies technology. Although these three elements
may radically change the traditional school classroom, for students they would merely incorporate commonplace tools currently used outside the classroom. The three essential elements include social-based learning, untethered learning, and digitally rich learning. The first element, social-based learning, is already occurring according to 2009 Speak Up data, but students would like to create a more formal learning community of experts. The 2009 data reflected that 72 percent of high school students and 65 percent of middle school students communicate with other students through IM-ing (instant messaging), e-mail or text messaging. The data also found that 59 percent of high school students and 51 percent of middle school students listed social networking sites as their primary means of communicating with their friends; they also used the social networking sites to communicate and collaborate for school-related work, but to a lesser degree. About one-third of the students noted two stumbling blocks to using technology more effectively in school, the first being the inability to access personal communications accounts at school, and the second being the inability to send other students messages during the school day for the purpose of collaborating on school-related work (Smith & Evans, 2010).

The second element, untethered learning, refers to the students’ vision of using technology to extend learning outside of school walls, funding constraints, geography, and teacher knowledge or skills (Smith & Evans, 2010). Students want the ability to expand beyond their sometimes-outdated textbooks and homogeneous communities. The last essential element is the students’ vision for digitally rich learning, harnessing technology to drive learning productivity and not just as a method to engage students in
learning. The current generation of students, according to the 2009 data, uses social networking sites to document their daily lives with text, photographs, and video (Smith & Evans, 2010, p. 25). The 2009 data shows that the third element, digitally rich learning environments in games and online textbooks, are supported by students and parents, but only 26 percent of teachers used learning games and 23 percent used online textbooks. The data reflected 66% of teachers only using technology for planning, test preparation or websites (Smith & Evans, 2010, p. 26).

According to the Smith and Evans (2010) article, students have taken over as directors of their own learning in order to incorporate commonplace technology tools into their school environment and learning. The article also mentions that using “…technology as a part of learning is an essential business practice for today’s students, not just an add-on for skill development or motivation” (Smith & Evans, 2010, p. 27). The high school students referred to as “Free Agent Learners” (Smith & Evans, 2010) may already be enrolled in universities across the nation since the data was collected in 2009, and thus theoretically, the free agent learner students could be at the junior level in their college programs. Given that previous studies performed by Speak Up also showed K-12 students embracing technology (Smith & Evans, 2010), it is logical to assume that most university programs have experienced more technology-savvy freshmen, less evidence of a digital divide based on socio-economic status, and less evidence of a gender difference in the use of technology. In an email conversation, Assistant Professor Chia-Ling Kuo (C. Kuo, personal communication, August, 2011) stated she has observed
that students in the required Educational Technology course have similar skills in the use
of technology and that there is no large variation of skills.

Jason Piatt’s comments (J. Piatt, personal communication, August 2011) pointed out
that while many students of the Educational Technology class did not believe they
needed the class, their performance on assessments (assignments) indicated they did. If
the incoming students have been “Free Agent Learners” throughout the K-12 years of
school, they could perceive themselves to be technology capable enough without the
course.

Starting in 2001, all North Carolina students have been required to pass a
computer literacy assessment in order to graduate from high school, and therefore, it is
assumed that every student entering college has some basic computer skills. A study of
North Carolina freshmen examined the students’ and faculty’s perceptions about the
former’s computer proficiency skills and compared the perceptions to reality. The study
found that students’ perceptions were affected by passing the required assessment in high
school and by prior computer experiences and that most students also felt the
introductory computer applications course at the college level was not necessary. Faculty
members shared the perception that students were becoming more computer literate.
This study is discussed in more depth later. However it is necessary to mention here that
the study found that actual student computer proficiency skills were mostly lower than
student perceptions of them (Grant et al., 2009).
Because Ohio requires no technology testing of high school graduates, there is no benchmark for the technology proficiency of Ohio students. There is the likelihood that teachers within the Ohio educational system focused their lessons and teaching on what was being tested (not technology proficiency). Another study focusing on digital natives as preservice teachers found that students had a proficient use of technology within a limited scope: Students were very proficient with the use of technology for social-communication activities, but lacked experience and expertise in classroom technologies. Students also exhibited ineffective skills while conducting searches on the Internet and had difficulty evaluating sources. This study also found that students could not imagine that technology would not be in the classroom as it was a part of life (Lei, 2009). The Lei (2009) study is discussed in more detail later in this chapter.

**Technology as a Tool**

National policy has consistently pointed out the advantages of using technology in the classroom; in particular, the United States Department of Education stated that proficiency with digital technology was quickly becoming a necessary condition for successful participation in society. It is therefore essential for schools to prepare their students to enter this world through the use of information and communication technologies, such as computers, networking, and other digital and non-digital technologies, as well as audio, video and other media tools (United States Department of Education, 2004; United States Department of Education, 2010b). The concept of preparing students for future successful participation in society has been repeated in
national policy for many years and was indirectly recommended years earlier by John Dewey as cited by PBS.org: Dewey believed that ideas should be grounded in experience and education should be based on psychological and physical development as well as the environment outside of school ("PBS.org." 2001, “Innovators,” para. 2).

Assuming the prevalence of technology will continue to grow in American society, K-12 students must acquire expertise in digital technologies such as computers, GPS, flash drives, and other business related technologies. However, it is more important that students learn to use technology to research, analyze, collaborate, evaluate, and communicate information (Larson & Miller, 2011). In 1998, Harold Wenglinsky, a researcher with the Academy for Educational Development, began a series of studies examining the link between computer use and student test performance. The studies were based on analyses of the National Assessment of Educational Progress (NAEP) database. The NAEP database contains the results of 4th-, 8th- and 12th-grade students’ tests of knowledge and skills in mathematics, reading, science, and history, as well as surveys administered to the students at all three grade levels and the teachers at the 4th- and 8th-grade levels, with both tests and surveys conducted annually or biennially. By analyzing the relationship between the NAEP test scores and the survey results, Wenglinsky was able to measure how various activities in the classroom, including computer access and use, correlated with student achievement (Wenglinsky, 2005). In 1998, he analyzed 1996 NAEP data relating to student achievement in mathematics (Wenglinsky, 1998). In 2005, he released studies analyzing 1996 NAEP data on science knowledge and reading for
students in the 4th and 8th grades. He also released a 2001 NAEP history assessment, which measured student knowledge of United States history from the Colonial period to 2001, “… as well as their ability to draw inferences and analyze primary documents” (Wenglinsky, 2005, p. 30).

Wenglinsky’s studies of the NAEP assessments in mathematics, science and reading for 4th and 8th graders found that the quality of computer work was more important than the amount of time spent on computers in the classroom. The quality of computer work was defined by how teachers chose to use technology, which meant that using computers to help students work through complex problems produced greater benefits than using computers for drill and practice on routine tasks. Technology was most effective in enhancing learning when teachers used technology to promote higher-order thinking skills. Unfortunately in 1996 and 1998, less than 30 percent of students were in classrooms where the teacher used technology to promote higher-order thinking skills (Wenglinsky, 2005).

The latest study, based on 12th-grade students’ performance on the 2001 NAEP U.S. history assessment, indicated that the benefits of technology use differed between middle school students and high school students. Middle school students benefited from technology that promoted higher-order thinking, whereas high school students benefited from technology that helped expand their thinking and enhance their work productivity. An interesting part of Wenglinsky’s analysis of the 2001 NAEP data was the finding that the more time students spent on computers at home, the better they were likely to perform
on the history assessment. However, the more time students spent on computers at school, the worse they were likely to perform on the history assessment. Wenglinsky (2005, p. 31) suggests that “…the high-quality schoolwork using computers happens outside school and that teachers can make better use of computers by having students complete such assignments at home rather than at school.” Wenglinsky’s study also indicated that using technology for history-specific tasks, such as reading primary documents, appeared to have no correlation with student performance on the assessment. However, using technology for “generic academic tasks” like word processing; art projects; creating charts, tables and graphs; organizing, planning and implementing large projects; and communicating through email and chat groups, resulted in higher student scores on the history assessment (Wenglinsky, 2005).

**Learning Environments**

According to the 2009 Kaiser Family Foundation report detailed earlier, over 93% of school children surveyed between the ages 8 and 18, have a computer at home, and 84% of them have high-speed Internet access (Rideout et al., 2010). However, inequity of computer exposure still exists due to socioeconomic reasons (Poynton, 2005; Judge, Puckett, & Bell, 2006), and/or due to gender differences (Ilban, Yildirim, & Sapar, 2006; Poynton, 2005). Although socioeconomic differences are decreasing in public schools, the home-versions of socioeconomic differences persist, in other words there are less home computers among lower socioeconomic status families. Wenglinsky’s study found that socioeconomic status greatly impacted achievement scores: Students from more
affluent backgrounds performed better than less affluent students on the NAEP assessments (Wenglinsky, 2005). The use of home computers is associated with reading and math achievement; and yet in 2002 less than half of low-income households had a computer (Judge et al., 2006). Based on 2001 data, Wenglinsky (2005) recommended providing classes in basic computer skills to students who lacked such skills, as the data analysis indicated that about 16% of the students who participated in the NAEP survey did not use e-mail. He also included the statement that 57 percent of children in the USA used a home computer to complete homework (Wenglinsky, 2005, p. 32). His second recommendation was to offer computer enrichment courses for students who planned to go into the science, mathematics or engineering fields after high school (Wenglinsky, 2005, p. 32).

Wenglinsky’s analysis of 2001 data indicated that high school teachers should not plan lessons around the use of technology, but should assume that students would use technology-based tools to complete some of their learning tasks. In other words, instead of assigning a research paper and requiring the use of the Internet, teachers should assign a research paper and assume that students will use technology in a number of ways to complete the assignment. Wenglinsky believes that this student-centered learning approach mirrors the work environment and better prepares the students for employment (Wenglinsky, 2005).

The K-12 Horizon Reports, written as a joint effort of the New Media Consortium and the Consortium for School Networking (CoSN) with funding from Microsoft,
examined “emerging technologies for their potential impact on and use in teaching, learning, and creative expression within the environment of pre-college education” on an annual basis (Johnson, Smith, Levine, & Haywood, 2010). Findings in the reports align with the views of the 2009 Speak Up survey (Smith & Evans, 2010) referred to earlier, which presented compelling evidence that K-12 students were taking responsibility for their own learning outside of the traditional school setting. The 2010 K-12 Horizon report also found that many dynamic activities related to learning are taking place outside of school, but were often undervalued or unacknowledged. In contrast to the classroom setting, students were using online resources to improve their learning and skills and using social networking sites to collaborate with others (Johnson et al., 2010, p. 5). According to these reports, this contrast detracts from engagement in learning because students see little connection between their world outside of school and their experiences in school.

Each K-12 Horizon Report introduced six technologies that would most likely enter mainstream use in the educational setting over the next one to five years, as well as critical trends and challenges that would affect teaching and learning over the same time frame. The technologies, trends, and challenges are identified by a collaboration of experts in business, industry, education, technology, and other fields and are based on published resources, current research, and practice. The trends identified in the 2010 report included technology as a means for empowering students for communication, socializing, and as “… a ubiquitous, transparent part of their lives” (Johnson et al., 2010,
Technology was once seen as isolating, but now is recognized as a primary way to communicate and “…take control of one’s own learning. Multisensory, ubiquitous, and interdisciplinary, technology is integrated into nearly everything we do. It gives students a public voice and a means to reach beyond the classroom for interaction and exploration” (Johnson et al., 2010, p. 4).

Another trend identified by the 2010 report is that technology “…continues to profoundly affect the way we work, collaborate, communicate, and succeed” (Johnson et al., 2010, p. 4). Technology impacts how people work, play, learn, socialize, and collaborate, which makes technology skills critical to success in almost every area. The digital divide was previously based on income, but is now based on availability and access to technology (Johnson et al., 2010, p. 4). The report also identified innovation as a trend that is valued by business, and stimulating student innovation should be a part of the educational system (Johnson, et al., 2010, p. 4). According to the report’s identified trends, if students were not satisfied with the traditional school classroom setting, they would have a growing opportunity to seek learning satisfaction from alternate sources, including online schools.

Under the critical challenges section of the 2010 K-12 Horizon report, the authors pointed out that students have changed, even as schools continued to rely on educational practices and materials that were developed decades ago. The teaching method should shift to a more learner-centered model; and so the tools, materials, and assessments must be adapted to new methods of working and thinking. A large challenge in adapting
education is the existing, firmly established K-12 education system and the differing opinions on how to make progress (Johnson, et al., 2010). Although the national and state education systems have not responded to the current technology-driven students in their quest for synchronization between home life and school, individual teachers have successfully and effectively integrated technology into their classrooms. Research supports that student proficiency with technology may be associated with the classroom teacher; if a classroom teacher is comfortable with technology, students tend to receive more exposure to technology in a positive manner (Banister & Vannatta, 2006; Brown & Warschauer, 2006; Collier et al., 2004; Mayo, Kajs, & Tanguma, 2005; Pearson, 2006; Rosenfeld & Martinez-Pons, 2005; United States Department of Education, 2004).

Teachers who believe that technology is valuable and beneficial for teaching and learning are likely to use technology more frequently than teachers who do not hold these beliefs. Teachers with more technology access and experience appear more comfortable using it in the classroom. Unfortunately, several studies suggest that much of the use of technology in the classroom is to support traditional, teacher-directed instruction, such as using PowerPoint to present a lesson (Ertmer & Ottenbreit-Leftwich, 2010; Smith & Evans, 2010; Wenglinsky, 2005). Using technology mainly to support lecture-based instruction does not meet the recommended standards or guidelines and falls far short of recommended best practice (ISTE et al., 2007). Given that research introduced earlier in this paper supports the idea that students are “free agent learners,” or are satisfying learning quests outside of the classroom (Smith & Evans, 2010), it is important that
students be provided with consistent, professional, knowledgeable guidance towards educational and career goals.

In many cases, the school district culture or context in which teachers work limits individual efforts to integrate technology effectively (Ertmer & Ottenbreit-Leftwich, 2010). However, in a pilot study of the Technology Immersion model, high-need middle schools were immersed in technology by providing each student and teacher with a laptop, along with wireless Internet access, curricular and assessment resources, professional development, and technical and pedagogical support (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010, p. 4). After three years of data collection from 21 ‘immersed’ schools and 21 control schools, the results indicated that teacher implementation was inconsistent and not a good predictor of student achievement, even as students’ use of laptops outside of school for homework and learning games was the strongest implementation predictor of achievement (Shapley et al., 2010, p. 4).

**Technological, Pedagogical, and Content Knowledge**

Lee Shulman, a teacher education researcher, originally came up with the basic concepts of teacher qualifications in 1986 and 1987. These concepts by Shulman, which he called “the knowledge base for teaching,” are still in use today (Ertmer & Ottenbreit-Leftwich, 2010; Ohio Department of Education, 2011a). According to Shulman (1986), teacher knowledge includes knowledge of the subject; knowledge of teaching methods and classroom management strategies; and knowledge of how to teach specific content to specific learners in specific contexts. Shulman’s notion of “the knowledge base of
teaching” was based on the idea that effective teaching occurs at the intersection of content and pedagogy or pedagogical content knowledge. Shulman defined pedagogical content knowledge (PCK) as teachers’ interpretations and transformations of subject-matter knowledge in the context of facilitating student learning. In 1987, he added additional elements to “the knowledge base of teaching,” to now include knowledge of the materials for instruction – including visual materials and media; knowledge of the characteristics of the learners – including their subject-related preconceptions; knowledge of educational contexts – including classrooms, schools, district, and beyond; and knowledge of educational goals and beliefs (Ertmer & Ottenbreit-Leftwich, 2010; Shulman, 1986; Shulman, 1987). Shulman’s inclusion of visual materials and media, suggested that technology content knowledge (TCK) be a component of teachers’ qualifications. However, the unfortunate consequence of retaining “the knowledge base of teaching” (Shulman, 1987) as a focal point for teacher qualifications, is the lack of importance placed on the use of technology in teaching (Ertmer & Ottenbreit-Leftwich, 2010; Ohio Department of Education, 2011a).

Due to consistent pressure over decades from federal, state, and local governments to effectively integrate technology into the classroom, knowledge of technology must be integrated into Shulman’s core ideas and adopted as the current “knowledge base of teaching.” In 2006, Mishra and Koehler introduced the technology pedagogical content knowledge (originally known as TPCK, now known as TPACK, or technology, pedagogy, and content knowledge) framework for technology integration.
Mishra and Koehler have worked to extend Shulman’s core ideas (PCK) to include technology (TPACK) in the most current framework for effective teaching with technology. The TPACK framework suggests that effective technology integration requires that teachers understand and negotiate the relationships between Technology, Pedagogy, and Content Knowledge. A teacher capable of negotiating the TPACK relationships has an added dimension or level of expertise beyond the PCK level (Koehler & Mishra, 2009).

Koehler & Mishra (2009) discuss the difficulty of defining the word technology and briefly describe some of the broad definitions of technology from pencil to computer. Using those definitions, they ascribe the difficulty in integrating digital technologies (like computers, software and handheld devices) in the classroom, to their being usable in a multiplicity of ways (no specific use), their instability because of rapid changes, and their opacity (the inner workings are hidden from users). The authors also note the “bias” of each technology — a term referring to the need to match uses of a technology to circumstances that will maximize benefits, as an additional difficulty in the integration of technology. As an example, the authors discuss how email is asynchronous, rather than synchronous, and how communications via email are convenient but lack inflection, tone, mood or facial expressions. Specific technologies may place constraints on the time, situation, and manner in which a teacher may incorporate that technology into the classroom (Koehler & Mishra, 2009).
Since its introduction, the TPACK framework has been investigated in educational technology research as a model for the knowledge that supports effective technology integration in the classroom and has been applied to the process of integration of technology into teacher education, teacher professional development and, ultimately, the classroom (Koehler, 2011). A table of TPACK-related research (Appendix G) is discussed in greater detail a little later in this chapter. As teachers tend to teach what they were taught and in the manner in which they were taught, preservice teachers need to experience a technology-enhanced, constructivist setting where the instructor acts as a facilitator in the learning environment. The technologies used by preservice teachers in the teacher education program must be similar to the technologies to be used in the classroom (Banister & Vannatta, 2006; Ertmer & Ottenbreit-Leftwich, 2010).

In addition to providing instruction and influence to preservice teachers’ future instructional practices, teacher education programs offer opportunities to observe demonstrations of preservice teachers’ knowledge, attitudes, and beliefs about integrating technology into the classrooms. According to a study by Jason Abbitt (2011), researchers found that teachers’ (preservice and inservice) individual knowledge and beliefs regarding computers and technology predict classroom technology use. Ertmer and Ottenbreit-Leftwich (2010) found that teachers must possess technology knowledge and feel comfortable using it in order to effectively integrate technology into the classroom. Abbitt (2011) summarized Bandura’s theory of self-efficacy as the expectation that belief in a higher ability would serve as a support for attaining that ability, whereas beliefs in
lower ability may discourage or otherwise hinder an individual from proficiency with the ability. Self-efficacy belief directly impacts the amount and duration of effort put into an action to obtain the desired results. Therefore, applying Bandura’s theory to the teacher education programs means that the successful acquisition of TPACK skills will lead to increased self-efficacy beliefs (Abbitt, 2011), which in turn should lead to the increased probability of preservice teachers becoming inservice teachers who effectively integrate technology in the classroom (Abbitt, 2011; Banister & Vannatta, 2006; Ertmer & Ottenbreit-Leftwich, 2010).

Using the TPACK framework as a guide, preservice teachers should be integrating technologies into the context of subject areas that they plan to teach. The focus should shift to teaching preservice teachers how to learn and implement new technologies on their own when the teaching and/or learning need arises, rather than teaching them word processing or presentation software (Williams, Foulger & Wetzel, 2009). This approach, described by Williams, Foulger, and Wetzel (2009) seems to contradict Wenglinsky’s 2005 study of 12th-grade students’ performance on the 2001 NAEP U.S. history assessment, in which he recommends the use of technology for word processing, organizing, presenting and similar tasks. In the study, Wenglinsky asserted that the data indicated that the effectiveness of technology differs in middle school students and high school students, and that high school students used technology in a manner that promoted higher-order thinking at home but not during subject-specific tasks at school (Wenglinsky, 2005). Any appearance of a contradiction of the application of
TPACK (Williams, et al., 2009) may be attributed to the grade-level and responsibility-levels of students, including the fact that the 12th-graders took charge of their own mastery of technology so that they could effectively utilize it as a learning tool (Wenglinky, 2005).

Both studies indicate that placing the focus on technology, whether through teaching preservice teachers technology applications or utilizing subject-specific technology, fails to instill the skills needed to effectively integrate technology, new and current, into the teaching and learning process (Nelson, Christopher & Mims, 2009; Wenglinsky, 2005; Williams, et al., 2009). Learning to teach must include teaching the core concepts in an integrated manner to emphasize the interconnectivity of technology, pedagogy, and content (Kohler & Mishra, 2009).

Koehler and Mishra (2009) reiterate the need to educate preservice and in-service teachers beyond the limitations of the traditional professional development workshop. A workshop may offer the basics of TPACK but will not be able to help learners develop an ability to apply its principles in an effective manner that connects technology with subject matter and pedagogy (Koehler & Mishra, 2009). Koehler and Mishra (2009) describe TPACK as a framework which provides structure for the development and creation of professional development programs or courses, that will assist learners with the effective integration of technology as one of the core concepts of teaching (Koehler & Mishra, 2009; Shulman, 1986).
Ertmer and Ottenbreit-Leftwich (2010) outline the difficulty of the integration of technology through professional development workshops and recommend extended, in-depth professional development that includes the development and creation of technology-based lessons for individual classroom use (Ertmer & Ottenbreit-Leftwich, 2010). Graham et al. (2009) published a study of in-service science teachers who participated in an eight day TPACK professional development program. The results of this study indicated teachers had greater confidence in using the TPACK framework to develop, create, and implement lessons in the classroom after attending this extended program. The study involved fifteen in-service teachers participating in a professional development program for science teachers, offered through Brigham Young University in 2008. Teacher participants were given a pre- and post-questionnaire to measure confidence related to the four TPACK constructs that involve technology: TK, TPK, TCK, and TPACK. The survey also included two open-ended questions that asked participants to describe how they currently used technology in a content-specific manner; what technologies they would like to use; and how they would use them.

The pre-questionnaire indicated that participants were confident with basic productivity software like MS PowerPoint and Word, but were less confident in their ability to produce media-rich materials or use science-specific technologies (Graham et al., 2009).

Graham et al. (2009) studied four of the seven distinct categories of teacher knowledge included in the TPACK framework. The TPACK framework introduces the relationships and the complexities between the three basic concepts or components of
knowledge, namely: technology, pedagogy and content. At the intersection of these three components of knowledge, is an intuitive understanding of teaching content with appropriate pedagogical methods and technologies. Seven components (see Figure 3) are included in the TPACK framework: Technology Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK) (Koehler & Mishra, 2009).

TK refers to the knowledge of various technologies, ranging from pencil and paper to the Internet, digital video and software programs. CK is knowledge about the subject matter that is to be taught or learned, while PK refers to the methods and processes of teaching, including knowledge of classroom management, assessment, lesson plan development, and student learning. PCK refers to teachers’ interpretations and transformations of subject-matter knowledge in the context of facilitating student learning, or a blend of content and pedagogy to facilitate student learning (Shulman, 1986). TCK refers to the knowledge of how technology can create new representations for content, and how teachers can use a specific technology to change the way learners practice and understand concepts within a content area. TPK refers to knowledge of how various technologies can be used in teaching and understanding that using technology may change how a teacher teaches. As a whole, TPACK refers to the knowledge required by teachers to integrate technology into their teaching in any content area, which
means teachers must have an intuitive understanding of the dependent relationship between the three basic components of knowledge (CK, PK, and TK) by teaching content via the appropriate pedagogical methods and technologies (Koehler & Mishra, 2009).

The TPACK framework focuses on designing and evaluating teacher knowledge related to effective student learning in several content areas. Using the TPACK framework as a measure of teacher knowledge may impact education programs for preservice teachers and professional development programs for in-service teachers (Schmidt et al., 2009). In the 2009 study investigating the use of TPACK as a measure of preservice teacher knowledge, the authors noted the need to develop reliable assessment approaches for measuring TPACK and its components, to better distinguish the more effective professional development approaches. The authors also stated that “… there is a continual need to rethink our preparation practices in the teacher education field and propose new strategies that better prepare teachers to effectively integrate technology into their teaching” (Schmidt et al., 2009, p. 126). Koehler and Mishra (2009) built upon a history of using survey methods to assess teachers’ levels of technology integration in order to develop their own survey to track changes in teachers’ perceptions of their understanding of content, pedagogy, and technology, in a course focusing on the design of educational technology. Their survey did track some changes, but these were course-specific and could not be generalized or applied to other areas. Other researchers (Angeli & Valanides, 2009; Archambault & Crippen, 2009) have also used survey-based approaches to measuring TPACK with some success and limitations. As they continued
Technological Pedagogical Content Knowledge (TPACK) attempts to identify the nature of knowledge required by teachers for technology integration in their teaching, while addressing the complex, multifaceted and situated nature of teacher knowledge. At the heart of the TPACK framework, is the complex interplay of three primary forms of knowledge: Content (CK), Pedagogy (PK), and Technology (TK). The TPACK framework builds on Shulman’s (1986) idea of Pedagogical Content Knowledge. Figure and figure explanation used with permission from http://tpack.org/ (Koehler, 2011).
to build on survey history, Koehler and Mishra paired with several other researchers to develop a fast, reliable, self-assessment survey that measured preservice teachers’ understanding of each component of the TPACK framework (Schmidt et al., 2009). The conclusions of the Schmidt et al. (2009) study indicated that the survey instrument provided a “promising starting point for work designed to examine and support preservice teachers’ development of TPACK” (Schmidt et al., 2009, p. 137). The conclusion also stated the authors’ intention to conduct a longitudinal study with the preservice teachers who participated in the study to examine the development of TPACK on completion of the content area methodology courses and student teaching (Schmidt et al., 2009, p. 137). The research plans also included following these preservice teachers during their first few years of teaching (Schmidt et al., 2009, p. 137). When contacted about the status of the longitudinal study, neither Koehler nor Schmidt replied, and the study does not seem to have been published, if it was ever conducted.

**Frameworks for Integration**

While other frameworks or models of integrating technology into the classroom – also known as Information and Communication Technologies (ICT) integration – do exist, teachers must be competent to devise the best method of integration based on individual classroom needs. Since TPACK builds on accepted guidelines for teacher knowledge, it may be more readily accepted than other frameworks. However, several other frameworks (some referred to as models) are also associated with the core ideas of content, pedagogy, social interaction, and technology:
The Pedagogical Technology Integration Content Knowledge (PTICK) (Brantley-Dias, Kinuthia, Shoffner, DerCastro, & Rigole, 2007); a strand of TPCK that specifically emphasizes relevant knowledge of information and communication technologies (ICT-TPCK) (Angeli & Valanides, 2009); and the Pedagogy, Social interaction, and Technology (PST) model (Wang, 2008).

The PTICK framework as described by Brantley-Dias et al. (2007) is built on the TPACK framework concepts as defined by Koehler and Mishra in 2006 with the addition of reflective and community knowledge; particularly as related to technology integration. PTICK contains five dimensions or forms of knowledge: technical procedural knowledge (knowledge and ability to operate the technology), technology integration conceptual knowledge (integrated concepts, principles, strategies, and ideas behind effective uses of technology for teaching and learning), pedagogical content knowledge (knowledge and ability to transform subject matter content addressing learners’ needs), reflective knowledge (metacognitive abilities to reflect, problem-solve and learn from experiences), and community knowledge (knowledge of local community, as well as participation in a professional learning community). According to Brantley-Dias et al. (2007) field experiences during the preservice teachers’ education program may provide an opportunity to develop these skills, but, as with the current study, may not be available until later in the course work and may be limited by various factors depending on placements.
The reflective component of the TPICK framework is described as preservice teachers’ abilities to reflect upon and make sense of the problems, find solutions, and assimilate the new information associated with experiences relating to teaching with technology. The community knowledge involves an understanding of the school, community, and state in which the teacher teaches, including an understanding of the barriers to technology integration. The authors suggested that teachers may join or form peer groups which could educate communities on the advantages of technology (Brantley-Dias et al., 2007).

The authors used a problem-centered approach in an attempt to provide applicable theory to the practical experience for preservice teachers. The problem-centered approach included having participants write three course reflection papers (in the beginning, middle, and at the end of the semester), four case study responses and four case study reflections. There were 33 participants in the study and all were enrolled in a 45-hour, four semester intensive alternative teacher education program. Participants were assigned problem-based exercise cases (Brantley-Dias et al., 2007, p.145). The participants, grouped by case, met online for discussion and submitted a group report based on the discussions. Group reports were discontinued due to excessive complaints from some of the participants. Each participant also wrote a reflection paper about each of the four assigned cases. During the data analysis phase, internal pattern matching and cross-case analyses were used by the researchers to address the research questions. The course reflection papers were intended to reveal the participants’ perceptions about their
ability to integrate technology into content areas. Over the period of the course, the papers indicated an increase in the participants’ perceptions of their ability to integrate technology as well as solve technical problems. The participants also demonstrated an understanding of PTICK concepts in their responses.

ICT-TPCK is described by the authors as a strand of TPCK that specifically emphasizes relevant knowledge of information and communication technologies (ICT) (Angeli & Valanides, 2009). The PCK part of this framework is based on Shulman’s (1986) concepts and, similar to other studies, the authors reiterate that Shulman did not specifically discuss technology and its relationship to content, pedagogy, and learners (Angeli & Valanides, 2009; Ertmer & Ottenbreit-Leftwich, 2010; Koehler & Mishra, 2009). Similar to the TPICK framework, ICT-TPCK uses TPCK as the conceptual base. However, Angeli and Valanides (2009) state that Koehler and Mishra (2009) failed to show TPCK as a unique body of knowledge when they first introduced the concept in 2007. Through a series of empirical investigations, Angeli and Valanides concluded that TPCK is a body of knowledge different from its constituent components (CK, PK, TL, TCK, TPK, and PCK). In particular, using data collected in an earlier study (Valanides & Angeli, 2008), Angeli and Valanides (2009) concluded that teachers who had extensive teaching experience and knowledge of several computer programs, but were not specifically trained how to teach with computers, did not perform significantly better on designing computer-mediated lessons for their students than other teachers who had less teaching experience, good computer skills, and no specific training in the educational use
of computers. However, after specific training on how to teach with computers, the more experienced teachers outperformed the less experienced teachers (Valanides & Angeli, 2008). These conclusions were based on data collected from ten secondary science teachers with varied expertise and experience. The participants self-reported the number of years teaching, knowledge of learners, computing skills, pedagogical knowledge, and content knowledge. The subjects attended sessions which demonstrated tools (computers, software) and attended workshops on how to use certain tools. Participants trained in pedagogy, curriculum development, and instructional design, and could examine several models of computer integration in various science topics. The participants then created ICT-enhanced instructional lessons which were assessed by the researchers. The assessment was based on several considerations: Selection of science topics to be taught using computers; the use of computers as a cognitive tool for scaffolding students’ thinking through presentations to transform science content (as compared to using the tools as a delivery vehicle for the textbook); the use of computers to support constructivist learning; and the integration of computer activities with appropriate pedagogy in the classroom (Valanides & Angeli, 2008). Similar results were found with preservice teachers by comparing freshmen with no specific training in the educational use of computers, to sophomores and juniors who also had no specific training in the educational use of computers. After receiving specific training in educational uses of computers, the sophomores and juniors outperformed the freshmen (Angeli & Valanides, 2009).
ICT-TPCK includes TPCK’s three knowledge bases, subject matter knowledge, pedagogical knowledge, and technology (restricted to ICT in this framework); as well as two additional elements: the knowledge of students, and the knowledge of the context within which learning takes place. The two additional elements were added as a result of studies (Valanides & Angeli, 2008) of in-service teachers, where the researchers observed that teachers drew upon their knowledge of students’ content-related difficulties as well as their knowledge of context; that is, what worked and what did not work in their classroom, and how teachers needed to teach to facilitate students’ learning. Koehler and Mishra (2009) and Shulman (1986) describe these elements as a part of pedagogy. ICT-TPCK is defined “. . . as the ways knowledge about tools and their pedagogical affordances, pedagogy, content, learners, and context are synthesized into an understanding of how particular topics that are difficult to be understood by learners, or difficult to be represented by teachers, can be transformed and taught more effectively with ICT, in ways that signify the added value of technology” (Angeli & Valanides, 2009, p. 158). Represented by Figure 4, ICT-TPCK is described as “a body of knowledge that grows continuously with systematic engagement in rich teaching experiences” (Angeli & Valanides, 2009, p. 159).
Figure 4. The ICT-TPCK Framework.

The ICT-TPCK framework shows that interaction with learners, context, content, ICT, and pedagogy result in continuous growth of the ICT-TPCK body of knowledge (Angeli & Valanides, 2009, p.159).
The PST model, shown in Figure 5, is intended to help teachers effectively integrate ICT into their curricula by providing a generic model which consists of three fundamental elements: pedagogy, social interaction, and technology. According to Wang (2008), pedagogical design is “an ongoing process, which cannot be predetermined before a lesson” (Wang, 2008, p. 412). Pedagogical design must include the selection of proper content, resources, and use of the resources “in an effective way in order to scaffold students during learning processes” (Wang, 2008, p. 412). Wang (2008) also outlines the importance of social activities in daily life and suggests that similar activities may be channeled through the computer to collaborate with other students. Wang maintains that the design of a learning environment must provide a safe and comfortable place where learners can easily share information with others. The technological component, in a technology-enhanced learning environment, must consist of an online learning environment which is available at all times. Access must be easy and fast with an appealing user-friendly interface (Wang, 2008).

According to Wang (2008), all three components of the PST model are critical for an effective technology-enhanced learning environment. Although pedagogical design and social interaction are the primary factors that influence the effectiveness of learning, the availability of technological support determines to what extent the other two components may be successfully applied in the classroom.
All of the models or frameworks – TPACK, TPICK, ICT-TPCK, and PST – feature core elements of content (what is being delivered or taught), pedagogy (how to deliver or teach), social interaction, and technology (how to support learning through ICT). Each model uses terminology slightly differently, and has some variations.

According to Shulman (1986), content refers to subject topics, concepts, theories, ideas, or organizational frameworks. The TPACK model clearly depicts content as a core idea, and refers to it as a construct or a primary component of knowledge (Koehler & Mishra, 2009), like the TPICK and ICT-TPCK frameworks. However, the PST model also includes content within the primary components of pedagogy and social interaction. Teachers and students may be content contributors in the learning environment but
teachers must be able to develop a pedagogical design that is effective for student learning (Wang, 2008).

Pedagogy represents the complex task of teaching. The TPACK and TPICK models adhere to Shulman’s definition of pedagogy in his body of knowledge (Shulman, 1986). Pedagogy includes all aspects of how a teacher delivers instruction to facilitate learning and assess students’ understanding (Shulman, 1986). Pedagogical knowledge is considered a core concept or construct in the TPACK model or framework (Koehler & Mishra, 2009) and the TPICK model or framework (Brantley-Dias et al., 2007). However, the ICT-TPCK framework separates the knowledge of students and the knowledge of context from pedagogical knowledge. In the PST model, the key component of pedagogy refers to a teacher’s ability to design a learning environment or to select an ICT tool for achieving specific learning objectives. The learning environment is expected to be flexible enough to support various teaching strategies (Wang, 2008).

Social interaction, including that which occurs in an online learning environment, is not clearly outlined in the TPACK, TPICK, or ICT-TPCK models, but is linked to pedagogical (including context and learner knowledge elements in ICT-TPCK) and technological knowledge. Pedagogical knowledge requires an understanding of social constructivist theories and their applications to learning contexts; whereas technological knowledge would include knowledge of social networking media. However, technological pedagogical knowledge (TPK) would enable teachers to design lessons
which involve social networking media to better engage students in social learning and enhance the learning process (Koehler & Mishra, 2009).

The PST model considers social affordances to be one of the key features of a technology enhanced learning environment. As mentioned in the brief introduction to PST earlier, Wang (2008) states that the design of a learning environment must provide a safe and comfortable place where learners can easily share information with others. The learning environment must include different forms of communication: both asynchronous and synchronous. The synchronous communication should allow an assortment of methods, including video, audio, and text. Wang also stresses that the technological component in a technology-enhanced learning environment must consist of an online learning environment which is available at all times (Wang, 2008).

The largest difference between the models seems to be the technological component. In the TPACK, TPICK, and ICT-TPCK models, technology knowledge is a prerequisite for teachers; that is, teachers must be knowledgeable enough to select appropriate technologies based on the learning environment, and be able to transfer that knowledge, or apply a basic understanding of technology, to emerging technologies (Angeli & Valanides, 2009; Brantley-Dias et al., 2007; Koehler & Mishra, 2009). The PST model considers technology to be a designing and supportive tool for learning environments, specifically those that are technology-rich (Wang, 2008). The PST model seems to view technology as a tool or support for specific avenues of learning, rather than as a normal part of everyday life in many aspects of the school environment.
The TPACK, TPICK, and ICT-TPCK models focus on what knowledge and skills teachers must have in order to effectively integrate technologies into the curriculum while the PST model focuses on what a technology-rich learning environment must have so that effective learning may take place. Because the TPACK model focuses on teachers’ competencies, it is the logical choice to use as an education guide for preservice teacher education programs (Koehler & Mishra, 2009). Even though the TPICK and ICT-TPCK models are based on the same concepts, the TPACK framework is more widely accepted according to the online journal *Contemporary Issues in Technology and Teacher Education (CITE)*.

*CITE* recently published an editorial titled, “Preparing Teachers for Tomorrow’s Technologies,” which reported that the TPACK framework is the topic of more than 200 articles in peer-reviewed journals, more than a dozen doctoral dissertations, and will be included in the fourth edition of AECT’s *Handbook of Research on Educational Communications and Technology* as well as the AACTE *Handbook of Technological Pedagogical Content Knowledge* (2008) (Dilworth et al., 2012). The editorial also stated that the single largest category of submissions for the most recent *CITE* conference was TPACK-related. The authors interpret this as evidence that presenters are increasingly aware of the need to use an integrated framework in order to prepare teachers to use technology in the classroom. Unfortunately, many of the TPACK-related papers submitted to the *CITE* conference do not reflect best practices related to TPACK, and the authors interpret this as an indication that teacher education faculty members may not
fully understand the application of the TPACK framework, leaving little hope of having preservice teachers fully prepared to effectively integrate technology into the classroom (Dilworth et al., 2012).

As mentioned earlier, the Ohio licensing requirements for teachers do not specify any technology knowledge; but instead focus on teacher education programs. All teachers must complete a qualified education program at an accredited four-year university, which typically consist of a combination of curricula and fieldwork. The curricula often include instruction on foundational knowledge and skills, pedagogy, and preparing future teachers to research, design and implement learning experiences in their field of study. The fieldwork component can include field observations, student teaching, and an internship. Although individual courses have assessments through assignments and tests, there is no standard assessment mandated by the state. The ODE website provides a link to the Ohio standards for the teaching profession, which likewise does not mention any technology requirements (Ohio Department of Education, 2011a). A result of the Ohio standards may be that teachers – both in-service and preservice – may not consider technology proficiency a skill needed to be a good teacher. Teachers may assume they are doing a great job even if technology is entirely absent from their classrooms. Preservice teachers may not recognize the importance of technology in teaching based on the standards and the curricula of the education program (Ertmer & Ottenbreit-Leftwich, 2010; J. Piatt, personal communication, August 2011).
Conversations with faculty members about the integration of technology into the teacher education course at KSU revealed that the use of technology is encouraged by administration. However, degrees of technology use vary among individual faculty members and seem to be inconsistent (J. Piatt, personal communication, August 2011). A review of the courses offered in the teacher education program does not offer enough detail to determine what technology, if any, is used during the courses, but some faculty appear to be standing by outmoded forms: Jason Piatt mentioned that he still gets requests for overhead projectors from some faculty members (J. Piatt, personal communication, August 2011).

Given that there is no assessment for technology proficiency at the state level and no assessment for incoming freshmen outside the individual courses; the technology capabilities of preservice teachers are difficult to determine with any certainty. The required Educational Technology course employs the ISTE NETS•T standards and TAGs requirements as objectives for the course, and these skills are assessed through course assignments. However, such assessments do not reflect a complete picture of technology capability, or whether the preservice teachers will incorporate technology into the classroom. As mentioned earlier, Jason Piatt, Direction of Technology and Distance Education in the Instructional Resource Center at KSU, indicated that he teaches one section of the Educational Technology course, where the majority of the students felt they did not need the course. However, the assessments (assignments) indicate that they do need it. While K-12 students have taken charge of their technology education as “Free
Agent Learners” (Smith & Evans, 2010), current students in the College of Education at KSU may lack the basic skills to perform effective Internet searches, evaluate sources, and effectively integrate technology into the classroom much like the students who participated in the Lei (2009) study. Since the State of Ohio currently has no test for technology proficiency as a part of teacher certification, teachers, both in-service and preservice, may undervalue the importance of technology in the classroom, in spite of the national push and the NETS•T and NETS•S standards (Johnson et al., 2010).

**Conditions Necessary to Educate 21st Century Teachers**

Given that research shows the importance of technology, and that classrooms are lagging behind society in the use of technology, and that students are becoming masters of their own education and learning at home; how do we get our teachers, in-service and preservice, to effectively embrace and integrate technology into the classrooms? Professional development for in-service teachers has been attempted and has met with limited success (Shapley et al., 2010) because, as mentioned earlier in this paper, empirical evidence has shown that teachers tend to teach as they were taught (Struyven et al., 2008). And, because teachers tend to teach what they were taught and in the manner in which they were taught, K-12 students and preservice teachers need to experience learning in a technology-enhanced, constructivist setting where the instructor acts as a facilitator in the learning environment (Banister & Vannatta, 2006; Ertmer & Ottenbreit-Leftwich, 2010).
Because teachers hold on to what and how they were taught, effective professional development for teachers means changing teachers’ knowledge culture and beliefs – a daunting task. In order to get teachers to adopt new beliefs about teaching and learning, they need to understand the positive impact of the new beliefs on students. Teachers may also perceive a need for changes by observing the effective technology integration achieved by other teachers (Ertmer & Ottenbreit-Leftwich, 2010). Ertmer and Ottenbreit-Leftwich (2010) cited a study by Elmore, Peterson, and McCarthy which concluded that teachers are unlikely to change their practices unless they are exposed to the desired technology-integrated teaching practice. Of course, all of these changes would have to be supported by the environment in which they work (Ertmer & Ottenbreit-Leftwich, 2010).

Research introduced earlier that supported the idea of students as “free agent learners,” because of a vast difference between their technology-rich world outside of school and their school experience (Smith & Evans, 2010) supports the idea that technology be effectively integrated into K-12 classrooms as quickly as possible to eliminate the lag between school and the outside world. However, instead of having the students lead the way (Johnson et al., 2010; Smith & Evans, 2010; United States Department of Education, 2010b; Wenglinsky, 2005), an effective method must be determined for fully integrating the education system with technology to increase student achievement (Ertmer & Ottenbreit-Leftwich, 2010; Johnson et al., 2010; Smith & Evans, 2010; United States Department of Education, 2010b; Wenglinsky, 2005). A step in the
right direction came when Ohio mandated the Educational Technology course as a TAGs course (see section Current Educational Technology Course Guiding Standards for an explanation of TAGs) (Ohio Department of Education, 2011). All preservice teachers are now required to take this course, a requirement consistent across any accredited teacher education program in the state of Ohio. The course objectives for the mandated Educational Technology course at KSU College of Education are adopted directly from the ISTE NETS•T standards and the TAGs outcomes. According to the syllabus (Appendix A), the objectives are met by the successful completion of seven complex assignments, some involving team work.

The research introduced earlier appears to indicate that ensuring preservice teachers are well-prepared to integrate technology into the classroom is the most effective way to make Ohio K-12 classrooms a more technology-rich learning environment. Despite the differences in the availability of computer hardware, software, and the Internet between districts, technology-savvy teachers can utilize students’ home computers effectively to meet NETS•S standards (Ertmer & Ottenbreit-Leftwich, 2010; Johnson et al., 2010; Rideout et al., 2010; Smith & Evans, 2010; United States Department of Education, 2010b; Wenglinsky, 2005). Kovalik, Jensen, Schloman, and Tipton (2010) published an article examining those portions of the current ISTE NETS•T and NETS•S standards which incorporate aspects of information literacy. Citing several sources, the authors reiterate the current need to incorporate information literacy into higher education and the importance of incorporating it into teacher education programs.
The authors point out the “widespread belief by faculty” (Kovalik, Jensen, Schloman, & Tipton, 2010, p. 147) that students enter college already possessing these skills, or that they have, or will pick them up on their own. The authors advocate for information literacy assessment of preservice teachers through a collaboration between librarians and teaching staff, because “deficiencies and strengths” (Kovalik, Jensen, Schloman, & Tipton, 2010, p. 149) in the teacher education program curriculum can be identified and remedied so that its graduates will have the skills and knowledge necessary to effectively integrate technology into the classroom and teach information literacy (Kovalik, Jensen, Schloman, & Tipton, 2010).

Research on current teacher technology capabilities, professional development for in-service teachers, and the technology capabilities of current college students, seems to underscore the importance of teacher education programs to ensure the effective integration of technology into the classroom. In order to determine the effectiveness of a teacher education program, it is important to establish a baseline of technology capabilities for current students. The logical place to check before-and-after technology capabilities is the required Educational Technology course. If students truly do not need to take this course, then why do their assessments not reflect this, and where did they acquire their skills? Would these students be able to satisfy the NETS•T standards and apply the NETS•S standards in the classroom before taking the Educational Technology course? Will they be able to meet the standards after the course? In spite of the long-term national push to effectively incorporate technology into the classroom, K-12 students are
still not receiving the learning and achievement benefits of an effectively integrated classroom (United States Department of Education, 2010b). With no state-level testing at the certification level, and a lack of professional development in our school districts, the responsibility of reaching the national vision of technology education falls on teacher education programs that currently prepare preservice teachers who will instruct Ohio’s students in 21st Century skills.

Rationale for Using Survey

Surveys have been used by several researchers to collect technology-related data, including attitudes, perceptions, and use. In 2008, Vannatta and Banister of Bowling Green State University (BGSU) in Ohio, used a survey to measure the impact of assessing technology competencies of incoming teacher education students. Previously, in 2006, Banister and Vannatta executed a study of the four-year process of revamping the Teacher Education program to ensure the effective integration of technology at every level of the program. BGSU developed the Assessment of Technology Competencies (ATC), which is included as a part of a required electronic portfolio. All students at the College of Education at BGSU must take a performance-based assessment which aligns with ISTE NETS•T standards and evaluates the same technology skills included in the Educational Technology course at KSU. The ATC is a five-page document that gives details on the digital products that the students must be able to produce during a proctored, two-hour session in a computer lab. Producing the digital products involves using word-processing, spreadsheets, presentation and graphics software applications. In
addition, students must demonstrate Internet and file management expertise in order to successfully complete the assessment. BGSU opted to develop their own assessment rather than use a commercial standardized assessment, because doing so increased their control over the content and enhanced security by allowing them to house everything on university servers. Administering an assessment test for all incoming freshmen enabled them to establish a baseline of technology abilities so technology could be integrated into courses rather than be taught as a precursor before students would be able to function in the course (Banister & Vannatta, 2006). A site that offers a practice test and practice test rubric for the ATC and tutorials to prepare students for the ATC can be found at: http://edhd.bgsu.edu/atc/info/ (S. Banister, personal communication, August 30, 2011).

The ATC, aligned with NETS•T standards, was changed when the new standards were released in 2007. Over the years, the ATC has been honed to a 50-minute session in a computer lab. Over a three year period, approximately 1,000 BGSU students have completed the ATC with less than 40 percent passing all sections on the first attempt. Creating spreadsheet formulas and utilizing PowerPoint templates proved to be most difficult for students, causing them to fail those sections. Students who opted to retake the ATC had a pass rate of approximately 95 percent on all sections. Pass rates have increased steadily over the years as the importance of the ATC has been better communicated by faculty and other students. Students who failed the ATC after two attempts had to complete a basic computer course before they were permitted to continue in the education program (Vannatta & Banister, 2008).
Although students are not required to pass the ATC, failure impacts their grade in an introductory education course. Vannatta and Banister (2008) used a self-reporting survey in a junior-level education course to collect and analyze student perceptions of the ATC. The survey used to assess the impact of the ATC included 13 items pertaining to students’ subsequent use of those technology skills assessed in the ATC; the value of the ATC in furthering additional technology skills; how much high school prepared the students to pass the ATC; the technology resources that have come to be utilized since the ATC first came into existence; subsequent courses that furthered the students’ technology capabilities; and the students’ overall response to the ATC. The scale used was a four-point Likert scale. The survey was administered once during fall 2005 to 148 students enrolled in a junior-level education course about diversity. The researchers administered the survey during the last ten minutes of class. In this particular class, 70 percent of the participants had passed all sections of the ATC after two attempts. Interestingly enough, the survey showed that students felt that their high school prepared them adequately to pass the ATC even though most of them did not pass all sections on their first attempt (Vannatta & Banister, 2008).

As explained in two examples above, universities use one or more methods to collect data on the technology capabilities of preservice teachers. Banister and Vannatta (2006), Gaide (2004) and Kenney (2006) for instance, used assessment tests for technology capabilities of incoming students. Gaide (2004) enumerated the reasons that a community college in Maryland opted to use an in-house developed technology
assessment called Core Competency Assessment which was aligned with national standards. The advantages of an in-house assessment were similar to those stated by Banister and Vannatta (2006) and included: security, content control, and establishment of a technology capability baseline for all students and faculty (Gaide, 2004).

Vannatta and Banister (2008) also used a combination of an assessment and a survey (as explained earlier in this section) as did Grant, Malloy and Murphy (2009). Grant et al. (2009) used a survey to determine 173 students’ perceptions of technology skills as compared to their actual skills, which were measured using an assessment instrument. The students of North Carolina Central University who participated in this study were required to take an introductory computer applications course; the course objectives of which were aligned with national technology standards. Most students indicated on the survey that they felt the introductory computer applications course was unnecessary because the state of North Carolina had implemented a computer literacy assessment. Passing the state computer literacy assessment is required for graduating high school. The researchers used the survey to capture demographic information, computer experience, computer access and usage, and students’ perception of their computer application skills prior to starting the introductory computer application course. The survey used a five-point Likert scale in several different computer application areas: file operation, applications for word processing, spreadsheets, and presentation, web-page development, and applications programming. This university used an off-the-shelf assessment tool called SAM Challenge 2003 version 3.0, because of its compatibility
with Microsoft Office textbooks. The SAMS Challenge assessment tests application knowledge in solving real world problems and complies with national standards. The skills assessment is a simulated Microsoft Office Suite environment offered online in the computer lab for a period of approximately 40 minutes. Students who volunteered were given the survey on the first day of class. Whether the survey was online or printed is not stated, but it was administered in the computer applications course. The data indicated that 75% of the student participants were from North Carolina, 92% owned a personal computer, and 63% were required to take a computer applications course in high school. Because they were enrolled in the university, it was assumed that the 75% of the participants from North Carolina passed the required computer and technology assessment mandated by the state of North Carolina. The data indicated some differences between the students’ perceptions of their word processing skills and actual performance, no difference between perception and actual performance in presentation skills, and a significant difference in perception and performance for their spreadsheet skills. Overall, the results showed the student perceptions of ability were higher than actual ability (Grant et al., 2009).

Collier, Weinburgh, and Rivera (2004) and Lei (2009) used surveys to collect only technology capability data from students. Collier et al. (2004) surveyed 43 participants from an urban university in the southeastern United States, all in their junior or senior year of the early childhood/elementary education program. Three self-reporting surveys were used to collect data from students and faculty. The students completed two
surveys, one on technology use and the other entitled, *I am a Learner*. The technology skills survey was an adaptation of the Milken Exchange on Educational Technology Professional Competency Continuum. The 12-item technology skills survey included basic computer operations, file management, word processing, spreadsheets, databases, graphics, Internet, communications, ethics understanding, information searching, video production, and imaging devices. The survey allowed students to select responses from three or four options in response to statements or questions. The “I am a Learner” survey included 22 items designed to assess student perceptions of their current level of preparedness and the importance of various program content for their preparation as future teachers. The faculty was surveyed to determine their opinions on technology priorities and expectations. The faculty survey used NETS•T standards, the same technology skills section included in the students’ survey; and researchers also collected course syllabi to determine when and to what degree technology was used by preservice teachers in their courses.

Lei (2009) specifically targeted “digital natives” (students born after 1981) and used a single survey administered at a large northeastern university in October 2007 to 55 freshmen in teacher education programs. The survey included eight categories: multiple choice questions on general technology use information, such as ownership of technology devices; time spent on computers and other technology activities; attitudes and beliefs toward technology statements, for which participants were made to use a five-point Likert scale; proficiency in 51 specific common technologies, and interest in learning
these technologies, likewise rated on a five point Likert scale; experiences and opinions on using technology in education – a category including two open-ended questions. The next four categories rated the participants’ level of technology use from basic (commonly used technology such as e-mail, word processing and surfing the Internet) to advanced (editing audio files, video-conferencing and designing web pages). Part of the results from this study indicated that students were proficient in the use of technology for social communication purposes but had limited proficiency in teaching-related technologies. The study used a survey to collect data on the students’ beliefs, attitudes, confidence, and interest in technology and evaluated strengths and weaknesses based on responses to the proficiency in 51 common technologies areas at four difficulty levels (Lei, 2009).

Results showed almost all (96.4%) of the preservice teachers were using computers before the sixth grade and nearly half of them started using computers in kindergarten or before the end of third grade. All participants owned at least one personal computer and a cell phone, almost all owned an iPod or other mp3 player, and more than half owned four or more of the five technology devices surveyed (personal computer, cell phone, iPod or mp3 player, game console, and PDA). Participants in this study also reported that they worked with computers on a daily basis; approximately 10% of them spent less than 2 hours a day on computers and about 14% of them spent more than 4 hours a day on computers. Most participants spent between 2 and 4 hours on computers every day. In general, the participants reported strong positive beliefs about technology including, trusting the reliability of computers (92.9%), believing that
technology can improve their teaching (82.8%), and about helping their students learn better (79.3%). Lei (2009) commented that the participants’ confidence in using technology was not as strong as what would be expected from digital natives. Only 48.2% felt that they did well with computer technologies, with one-third of the participants being neutral in statements concerning their ability, and 22.5% not thinking they did well with computer technologies. Their confidence was even lower with their ability to solve computer problems. Only 13.8% felt confident that they could solve most of the problems with their computers. Lei (2009) stated that even though the participants would be considered digital natives, there could not be an assumption of a homogeneous group with the same technology experiences, because of digital divide issues.

Lei (2009) used a survey to determine students’ attitudes about, and experiences with digital technology; citing several studies which indicated that increased access to technology does not mean increased use of technology in classrooms, showing that digital native preservice teachers have been using technology on their own and outside of school during their K-12 years because their teachers did not use much technology in the classroom.

Surveys are useful in describing the characteristics of a large population – including attitudes and perceptions. Measuring student perceptions on technology in learning may provide insight on issues that affect learning and allows student input on their educational experience. Although most of the frameworks (or models) of technology integration focus on the knowledge and skills necessary for teachers to
effectively integrate technologies into the curriculum, the TPACK model focuses on teachers’ competencies, and is therefore the logical choice to use as an education guide for preservice teacher education programs (Koehler & Mishra, 2009). The TPICK and ICT-TPCK models are based on the same concepts, but the TPACK framework is more widely accepted (Dilsworth et al., 2012).

The current study examines students’ perceptions about technology capabilities as related to the TPACK framework, and as measured by the TPACK survey, in an attempt to establish a baseline level of technology skills as related to the teaching profession, albeit perceived. By examining the students’ perceptions of how current KSU instructors integrate technology into the classroom and their perceptions of how well-prepared they are to integrate technology into the classroom, the current study hopes to provide a catalyst for additional research on how to improve teacher education programs as related to integrating technology into the classroom.

**Rationale for using TPACK survey for preservice teachers**

As the TPACK framework gained momentum in the realm of educational research, the quest to create a reliable measure also increased. The idea of developing the TPACK survey for preservice teachers was first presented at the 2008 Society for Information Technology and Teacher Education international conference and the results of the instrument development were later released in a study (Schmidt et al., 2009). According to Schmidt et al. (2009), several researchers have developed assessment instruments to measure both preservice and inservice teachers’ levels of TPACK,
including Koehler and Mishra, who used a survey to track changes in teachers’ perception of their TPACK over the course of a workshop on the design of educational technology. Even though the instrument Koehler and Mishra developed was effective in tracking changes in perception, the survey was specific to the workshop and not generalizable to other learning experiences (Schmidt et al., 2009). Angeli and Valanides (2009) explored the use of self-assessment, peer assessment, and expert assessment of design-based performance assessments as part of learning experiences, but this method of assessment was time-consuming and context-specific. Appendix G consists of a table listing TPACK research relating to the validity of survey measurement of TPACK, including preservice teacher perceptions of their technical capability as related to teaching, and to the use of the TPACK survey for preservice teachers (Schmidt et al., 2009) to measure TPACK. The TPACK-related research listed in Appendix G is a small selection of research which was chosen to demonstrate the validity and reliability of the TPACK survey for preservice teachers (Schmidt et al., 2009), accurately measuring TPACK in preservice teachers as well as the accepted practice of the use of a survey in TPACK-related research.

The TPACK survey for preservice teachers (Schmidt et al., 2009) was developed by examining and extending the work of two studies: the Koehler and Misha survey mentioned earlier and the 2009 study of Archambault and Crippen. The TPACK survey uses triangulation and factor analysis on preservice teachers’ self-reported experiences with technology specific to content areas. The instrument, the TPACK survey for
preservice teachers, was specifically developed for elementary or early childhood education majors, with a focus on content areas which they would be preparing to teach (Schmidt et al., 2009). The research team that developed the TPACK survey for preservice teachers included Koehler and Mishra, among others. The team reviewed literature that described instruments being used to assess technology in educational settings, most of which focused on specific technology skills, attitudes and beliefs, support for technology, and hindrances to integrating technology into the classroom. The purpose of developing the TPACK survey for preservice teachers was to measure preservice teachers’ self-assessments of the seven TPACK domains, but not their attitudes toward TPACK. After developing the initial TPACK for preservice teachers survey, the team sent the survey to three nationally known researchers with expertise in TPACK to be evaluated for content validity. Each expert rated to what extent each question of the survey measured one of the seven TPACK knowledge domains and also supplied comments and suggestions (Schmidt et al., 2009).

The research team reviewed the ratings and comments and then revised several items within the survey. The survey was finalized by working closely with two of the experts to finish rewriting all items. The finished survey contained 75 items which included items within all seven TPACK domains, answered using a five-level Likert scale, demographic information, as well as faculty and teacher models of TPACK. The finished TPACK survey was administered online to students who had just completed a required three-credit, 15-week introductory technology university course designed for
PK-6 preservice teachers. The course had recently been redesigned using the TPACK framework by one of the researchers. Although developing technology knowledge was still the focus of the course, it also emphasized developing content and pedagogical knowledge. The course projects and assignments were altered so that the preservice teachers were required to make connections between content, pedagogy, and technology as related to instructional goals. The survey was posted on the WebCT site for course participants and participants logged in to read about the purpose of the study and then indicated their consent to participate on a volunteer basis. All participants completed the survey during their last lab of the semester (Schmidt et al., 2009).

After collecting all of the data, the team used quantitative research methods to check the validity and reliability of the instrument. Each TPACK knowledge domain subscale was checked for internal consistency using the Cronbach’s alpha reliability technique. Construct validity for each knowledge domain subscale was then investigated using a principal components factor analysis with varimax rotation within each knowledge domain and Kaiser normalization, but the sample size was too small to perform a factor analysis on the entire instrument. The factor analysis consisted of running a factor analysis on the items within each subscale to ascertain the covariation among the items and whether the patterns fit well into the TPACK construct using the Kaiser Guttman rule (which states that factors with Eigen values greater than one should be accepted). Additionally, the team calculated reliability statistics for items in each subscale to identify any problematic items. Each item that affected the reliability and
construct validity was eliminated. The researchers eliminated 28 items from the original survey and ran a second factor analysis on the results and presented those results in a published study. The resulting, final survey exhibited strong internal consistency reliability (from .75 to .92) and included 47 items (Schmidt et al., 2009).

Additional studies which used and further validated the accuracy of the TPACK survey for preservice teachers (Schmidt et al., 2009) include a study performed in the Philippines on 214 volunteer preservice teachers (Chai, Koh, & Tsai, 2011) as well as a study at an Ohio university where the TPACK survey was administered as a pre- and post-test to 45 volunteer preservice teachers enrolled in a one-credit course on technology integration (Abbitt, 2011). Abbitt (2011) also administered the Computer Technology Integration Survey (CTIS) developed by Wang, Ertmer and Newby in 2004 (Abbitt, 2011). The CTIS is used to measure self-efficacy beliefs towards technology integration. Abbitt (2011) found that preservice teachers’ perceived knowledge as measured by the TPACK survey may be predictive of self-efficacy beliefs about technology integration.

The focus of the current study is to determine the preservice teachers’ perceptions of their technology capabilities as related to teaching. The TPACK survey for preservice teachers (Schmidt et al., 2009) was chosen as the measurement instrument because of the consistent results (reliability) of the instrument and because it has been shown that it measures what it is intended to measure (validity). The TPACK survey contains seven TPACK domains: five are directly related to technology knowledge, while the others are related to pedagogy and content knowledge; but do not measure technology knowledge.
Because the current study does not focus on preservice teachers’ perceptions of teaching ability or content knowledge, the research questions will be answered by the data contained within the five technology-related domains or constructs, namely Technology Knowledge (TK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), the use of Technology Pedagogy and Content Knowledge (TPACK), and the observation of TPACK. The remaining data collected from the survey will be used to describe the participants, when applicable.
CHAPTER THREE

METHODS

The focus of the current study was to investigate the perceived technology capabilities of undergraduate students at Kent State University in the College of Education, Health, and Human Services teacher education programs using the TPACK survey for preservice teachers (Schmidt et al., 2009) as the assessment instrument. The survey was administered to education major students at all levels: freshman, sophomore, junior, and senior. The survey was administered once to freshmen and seniors, and twice to students enrolled in the Educational Technology course – who were mostly sophomores (42%) or juniors (34%), to investigate any differences in their perceptions of their technology skills between the beginning and end of the course. This chapter has the following sections: 1) purpose, 2) participants and research context, 3) data sources/instrumentation, 4) procedures, and 5) data analysis.

Purpose

The purpose of this study is to determine the perceived technology capabilities of different levels of undergraduate students of Kent State University in the College of Education, Health, and Human Services teacher education programs; to determine if the perceived technology capabilities of students beginning the teacher education program differ from those nearing completion of the program; and, if the perceived technology
capabilities of students change from the start to the end of the Educational Technology course.

**Participants and Research Context**

The survey was administered during the first two weeks of the spring 2012 semester to 98 volunteers enrolled in the CULT 29535 Education in a Democratic Society course, 18 volunteers enrolled in the student teaching course, and 77 volunteers enrolled in the ITEC 19525 Educational Technology course. The survey was administered again during the last two weeks of the semester to the volunteers from the Educational Technology course. Participants were at three specific points in their educational experience: (a) participants enrolled in the CULT course, (b) participants enrolled in the Educational Technology course, and (c) participants enrolled in the student teaching course. Typically these courses occur in the preservice teachers’ first semester, junior year, and last semester of study in the College of Education, respectively. The current study participants by class level included 78 freshmen, 52 sophomores, 34 juniors, and 29 seniors (See Table 1 under the Participants section for details).

All freshman student participants were assumed to have been admitted to the teacher education program during either the semester of the study or the previous semester. It was assumed that freshman student participants had little previous college experience and were 18 or 19 years of age. The participants in the study were comprised
of 22 percent males and 78 percent females, and there was no question concerning the ethnicity of the groups.

The college of education at KSU is typical of other Ohio universities in that the Educational Technology course is required and it is also a TAGs course. Transfer Assurance Guidelines, or TAGs courses, are courses that enable the course credit to be fully transferable to any Ohio university. The goal of the Educational Technology course is to enable preservice teachers to meet the current National Educational Technology Standards for Teachers.

The content outline of the course and contact hours, as approved by the department chair/school director/campus dean, as of spring 2010 includes:

1. develop basic technology competencies through the effective use of multiple operating systems, 6 contact hours;
2. develop basic skills in using productivity and utility software applications, 18 contact hours;
3. apply an understanding of copyright law, use of copyrighted materials, software licensing, and other ethical issues, 3 contact hours;
4. develop the ability to align curricular goals, instructional objectives, and the capabilities of electronic media through the principles of effective visual design, specification of clear instructional objectives, and the production of electronic media in various digital and non-digital formats, 9 contact hours.
The course and objectives have changed little since 2008 when the course was designed to meet the National Educational Technology Standards for Teachers (NETS•T) developed by the International Society for Technology in Education. The NETS•T standards, discussed in more depth in Chapter Two, are organized into five categories:

1. Facilitate and Inspire Student Learning and Creativity
2. Design and Develop Digital-Age Learning Experiences and Assessments
3. Model Digital-Age Work and Learning
4. Promote and Model Digital Citizenship and Responsibility
5. Engage in Professional Growth and Leadership

According to the syllabus from 2011, the course also meets the following Transfer Assurance Guidelines (TAGs): Candidates are expected to fulfill the four parts of the content outline for 2010, listed earlier in this section. TAGs are discussed in more depth in Chapter Two.

**Data Sources/Instrumentation**

The use of surveys in several studies is explored in Chapter Two of this study. Several reliable surveys are available for use in educational technology studies, although many of them are technology-specific, which means the survey must be updated to reflect the latest technology hardware and software every time it is used. Many of the surveys available for use target in-service teachers, and so the instrument chosen for this study was the TPACK survey for preservice teachers. This instrument is intended to measure perceived technology proficiency as related to teaching. Because specific
Table 1

Participant involvement details.

<table>
<thead>
<tr>
<th>Category</th>
<th>Total volunteers</th>
<th>Course in which survey was taken</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>CULT 29535</td>
</tr>
<tr>
<td>Related Question</td>
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<td>n</td>
</tr>
<tr>
<td>Primary</td>
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<td>98</td>
</tr>
<tr>
<td>Secondary Q1</td>
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<td>70*</td>
</tr>
<tr>
<td>Secondary Q2</td>
<td>45</td>
<td>0</td>
</tr>
<tr>
<td>Year in College</td>
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<td></td>
</tr>
<tr>
<td>Freshman</td>
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<td>69</td>
</tr>
<tr>
<td>Sophomore</td>
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<td>20</td>
</tr>
<tr>
<td>Junior</td>
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<td>8</td>
</tr>
<tr>
<td>Senior</td>
<td>29</td>
<td>1</td>
</tr>
<tr>
<td>Student Recruit.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F2F intro.</td>
<td>49</td>
<td>4</td>
</tr>
<tr>
<td>e-Mail intro.</td>
<td>144</td>
<td>94</td>
</tr>
</tbody>
</table>

Note: For all course sections, the instructor introduced me to the class, either face to face or by email. F2F intro. refers to my appearance in the classroom to introduce the study after being introduced to the class by the instructor. E-Mail intro. refers to my e-mail introduction of the study after the instructor alerted the class to watch for an e-mail from me. The instructors chose the method of introduction to the class to minimize disruption.

* Secondary Q1 compared seniors to freshman, but there was one senior in CULT which is why this number is 70 rather than 69; in ITEC, there were seniors (10) and freshmen (9).

All student volunteers (N = 193) were included in the Primary Research Question; Secondary Question One included only freshmen (N = 78) and seniors (N = 29); Secondary Question Two included only students (N = 45) enrolled on the Ed. Tech. (ITEC 19525) course who completed the survey two times (once at the beginning of the course and again at the end of the course).
technology is not named and the survey focuses on the individual’s perception of
technology skills as related to teaching, there is no need to update the survey items to
reflect the latest technology. The TPACK survey for preservice teachers was
administered online once to all students; with the exception of students enrolled in the
Educational Technology course, to whom it was administered twice – once at the
beginning and once at the end of the course.

The TPACK survey consists of 64 questions, seven demographic questions which
consist of multiple choice questions or statements concerning class-standing, gender,
age-range, and other personal and school-related information, as well as one question
concerning the students’ acquisition of technology knowledge. Fifty-six of the 64
questions use a five-level Likert scale to assess the seven TPACK domains and each item
response is scored with a value of 1 assigned to strongly disagree, all the way to 5 for
strongly agree. The sections are labeled on the attached survey (Appendix E), but were
not labeled in the online version of the survey administered to the students. For each
TPACK knowledge domain, the participants’ responses were averaged. For example, the
6 questions under TK (Technology Knowledge) were averaged to produce one TK
(Technology Knowledge) score (Schmidt et al., 2009). An eight-question section on
students’ perceptions of TPACK in use by faculty and in-service teachers in
content-specific courses uses the same Likert scale as the previous knowledge sections.
A three-question section on students’ perceptions of TPACK in use during the course of
their program allowed students to choose one of four percentage ranges. The last
question of the survey asked the students where they predominantly learned their technology skills and students have a choice of answers ranging from a school setting — high school or college — to a friend or independently.

A survey method of data collection was chosen so that student perceptions about technology knowledge could be determined as well as student perceptions about teaching knowledge. The survey, adapted from the “Survey of Preservice Teachers’ Knowledge of Teaching and Technology” (known as the TPACK survey for preservice teachers)(Schmidt et al., 2009) which was developed as a result of several research studies, was administered to participants at different levels in the teacher education program. One particular study named, “Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers” (Schmidt et al., 2009) engaged survey experts and professors from Iowa State University and professors from Michigan State University to produce a valid survey. The 2009 survey data was collected from 124 students enrolled in Education programs at a Midwestern four-year institution of higher learning (Schmidt et al., 2009). The results are discussed in Chapter two, under the Learning Environments section.

The adaptations to the survey for the purpose of this study included the removal of two questions from the demographic section and the removal of three essay questions asking students to describe specific events where TPACK was modeled. The questions removed from the demographic section consisted of a request for students’ email addresses and a question about completing an educational computing minor, which did
not apply to Kent State University’s education program. The terminology within the survey was altered slightly to match Kent State University’s education program terminology.

One item was added for the purpose of collecting additional information on the perceived origin of students’ technology skills. The additional question was, “Predominantly, where did you learn your technology skills?” The students had the option to choose from six possible responses: from a high school class, from a college class, from a friend, from manuals and books, from a website, and on my own. No other modifications to the original survey were made for the purpose of this study.

**Procedures**

The researcher administered the TPACK survey for preservice teachers via an online survey system, Qualtrics, two times during the 15-week semester. After approaching the instructors of the CULT course, the ITEC course, and the coordinator for the student teachers, each instructor who agreed to have their students recruited to participate introduced the idea to their class. The first group to complete the survey was a sample group of freshmen in teacher education programs in the CULT course sections. Participating students gave their KSU email addresses to the researcher and a survey link, along with a reiteration of the study and deadlines, was emailed to them through Qualtrics for completion. At the request of one instructor, the researcher personally appeared in one section of CULT to recruit students and explain the survey process. Students who volunteered gave their email addresses and were sent a link to the survey.
through Qualtrics. There was a 39% response rate from the CULT sections; a total of 266 students were solicited as volunteers in the current study, and 98 students completed the survey.

The second group to complete the survey was a sample group of students enrolled in the ITEC Educational Technology course sections. On the Kent campus, at the request of the instructor of four sections, the researcher personally appeared in all four sections to recruit students and explain the survey process. All volunteers were told that they would need to complete the survey near the beginning of the course (first or second week) and again near the end of the course (last two weeks of the semester). For the first ITEC section approached, the researcher collected the email addresses of the students and then gave students a printed link which allowed them to access the survey; for the second ITEC section approached, the email addresses of the volunteer students were collected, and the survey link was sent to them through Qualtrics, which allowed for better tracking of each individual. The survey was also altered to include email addresses of each participant so that tracking could be done by unique email addresses. Based on the immediate participation from the four sections of the ITEC course offered at the Kent campus, all remote-campus instructors of the ITEC course were solicited via email to allow their students to be recruited for the current study. Three instructors of four additional sections of the ITEC course at three locations agreed that their students could be recruited. Near the end of all sections of the ITEC course, timed around class assignment due dates, the second survey was emailed to all students who participated in
the first survey. The second survey was the same as the first survey. When students completed the survey, a follow-up thank-you note was sent. The initial response rate for the ITEC sections was 32%; out of 244 students approached, 77 students participated. The response rate dropped to 18% for the completion of the second survey: out of 244 students, only 45 completed the second survey. However, considering the 77 students who completed the first survey, the response rate for the second survey (based on the 77 participants) was 58%.

To recruit student teachers, the coordinator for student teaching was approached in person at the Kent campus. During the meeting, the purpose of the study and the extent of student involvement were discussed and the coordinator agreed to forward an email to all student teachers. An email explaining the study and the need for volunteer student participation was developed and sent to the coordinator who, in turn, forwarded it to all student teachers. Additionally, at the researcher’s request, the coordinator encouraged the student teachers by email to participate shortly before the deadline. Response rate for students participating in student teaching was extremely low; out of 173 students approached to volunteer, 18 students participating in completing the survey making the response rate 10%.

Participation in the survey was voluntary and the survey responses were anonymous even though they included each student’s unique university email address, which was only used to match pre-test to post-test results in the Educational Technology course. Possible reasons for student participation versus non-participation are discussed
later. The survey instrument contained a consent form which briefly explained the study and the use of the data collected along with an informed consent. Volunteers who consented to participate could complete the survey. Volunteers had a deadline to complete the survey before the end of the third week of the semester; after which time the surveys could not be accessed. For the ITEC Educational Technology course sections, the informed consent included that the survey would need to be completed again during the last two weeks of the semester. For the ITEC course, there was a second deadline to complete the survey as a post-test before the beginning of final examinations week, the week immediately following the end of the 15-week semester; after that time, associated surveys could not be accessed. For all surveys, the response progress was monitored through Qualtrics. The researcher was responsible for answering any questions for faculty and students during the administration of the survey. Some students (N = 32) started the survey but did not complete it, and 32 students enrolled in the Educational Technology course did not complete the second survey. Incomplete surveys were not used to collect any data and, for the Educational Technology course, the data used to compare pre- and post-surveys was collected from volunteers who completed both surveys. Upon completion of all the surveys, the researcher compiled all the results and comments. For students who completed the survey, a follow-up thank-you email was sent. Instructors who permitted their classes to participate were thanked with a handwritten note.
Data Analyses

The TPACK survey for preservice teachers was administered online near the beginning of the semester for all three courses and was administered again near the end of the semester in the Educational Technology course. The survey contains seven knowledge domains or categories with multiple questions. The students’ scores were averaged by domain or category to produce one category scale score. Only one survey was used and the variables included demographic information (such as gender) and individual construct knowledge scores (knowledge domain scores). Each item on the survey used the Likert scale and each item response was scored on a scale of 1 to 5. Participant’s responses were averaged to produce individual construct knowledge scores. Since the TPACK survey uses numbers corresponding to responses to produce an average response by category per student, the Likert scale is considered to be equally spaced intervals (“Introduction to SAS”, n.d., “Nominal Ordinal Interval,” para. 5). The survey contains items within each of the seven knowledge domains or constructs:

Technology Knowledge (TK) construct; Each participant’s responses to the six questions were averaged to produce one TK score.

Content Knowledge (CK) construct; Each participant’s responses to the twelve questions were averaged to produce one CK score.

Pedagogical Knowledge (PK) construct; Each participant’s responses to the seven questions were averaged to produce one PK score.
Primary Research Question

To answer the primary research question, “What are the perceived academic technology capabilities of undergraduate students in the Kent State University College of Education, Health, and Human Services teacher education programs as measured by the TPACK survey for preservice teachers?”, descriptive statistics, means and standard deviation, were used for the five technology-related TPACK scale scores. Items of the self-reporting TPACK survey for preservice teachers items which were used to answer the primary question were survey items 8-13 (TK), 36-40 (TCK), 41-49 (TPK), 50-53 (TPACK), and 54-60 (TPACK modeling).

The statistical program SPSS was used to run Cronbach’s measure of internal reliability, a repeated measures ANOVA, a one way ANOVA, and Bonferroni post hoc tests. Cronbach’s alpha was determined by measuring the degree of consistent responses. The repeated measures ANOVA was run to determine if there were any significant
differences and the Bonferroni post hoc test was used to determine which scale scores were significantly different compared to other scores. The one way ANOVA was used to compare TPACK scores with class level (between subjects ANOVA) and the Bonferroni post hoc test determined which scores were significantly different from others. The Bonferroni post hoc test was chosen because it is available in SPSS, it is commonly used because of flexibility, and has an adjustment to overcome Type I errors.

Participants were a volunteer sample (N = 193) of undergraduate students, freshmen to senior level, enrolled in the teacher education program at Kent State University in the following courses: CULT (N = 98), Educational Technology (N = 77), and student teaching (N = 18). Participants completed the survey online during the first two weeks of the semester.

Secondary Question One

To answer the first sub-question, “Are there differences in the perceived TPACK capabilities between students beginning the teacher education program and those finishing the teacher education program?”, descriptive statistics, means and standard deviation, were used for the five technology-related TPACK category scale scores. Independent t-tests and point-biserial correlation were used to check for any significant differences between the scores of the freshmen (in the CULT course) and the seniors (preferably in student teaching courses). The point-biserial correlation was used because it is available in SPSS and provides correlation (strength of relationship) between
variables; and, the point-biserial correlation provides the same results as independent $t$-tests with the same level of significance.

Participants included a volunteer sample ($N = 107$) of undergraduate students at the beginning of the teacher education program enrolled in the CULT course (freshmen, $N = 78$) and senior undergraduate students ($N = 29$), most of whom were enrolled in a student teaching course ($N = 18$).

The TPACK survey for preservice teachers was administered online in the first two weeks of the semester in the CULT course and in the student teaching courses. The survey contains seven knowledge domains or categories with multiple questions. However, only the scores from the five technology-related of the seven knowledge domains were used to answer sub-question one, as well as the number of years in college from the demographic section.

**Secondary Question Two**

To answer the second sub-question, “How do the perceived capabilities change during the mandatory College of Education Educational Technology course?”, descriptive statistics, means and standard deviation, were used for the five technology-related TPACK category scale scores. Dependent $t$-tests were performed to explore any significant differences between pre- and post-survey TPACK knowledge scores and Cohen’s $d$ was calculated to determine effect size. The Dependent $t$-test was used because it is available in SPSS and is appropriate for comparing means of two dependent samples (pre- and post-survey data). The technology-related TPACK survey items
specifically related to answering secondary research question two are items 8-13 (TK), 36-40 (TCK), 41-49 (TPK), 50-53 (TPACK) and 54-60 (TPACK modeling).

Participants (N = 45) included volunteers enrolled in the Educational Technology course who completed a second survey near the end of the spring 2012 semester. The variables of time within the Educational Technology course when the survey was completed (the first two weeks of the course versus the last two weeks of the course) and individual construct knowledge scores (knowledge domain scores) were analyzed for any differences between the scores. The data used to compare pre- and post-surveys was collected from volunteers who completed both surveys.
CHAPTER 4

RESULTS

The results are presented starting with a re-statement of purpose, description of the sample, any reliability tests, assumptions, and effect size, when applicable. This is followed by statistical tests and analytical descriptions of the data related to and based on the order of the research questions.

The purpose of this study is to determine the perceived technology capabilities of different levels of undergraduate students of Kent State University in the College of Education, Health, and Human Services teacher education programs; to determine if the perceived technology capabilities of students beginning the teacher education program differ from those nearing completion of the program; and, if the perceived technology capabilities of students change from the start to the end of the Educational Technology course.

The instrument used was the TPACK survey for preservice teachers (Schmidt et al., 2009) distributed during the first and second weeks of the spring semester 2012, to the following groups: several sections of CULT 29535 “Education in a Democratic Society,” which is required for admission to advanced study; Student Teaching sections; and several sections of ITEC 19525, the required Educational Technology course. Data was collected from 193 volunteer preservice teachers, 42 males and 151 females.
Table 2 displays the frequency counts for the demographic variables of gender, age range, and major area of study. The majority of the students participating in the study were female (78%), between 18-22 years of age (89%), and at the freshman or sophomore levels (67%). Major areas of study were divided into five areas: Early childhood, Middle childhood, Adult Education (ADED), K-12 which included physical education, art, music or any other area, which the student may be certified to teach in grades K-12, and special education which includes intervention specialists, American Sign Language (ASL), speech teachers, and others. Early childhood, ADED, and K-12 each involved 45, 46, and 44 students, respectively (each category included 23% of the students). Middle childhood and Special Education each had 29 students (each had 15% of total sample). Out of 193 participating students, only 62 (32%) possessed some field experience in any PreK through 12 grade classroom (Table 2). The survey included a question (number 7) which asked students to list the semester and year they anticipated taking the four or five Advanced Study Course blocks (Block I, usually 2000- and 3000-level courses, through Student teaching) required by their program. However, most freshmen were not aware of the blocks and entered invalid answers, such as indicating the intent to take all blocks in one semester. The question was intended to ensure that freshmen were at the beginning of their academic program, and their lack of knowledge about Advanced Study Course blocks seemed to imply that. However, the data associated with this question was not included in the results.
Table 2

*Frequency Counts for Demographic Variables (N=193)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>42</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>151</td>
<td>78</td>
</tr>
<tr>
<td>Age Range</td>
<td>18-22</td>
<td>171</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td>23-26</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>27-32</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>33 and over</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Major Area of Study</td>
<td>Early childhood</td>
<td>45</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Middle childhood</td>
<td>29</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>ADED (Adult Education)</td>
<td>46</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>K-12 (Phys.Ed., music, art, etc.)</td>
<td>44</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Special Ed (includes ASL, etc.)</td>
<td>29</td>
<td>15</td>
</tr>
<tr>
<td>Year in College</td>
<td>Freshman</td>
<td>78</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Sophomore</td>
<td>52</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Junior</td>
<td>34</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Senior</td>
<td>29</td>
<td>15</td>
</tr>
<tr>
<td>Field experience?</td>
<td>Yes</td>
<td>62</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>131</td>
<td>68</td>
</tr>
</tbody>
</table>
Table 3 provides a break down categorized by the course in which participants took the survey—CULT, ITEC (Ed. Tech), and Student teaching—and cross tabulated by gender, age range, major area of study, year in college (freshman, sophomore, junior or senior), and whether or not they had any field experience. The largest percentage of the preservice teacher volunteers from all three courses (CULT 94%, ITEC 88%, Student Teach. 61%) fell into the 18-22 years of age range. The majority of participants were female (CULT 80%, ITEC 77%, Student Teach. 78%) and the CULT course had the largest course percentage (70%) of freshmen. The ITEC course did have nine (12% of the course volunteers) freshmen and the CULT course had one senior preservice teacher. Refer to Table 1 in Chapter 3 for a breakdown on which students’ data was used for each research question.

Table 4 displays characteristics for all eight areas of knowledge scale scores, even though only the five technology-related scale scores were utilized to answer the research questions. This data was collected because the survey was only altered to accommodate KSU terminology and one extra question (details in Chapter 3, under the Data sources/instrumentation section). The Cronbach alpha reliability coefficients ranged from $\alpha = .68$, to $\alpha = .92$, with a median alpha of $\alpha = .79$ indicating the survey is reliable. Reliability refers to the consistency of the instrument in measuring whatever it measures. Reliability coefficients can take on values of 0 to 1.0, inclusive, with 0 indicating that the observed score indicates a completely unreliable measure. The reliability coefficients in
Table 3

Cross Tabulation Counts for Class with Selected Variables (N=193)

<table>
<thead>
<tr>
<th>Category</th>
<th>CULT 29535</th>
<th>ITEC 19525</th>
<th>Student Teach.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>20</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>Female</td>
<td>78</td>
<td>80</td>
<td>59</td>
</tr>
<tr>
<td>Age Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-22</td>
<td>92</td>
<td>94</td>
<td>68</td>
</tr>
<tr>
<td>23-26</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>27-32</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>33+</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Major</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early</td>
<td>27</td>
<td>28</td>
<td>18</td>
</tr>
<tr>
<td>Middle</td>
<td>14</td>
<td>14</td>
<td>11</td>
</tr>
<tr>
<td>ADED</td>
<td>17</td>
<td>17</td>
<td>21</td>
</tr>
<tr>
<td>K-12</td>
<td>27</td>
<td>28</td>
<td>14</td>
</tr>
<tr>
<td>Special Ed</td>
<td>13</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Year in College</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>69</td>
<td>70</td>
<td>9</td>
</tr>
<tr>
<td>Sophomore</td>
<td>20</td>
<td>20</td>
<td>32</td>
</tr>
<tr>
<td>Junior</td>
<td>8</td>
<td>9</td>
<td>26</td>
</tr>
<tr>
<td>Senior</td>
<td>1</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Field exp.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>18</td>
<td>19</td>
<td>25</td>
</tr>
<tr>
<td>No</td>
<td>79</td>
<td>81</td>
<td>52</td>
</tr>
</tbody>
</table>

Note: For each course, the symbol *n* refers to the total volunteer enrolled in that course, and the % symbol indicates the percentage of the population of the total enrolled in that course.
Table 4

*Characteristics for Scale Scores (N=193)*

<table>
<thead>
<tr>
<th>Scale</th>
<th>Number of Items</th>
<th>M</th>
<th>SD</th>
<th>Low</th>
<th>High</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology Knowledge (TK)</td>
<td>6</td>
<td>3.68</td>
<td>0.80</td>
<td>1.17</td>
<td>5.00</td>
<td>.91</td>
</tr>
<tr>
<td>Content Knowledge (CK)</td>
<td>12</td>
<td>3.66</td>
<td>0.52</td>
<td>1.50</td>
<td>5.00</td>
<td>.76</td>
</tr>
<tr>
<td>Pedagogical Knowledge (PK)</td>
<td>7</td>
<td>3.93</td>
<td>0.64</td>
<td>1.00</td>
<td>5.00</td>
<td>.91</td>
</tr>
<tr>
<td>Pedagogical Content Knowledge (PCK)</td>
<td>4</td>
<td>3.57</td>
<td>0.66</td>
<td>1.50</td>
<td>5.00</td>
<td>.69</td>
</tr>
<tr>
<td>Technological Content Knowledge (TCK)</td>
<td>4</td>
<td>3.51</td>
<td>0.75</td>
<td>2.00</td>
<td>5.00</td>
<td>.79</td>
</tr>
<tr>
<td>Technological Pedagogical Knowledge (TPK)</td>
<td>9</td>
<td>3.84</td>
<td>0.63</td>
<td>1.00</td>
<td>5.00</td>
<td>.92</td>
</tr>
<tr>
<td>Technological Pedagogical and Content Knowledge (TPACK)</td>
<td>4</td>
<td>3.47</td>
<td>0.69</td>
<td>2.00</td>
<td>5.00</td>
<td>.78</td>
</tr>
<tr>
<td>TPACK Modeling (by professors)</td>
<td>7</td>
<td>3.46</td>
<td>0.52</td>
<td>1.71</td>
<td>5.00</td>
<td>.68</td>
</tr>
<tr>
<td>TOTAL Scale scores</td>
<td>53</td>
<td>3.67</td>
<td>0.41</td>
<td>1.72</td>
<td>5.00</td>
<td>.93</td>
</tr>
</tbody>
</table>

*Note:* Ratings based on a 5-point metric, 1 = *Strongly Disagree* to 5 = *Strongly Agree.*
this study suggest that all eight scales have adequate levels of internal reliability (Wiersma, 1995).

In addition to the five technology-related knowledge areas and the other pedagogy and content knowledge areas (including recognizing TPACK being modeled), there are three questions under the Models of TPACK section where participants were asked to choose from percentage ranges representing their perceptions of how often they observed an effective model of combining content, technologies, and teaching approaches in their courses during the teacher education program. Two out of the three questions in this section were related to the observation of an effective model by sources outside of the teacher education program. As shown in Table 2, the study’s sample population was comprised mainly of freshmen (40%) and many (68%) of the participants had no field experience. The only participants who had experience with cooperating inservice teachers were the seniors (N=18) enrolled in student teaching. Participants had to choose a percentage (there was no option titled “not applicable”) during the online survey, and so the data collected from this question was not applicable to this study.

The Primary Research Question

The Primary Research Question asked, “What are the perceived academic technology capabilities of undergraduate students in the Kent State University College of Education, Health, and Human Services teacher education programs as measured by the TPACK survey for preservice teachers?” To answer this question, Table 5 displays the means and standard deviations for the five technology-related knowledge areas (TK,
TCK, TPK, TPACK, and TPACK modeling) for the entire sample (193 students). Using a scale of one to five, with one indicating the least perceived knowledge, each survey item response is scored with a value of 1 assigned to Strongly Disagree, 2 assigned to Disagree, 3 assigned to Neither Agree or Disagree, 4 assigned to Agree, and 5 assigned to Strongly Agree. For each construct, or knowledge area, the participants’ responses are averaged. For example, the 6 questions under TK (Technology Knowledge) are averaged to produce one TK (Technology Knowledge) Score (Schmidt et al., 2009). A repeated measures ANOVA model was used to compare the five technology-related scores and found significant difference among the means ($p = .001$). To determine which means were significantly different from the others, Bonferroni post hoc tests were run and found the score for TPK ($M = 3.84$) to be significantly higher than any of the other four mean scores. In addition, the TK score ($M = 3.68$) was significantly higher than the mean scores for TPACK ($M = 3.47$) and TPACK modeling ($M = 3.46$).

Referring to the one to five scales of the TPACK knowledge areas, a knowledge scale score of four is the minimum “agree” score; all of the knowledge area mean scores are lower than four, but higher than the middle, neutral score (3 = Neither Agree or Disagree) (Table 5). Table 5 lists the low and high scale scores for each of the five knowledge areas which are calculated for each student for each of the knowledge areas; for example, Table 5 shows the TK low score as 1.17, meaning this is lowest scale score achieved by any student (in this case, two students had this scale score). The mean scores in Table 5 include the total sample population, freshmen through seniors, and, as 40% of
the students participating in the study were freshmen (N=78), the mean scores do not provide an accurate view of students’ perceptions at different levels of the teacher education program.

Table 5

*Repeated Measures ANOVA Test Comparing the Scores for the Five Knowledge Areas (N=193)*

<table>
<thead>
<tr>
<th>Scale</th>
<th>M</th>
<th>SD</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Technology Knowledge (TK)</td>
<td>3.68</td>
<td>0.80</td>
<td>1.17</td>
<td>5.00</td>
</tr>
<tr>
<td>5. Technological Content Knowledge (TCK)</td>
<td>3.51</td>
<td>0.75</td>
<td>2.00</td>
<td>5.00</td>
</tr>
<tr>
<td>6. Technological Pedagogical Knowledge (TPK)</td>
<td>3.84</td>
<td>0.63</td>
<td>1.00</td>
<td>5.00</td>
</tr>
<tr>
<td>7. Technological Pedagogical and Content Knowledge (TPACK)</td>
<td>3.47</td>
<td>0.69</td>
<td>2.00</td>
<td>5.00</td>
</tr>
<tr>
<td>8. TPACK Modeling (by professors)</td>
<td>3.46</td>
<td>0.52</td>
<td>1.71</td>
<td>5.00</td>
</tr>
</tbody>
</table>

Repeated Measures ANOVA: $F(4, 768) = 17.77, p = .001$

Bonferroni Post Hoc Tests (all significant at the $p < .05$ level): TPK>TK, TCK, TPACK, TPACK Modeling; TK> TPACK, TPACK Modeling; all other pairs of means were not significantly different from each other at the $p < .05$ level.
To further investigate preservice teachers’ perceived technology knowledge as it relates to teaching, Table 6 displays the results of the one-way ANOVA tests comparing each of the five technology-related scale scores with the student’s class level. The Greek symbol η is used to represent Eta in Table 6. For four of the five tests, the resulting $F$ tests were not significant at the $p < .05$ level. However, the TPACK scores were significantly different between the four class levels ($p = .04, \eta = .21$). Bonferroni post hoc tests found junior TPACK scores ($M = 3.22$) to be significantly lower than senior TPACK scores ($M = 3.68$) ($p < .05$) but no other between group comparisons were significant (Table 6). The result of junior TPACK scores significantly lower than senior TPACK scores could be due to several factors. Therefore, future research should delve into this difference to better delineate the underlying patterns and constructs that drive this relationship. The lack of significant difference between the senior TPACK scores and the freshmen scores may be attributable to the over-confidence in technology ability by freshmen shown in earlier studies (Grant, et al., 2009; Vannatta & Banister, 2008).

Table 7 provides a more in-depth view of students’ perceptions at each level by using the five technology-related knowledge areas and cross tabulating scale score ranges by year in college. The survey used a one to five scale, with a value of 1 assigned to Strongly Disagree, 2 assigned to Disagree, 3 assigned to Neither Agree or Disagree, 4 assigned to Agree, and 5 assigned to Strongly Agree. In Table 7, the knowledge area scale scores were grouped into three categories: Disagree (< 2.99), Neutral (3 to 3.99), and Agree (4 to 5). Grouping the students’ perceptions by those that disagreed (including
<table>
<thead>
<tr>
<th>Scale Score</th>
<th>Class Level</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>η</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Technology Knowledge (TK) ^a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>78</td>
<td>3.69</td>
<td>0.73</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sophomore</td>
<td>52</td>
<td>3.61</td>
<td>0.96</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junior</td>
<td>34</td>
<td>3.70</td>
<td>0.76</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior</td>
<td>29</td>
<td>3.75</td>
<td>0.76</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Technological Content Knowledge (TCK) ^a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>78</td>
<td>3.60</td>
<td>0.69</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sophomore</td>
<td>52</td>
<td>3.54</td>
<td>0.79</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junior</td>
<td>34</td>
<td>3.23</td>
<td>0.81</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior</td>
<td>29</td>
<td>3.56</td>
<td>0.69</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Technological Pedagogical Knowledge (TPK) ^a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>78</td>
<td>3.82</td>
<td>0.55</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sophomore</td>
<td>52</td>
<td>3.70</td>
<td>0.76</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junior</td>
<td>34</td>
<td>3.87</td>
<td>0.62</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior</td>
<td>29</td>
<td>4.08</td>
<td>0.53</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Technological Pedagogical and Content Knowledge (TPACK) ^b</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>78</td>
<td>3.54</td>
<td>0.64</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sophomore</td>
<td>52</td>
<td>3.40</td>
<td>0.66</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junior</td>
<td>34</td>
<td>3.22</td>
<td>0.82</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior</td>
<td>29</td>
<td>3.68</td>
<td>0.64</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. TPACK Modeling (by professors) ^a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>78</td>
<td>3.47</td>
<td>0.52</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sophomore</td>
<td>52</td>
<td>3.51</td>
<td>0.56</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junior</td>
<td>34</td>
<td>3.39</td>
<td>0.57</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior</td>
<td>29</td>
<td>3.43</td>
<td>0.42</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

^a Bonferroni post hoc test results: no significant differences between the class levels at p < .05.

^b Bonferroni post hoc test results: Juniors < Seniors (p < .05); no other significant differences.
Table 7

Cross Tabulation of the Five Technology-Related Knowledge Area Scale Score Ranges by Class Level (Freshman, Sophomore, Junior, Senior) (N=193)

<table>
<thead>
<tr>
<th>Scale score ranges</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 2.99</td>
<td>3 to 3.99</td>
<td>4 to 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scale</th>
<th>n</th>
<th>%</th>
<th>n</th>
<th>%</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Technology Knowledge (TK)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>freshmen</td>
<td>8</td>
<td>10</td>
<td>41</td>
<td>53</td>
<td>29</td>
<td>37</td>
</tr>
<tr>
<td>sophomores</td>
<td>11</td>
<td>21</td>
<td>18</td>
<td>35</td>
<td>23</td>
<td>44</td>
</tr>
<tr>
<td>juniors</td>
<td>5</td>
<td>15</td>
<td>13</td>
<td>38</td>
<td>16</td>
<td>47</td>
</tr>
<tr>
<td>seniors</td>
<td>4</td>
<td>14</td>
<td>12</td>
<td>41</td>
<td>13</td>
<td>45</td>
</tr>
<tr>
<td>5. Technological Content Knowledge (TCK)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>freshmen</td>
<td>9</td>
<td>12</td>
<td>40</td>
<td>51</td>
<td>29</td>
<td>37</td>
</tr>
<tr>
<td>sophomores</td>
<td>8</td>
<td>15</td>
<td>22</td>
<td>42</td>
<td>22</td>
<td>42</td>
</tr>
<tr>
<td>juniors</td>
<td>8</td>
<td>24</td>
<td>17</td>
<td>50</td>
<td>9</td>
<td>26</td>
</tr>
<tr>
<td>seniors</td>
<td>4</td>
<td>14</td>
<td>16</td>
<td>55</td>
<td>9</td>
<td>31</td>
</tr>
<tr>
<td>6. Technological Pedagogical Knowledge (TPK)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>freshmen</td>
<td>2</td>
<td>3</td>
<td>40</td>
<td>51</td>
<td>36</td>
<td>46</td>
</tr>
<tr>
<td>sophomores</td>
<td>4</td>
<td>8</td>
<td>25</td>
<td>48</td>
<td>23</td>
<td>44</td>
</tr>
<tr>
<td>juniors</td>
<td>2</td>
<td>6</td>
<td>17</td>
<td>50</td>
<td>15</td>
<td>44</td>
</tr>
<tr>
<td>seniors</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>38</td>
<td>18</td>
<td>62</td>
</tr>
<tr>
<td>7. Technological Pedagogical and Content Knowledge (TPACK)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>freshmen</td>
<td>4</td>
<td>5</td>
<td>50</td>
<td>64</td>
<td>24</td>
<td>31</td>
</tr>
<tr>
<td>sophomores</td>
<td>8</td>
<td>15</td>
<td>31</td>
<td>60</td>
<td>13</td>
<td>25</td>
</tr>
<tr>
<td>juniors</td>
<td>8</td>
<td>24</td>
<td>17</td>
<td>50</td>
<td>9</td>
<td>26</td>
</tr>
<tr>
<td>seniors</td>
<td>2</td>
<td>7</td>
<td>16</td>
<td>55</td>
<td>11</td>
<td>38</td>
</tr>
<tr>
<td>8. TPACK Modeling (by professors)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>freshmen</td>
<td>3</td>
<td>4</td>
<td>63</td>
<td>81</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>sophomores</td>
<td>4</td>
<td>8</td>
<td>36</td>
<td>69</td>
<td>12</td>
<td>23</td>
</tr>
<tr>
<td>juniors</td>
<td>6</td>
<td>18</td>
<td>22</td>
<td>64</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>seniors</td>
<td>4</td>
<td>14</td>
<td>21</td>
<td>72</td>
<td>4</td>
<td>14</td>
</tr>
</tbody>
</table>

Note: Percentages are calculated by each class level: freshmen (n = 78), sophomore (n= 32), juniors (n = 34), and seniors (n = 29).
strongly), those that were neutral (neither agree nor disagree), and those that agreed (including strongly) provides a clearer view of students’ perceptions at each level by knowledge area. The percentage of students at each class level is displayed for each category as well. Table 7 provides some explanation for the lower mean scores at the sophomore level than at the freshman level in four out of five of the knowledge areas (Table 6). The Chi-square test was run on the data used in Table 7 and showed no significant differences in the students’ perceptions (disagree, neutral, or agree) when cross tabulated with year in college.

**Secondary Question One**

Secondary Question One asked, “Are there differences in the perceived technology capabilities as measured by the TPACK survey between students beginning the teacher education program and those finishing the teacher education program?” To examine this, Table 8 displays independent t-tests and eta coefficients for the five scores based on whether the respondent was a freshman or a senior. The point-biserial correlation was used along with independent t-tests to demonstrate that the point-biserial correlation produced the same results as the independent t-tests with the same level of significance (p value) attached to it. The advantage of the point-biserial correlation is that it provides the measure of effect size (strength of relationship) that is recommended in the APA manual (American Psychological Association, 2010, p. 34) while the t-test does not. In other words, it provides the ability to determine whether the strength of the relationship between the two variables is weak ($r = .10$), moderate ($r = .30$), or strong ($r =$
.50). This is important when the study involves a large sample ($N > 100$) where there may be a statistically significant correlation even though the relationship between the variables may be weak. The eta coefficient, in the case of linear relationships, becomes the correlation coefficient ($r$) which “measures the degree of association between two variables” (Richardson, 2011, p.1). In Table 8 the TPACK scale and the class level are both variables. For results to be educationally or practically significant, $r$ should be .25 or greater (Wiersma, 1995). In this study, eta is equivalent to Pearson's correlation coefficient represented by the letter $r$ and is listed next to $t$ in Table 8 for comparison.

Table 8

*Independent T-tests, Freshmen vs. Seniors (n=107)*

<table>
<thead>
<tr>
<th>Scale</th>
<th>Year</th>
<th>$n$</th>
<th>$M$</th>
<th>$SD$</th>
<th>$Eta (r)$</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Technology Knowledge (TK)</td>
<td>Freshman</td>
<td>78</td>
<td>3.69</td>
<td>0.73</td>
<td>0.03</td>
<td>0.34</td>
<td>.73</td>
</tr>
<tr>
<td></td>
<td>Senior</td>
<td>29</td>
<td>3.75</td>
<td>0.76</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Technological Content Knowledge (TCK)</td>
<td>Freshman</td>
<td>78</td>
<td>3.60</td>
<td>0.69</td>
<td>0.03</td>
<td>0.28</td>
<td>.78</td>
</tr>
<tr>
<td></td>
<td>Senior</td>
<td>29</td>
<td>3.56</td>
<td>0.69</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Technological Pedagogical Knowledge (TPK)</td>
<td>Freshman</td>
<td>78</td>
<td>3.82</td>
<td>0.55</td>
<td>0.21</td>
<td>2.16</td>
<td>.03</td>
</tr>
<tr>
<td></td>
<td>Senior</td>
<td>29</td>
<td>4.08</td>
<td>0.53</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Technological Pedagogical and Content Knowledge (TPACK)</td>
<td>Freshman</td>
<td>78</td>
<td>3.54</td>
<td>0.64</td>
<td>0.10</td>
<td>1.05</td>
<td>.30</td>
</tr>
<tr>
<td></td>
<td>Senior</td>
<td>29</td>
<td>3.68</td>
<td>0.64</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. TPACK Modeling (by professors)</td>
<td>Freshman</td>
<td>78</td>
<td>3.47</td>
<td>0.52</td>
<td>0.04</td>
<td>0.43</td>
<td>.67</td>
</tr>
<tr>
<td></td>
<td>Senior</td>
<td>29</td>
<td>3.43</td>
<td>0.42</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Ratings based on a 5-point metric, 1 = Strongly Disagree to 5 = Strongly Agree.*
Four of the five t tests were not significant based on the mean scores of freshmen as compared to the mean scores of seniors. Further, in the TK, TCK, TPACK and TPACK Modeling scale scores, the eta (or r) indicates little (weak) to no correlation of perceived technology capabilities as measured by the TPACK survey between students beginning the teacher education program (freshmen) and those finishing the teacher education program (seniors). The only statistically significant difference arose in the TPK knowledge area, where seniors (M = 4.08) had significantly higher TPK scores than did freshmen (M = 3.82) (Table 8). However, the correlation is weak and accounts for only a small part of the variance.

**Secondary Question Two**

Secondary Question Two asked, “How do the perceived capabilities change during the mandatory College of Education Educational Technology course?” Table 9 displays the dependent t-test data comparing pre- and post-survey category scores. The pre-survey was administered during the first and second week of classes at the start of the spring 2012 semester. The post-survey was administered during the last two weeks (weeks 14 and 15) of classes during the spring 2012 semester. Close inspection of the results found four (TCK, TPK, TPACK, and TPACK modeling) of the five scores to be significantly higher at post-test (Table 9). All five scores were higher at post-test, but TK was not significantly higher. As noted earlier, the t-test does not provide a measure of effect size; however a measure of effect size can be calculated for statistically significant findings by dividing the difference between two means by the pooled standard deviation (Cohen’s d).
Effect size was calculated for the four scores with significantly higher results (TCK, TPK, TPACK, and TPACK modeling) using Cohen’s $d$ (Becker, 2000). If desired, for consistency, the effect size ($d$) may be converted to an eta (or $r$) correlation. Even though four categories were significantly higher, Cohen’s $d$ ($d$ column) indicated a small-to-moderate correlation to the course resulting in increased perceived technology capabilities.

Table 9

*Dependent T-tests Comparing Pre/Post Survey Category Scores (n=45).*

<table>
<thead>
<tr>
<th>Scale</th>
<th>Time</th>
<th>$M$</th>
<th>$SD$</th>
<th>$d$</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Technology Knowledge (TK)</td>
<td>Pre</td>
<td>3.47</td>
<td>1.00</td>
<td>.10</td>
<td>1.59</td>
<td>.12</td>
</tr>
<tr>
<td></td>
<td>Post</td>
<td>3.65</td>
<td>0.84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Technological Content Knowledge (TCK)</td>
<td>Pre</td>
<td>3.39</td>
<td>0.78</td>
<td>.25</td>
<td>3.08</td>
<td>.004</td>
</tr>
<tr>
<td></td>
<td>Post</td>
<td>3.77</td>
<td>0.57</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Technological Pedagogical Knowledge (TPK)</td>
<td>Pre</td>
<td>3.89</td>
<td>.61</td>
<td>.29</td>
<td>3.75</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>Post</td>
<td>4.24</td>
<td>.55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Technological Pedagogical and Content Knowledge (TPACK)</td>
<td>Pre</td>
<td>3.35</td>
<td>.67</td>
<td>.27</td>
<td>3.37</td>
<td>.002</td>
</tr>
<tr>
<td></td>
<td>Post</td>
<td>3.72</td>
<td>.62</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. TPACK Modeling (by professors)</td>
<td>Pre</td>
<td>3.31</td>
<td>.53</td>
<td>.29</td>
<td>4.40</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>Post</td>
<td>3.61</td>
<td>.47</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note:* A total of 45 volunteers enrolled in the Educational Technology course completed a pre- and a post-survey.
Earlier, gender was mentioned as a possibility for inequity of computer exposure in an earlier study (İlban, Yildirim, & Sapar, 2006; Poynton, 2005), and the TPACK survey demographic questions included students’ gender. Therefore, a one-way ANOVA was used to compare males to females by all eight TPACK scale scores (not shown in a table), not just the technology-related scores. The data reflected significance for PCK knowledge (scale 4), and TPK knowledge (scale 6) with females scoring higher than males. There were no significant differences between genders for the other six scales.

The TPACK survey for preservice teachers (Schmidt et al., 2009) was adapted for the current study by the use of KSU terminology and the addition of the last question on the survey, which asked preservice teachers where they predominantly acquired their technology knowledge. To determine this, preservice teachers were asked to rank the source of learning technology according to degree of learning based on a five-point metric, 1 = Very Important to 5 = Unimportant. In other words, if the student learned about technology mostly from a friend, this choice would be ranked as very important.

The students had six source choices, and an opportunity to list any unique sources under the “Other” category (Table 10). A total of 20 comments were entered from the total number of students (36) who selected and ranked the “Other” source category as more than unimportant. Most of the comments reflected learning technology from a family member (7 students) or a teacher (4 students). Overall, the “Other” category was selected by 54 out of 193 participants and only 24 students entered comments. The comments are not very useful in determining sources other than the six pre-set choices.
Table 10

*Frequency Counts for Where Technology Skills were Predominantly Learned (N=193)*

<table>
<thead>
<tr>
<th>Category</th>
<th>Very Important</th>
<th>Important</th>
<th>Moderately Important</th>
<th>Of little Importance</th>
<th>Unimportant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>H.S. class</td>
<td>81</td>
<td>42</td>
<td>56</td>
<td>29</td>
<td>31</td>
</tr>
<tr>
<td>College class</td>
<td>65</td>
<td>34</td>
<td>50</td>
<td>26</td>
<td>39</td>
</tr>
<tr>
<td>Friend</td>
<td>31</td>
<td>16</td>
<td>69</td>
<td>36</td>
<td>49</td>
</tr>
<tr>
<td>Manuals/books</td>
<td>16</td>
<td>8</td>
<td>32</td>
<td>17</td>
<td>58</td>
</tr>
<tr>
<td>Website</td>
<td>31</td>
<td>16</td>
<td>44</td>
<td>23</td>
<td>64</td>
</tr>
<tr>
<td>On my own</td>
<td>102</td>
<td>53</td>
<td>56</td>
<td>29</td>
<td>19</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>4</td>
<td>7</td>
<td>4</td>
<td>18</td>
</tr>
</tbody>
</table>

Students were able to select all that applied, meaning that each student could select more than one category or not select a category, which resulted in different totals by category; in other words, Table 10 lists all categories and the number of responses under each ranking (Very Important to Unimportant). By combining the Very Important and Important columns (the columns with the most responses), Table 10 shows that the most frequently chosen source was “On my own” (82% of students), followed by “H. S. class” (71% of students).
**Summary of Results**

The TPACK survey for preservice teachers (Schmidt et al., 2009) measured the perceptions of preservice teachers’ technology capabilities as related to teaching. For the entire sample, relating to the primary research question, the results indicated that preservice teachers perceived that they were more prepared to integrate technology into the classroom (TPK) more than they were prepared with technology knowledge (TK) or the other knowledge scale scores. The TK mean score was also higher than the other mean scores, except TPK. In comparing the seniors to the freshmen, related to Secondary Question One, there were no significant differences in the technology-related scale scores except for the TPK knowledge area, where seniors had significantly higher TPK scores than did freshmen (Table 8) however, the correlation is weak and accounts for only a small part of the variance. The lack of significant differences in the technology-related scales scores between seniors and freshmen seems to contradict the findings for Secondary Question Two, where students enrolled in the ITEC Educational Technology course completed a pre- and post-survey and four of the five technology-related scores were significantly higher at post-test. Although all five of technology-related scores were higher at post-test, only four (TCK, TPK, TPACK, and TPACK modeling) were significantly higher, with TK being the only technology-related score that was not significantly higher. The findings and implications will be discussed further in the next chapter.
CHAPTER FIVE

DISCUSSION OF FINDINGS

The discussion of the key findings from this study will be divided into sections relating to each research question: examining students’ perceptions of their technology knowledge as related to teaching; students’ perceptions at the freshman, sophomore, junior and senior level; differences in students’ perceptions at the beginning of the teacher education program (freshmen) and the end of the program (seniors); and changes in students’ perceptions over time in the Educational Technology course sections. The next sections will discuss the current study’s limitations and implications of the study, followed by a summary. The conclusions and implications for education of the current study are intended to initiate discussion among all teacher education faculty about future changes in the teacher education program, and the need for additional research.

Perceptions at Each Level

The perceived technology capabilities of different levels of undergraduate students of Kent State University in the College of Education, Health, and Human Services Teacher Education Program were examined in this study to determine how their perceptions differed at various levels. There are two ways to view the results, both of which are discussed in detail in this section: The overall mean score for the TK scale, and the percentages of the students by scale score.
Based on the overall mean score (Table 5) for the TK area (3.68), the findings seem to indicate that the majority of students perceived that they do have good technological abilities, as the overall mean score is closer to the minimum “agree” score (4 = agree) than the neutral (3 = Neither Agree or Disagree) score. The technology-related mean scores from the current study are similar to the technology-related mean scores of earlier studies (Abbitt, 2011; Chai, Koh, & Tsai, 2010) which also used the TPACK survey for preservice teachers (Schmidt et al., 2009) to measure technological ability as related to teaching. The Standard Deviation for the TK section was .80, which reflects a wide range of values. The overall mean score does not accurately represent this population’s perceptions, however, because the data (Table 7) indicates that 53% of freshmen (N = 78) were neutral and 37% perceived they had good technological abilities. The sophomores (N = 52), juniors (N = 34), and seniors (N = 29), all had the highest percentages in the agree scores, indicating a perception of good technological abilities (TK area). Even though the overall mean score does indicate a perception of good technology skills, it does not give a clear view of the perceptions at different class levels within the study. The overall mean score is skewed by the large percentage (40%) of freshmen in the study.

A study by Vannatta and Banister (2008) indicated that incoming freshmen would probably perceive that their technological abilities were high, and the data from this current study (Table 6) does show that in four out of the five technology-related knowledge areas (TK, TCK, TPK, and TPACK), freshmen had a higher mean score than
sophomores. However, further analysis (Table 7) revealed that the percentages of freshmen who perceived good technological ability in the TK (37%) and TCK (37%) areas were lower than the percentages of sophomores who perceived good technological ability in the TK (44%) and TCK (42%) areas; though none of the differences were significant. This finding is in contrast to the study by Vannatta and Banister (2008) and a possible explanation for the difference may be freshmen perceptions of the type of technology associated with teaching and learning may differ from the technology they are currently using. Another reason may be attributed to the differences in the survey instruments used; Vannatta and Banister (2008) used a technology-specific (specific questions on how to use Microsoft Word, Excel, and PowerPoint) survey followed by a technology-specific skills test, whereas the current study did not use specific technology.

A comparison of freshmen versus seniors (Table 8) also showed little to no correlation between the students’ year in college and perceptions of technological knowledge. Today’s college students have grown up immersed in digital media which they have used for entertainment, communication, learning, and shopping (Brooks-Young, 2005); more than 93% of school children ages 8-18 surveyed have a computer at home and 84% of them have high-speed Internet access (Rideout et al., 2010); and, K-12 students are taking responsibility for their own learning outside of the traditional school setting (Smith & Evans, 2010). Despite these claims, the current study’s findings indicate there are many students who do not perceive that they have high technology knowledge (Table 7). Particularly, the perceptions of freshmen as recorded by the TK
section of the survey reflected that 53% of them chose a neutral response (Table 7) when presented with statements about technology in general, such as “I know how to solve my own technical problems” and “I have the technical skills I need to use technology” (Schmidt et al., 2009, “Technology Knowledge”).

The perceptions of the freshmen preservice teachers concerning their technology skills in the current study support the findings from an earlier study which specifically targeted “digital natives” (students born after 1981) at a large northeastern university (Lei, 2009). Lei (2009) administered a survey to 55 freshmen in teacher education programs and resulting data indicated that students were proficient in the use of technology for social communication purposes but had limited proficiency with teaching-related technologies. The Lei (2009) study results showed that 96.4% of the preservice teachers started using computers before the sixth grade and nearly half of them started using computers in kindergarten or before the end of third grade. All participants owned at least one personal computer and a cell phone, and almost all owned an iPod or other mp3 player. Participants in this study reported that they worked with computers on a daily basis and held strong positive beliefs about technology, including the belief that technology can improve their teaching (82.8%), and help their students learn better (79.3%). The Lei (2009) study found that only 48.2% of the participants felt that they did well with computer technologies, while one-third of the participants were neutral about statements concerning their ability, and 22.5% of them did not think they did well with computer technologies. Their confidence was even lower in their ability to solve
computer problems. Lei (2009) stated that, in spite of the daily use of digital technology, there could not be an assumption of a homogeneous group with the same technology experiences because not every child had equal access to digital technology.

Similarly, even though the majority of students enrolled at KSU are Ohio natives (Research, Planning and Institutional Effectiveness office, 2011), large differences persist among the school districts of Ohio in their access to digital technology, and school systems have made slow progress toward the goal of producing tech-savvy students (United States Department of Education, 2011a); therefore, like the Lei (2009) study, there could not be an assumption of a homogeneous group with the same technology experiences. The Lei (2009) study surveyed the participants about technology abilities, but specific technologies were named in the survey, such as iPod and mp3 players among others, in contrast to the survey in the current study (Appendix D) where a particular type of technology was not specified. Also, the Lei (2009) study had a separate scale for ability to solve computer problems but it was included as a part of the TK area of the current study. Comparing the current study to the Lei (2009) study by considering only the freshmen in the current study (Table 7), the results are slightly less than the Lei (2009) study, with 37% indicating a perception of high technology skills, one-half neutral, and 10% indicating a perception of low technology skills. One reason for the lower Agree percentage in this current study as compared to the Lei (2009) study may be the separate scale for ability to solve computer problems in the Lei (2009) study. The Lei (2009) study found that only 13.8% of participants felt confident that they could solve
most computer problems. If the responses from this separate scale had been included as a part of the technology knowledge scale of the Lei (2009) study, the results from the current study would have clearly supported her findings.

**Differences between Start and Finish of Teacher Education Program**

To determine the differences in perception of technological capabilities between the start and the finish of the teacher education program, freshmen perceptions versus senior perceptions were examined in the current study. One of the key findings in this study was the statistically significantly higher TPK scores for seniors over freshmen and the fact that there were no significant differences in the other technology-related scales. According to Koehler and Mishra (2009), TPK is an understanding of how teaching and learning can change when particular technologies are used in particular ways, which means that teachers must know the pedagogical affordances and constraints of a range of technological tools, as related to content-appropriate and development-appropriate designs and strategies. Table 7 (Chapter 4) shows the seniors’ TPK responses grouped by disagree, neutral, or agree. Zero percent of the responses by seniors are disagree, and 62% of the responses are in the agree category. The significantly higher scores indicate seniors perceive that they are able to choose and use technologies that appropriately enhance teaching and learning, they have a good understanding of technology, and they are able to help others coordinate the effective use of technology in the classroom. If their perceptions are accurate, then the findings from the current study support the findings of earlier studies, which are the lack of effective technology integration in the
classroom (Johnson et al., 2010; Smith & Evans, 2010; United States Department of Education, 2010b; Wenglinsky, 2005) may be attributed to other reasons, such as the age of existing teachers in the classroom (Shapley et al., 2010) and/or lack of technology support in the individual districts (Ertmer & Ottenbreit-Leftwich, 2010). The survey specifically measured preservice teachers’ self-assessment of their development of TPACK rather than their attitudes about or actual use of technology in the classroom. The problem with self-assessment, as reported in the Vannatta and Banister (2008) study, is that students may tend to self-assess at a higher level of technology skill, than they could actually demonstrate.

Another possible reason for seniors’ perceptions not reflecting actual understanding and application of TPK could be a lack of understanding of what teaching encompasses, as the majority the participants (68%) in the current study had no teaching experience (field experience) until the student teaching course (Table 3). The survey was administered during the first two weeks of their student teaching, so participants may not have had enough experience to provide an accurate view of actual use of technology in the classroom.

The Student Teacher Assessment form (Appendix E) provided by Kent State University College of Education to supervising teachers and KSU staff may provide some insight as to what is expected in the classroom from student teachers. Student teachers are currently supervised by the cooperating teacher and a faculty member from KSU using the Student Teacher Assessment form (Appendix E) provided by KSU. This form
consists of seven areas, referred to as Standards, on which the student teacher is assessed. Those seven areas include 3-7 statements which employ a Likert scale ranging from Not Observed to Strongly Agree to rate the student teacher. There is no space provided for comments on this form. The only reference to the use of technology on the assessment form appears under the Standard 4 Instruction heading: “Teachers plan and deliver effective instruction that advances the learning of each individual student.” Statement g. under that section asks observers to rate the students in relation to the statement: “Candidate effectively uses resources, including technology, to enhance student learning on a consistent basis.” To rate the student teachers’ performances, observers may choose from: “Not Observed,” “Strongly Disagree,” “Disagree,” “Agree,” or “Strongly Agree” (Appendix E). Student teachers are mostly observed by the cooperating teachers, so there are a variety of factors influencing the assessment, such as age and experience of cooperating teacher, district, and community, among others. Since technology is not defined, interpretation of that term is left to the assessor. Since the assessments of the student teachers are subjective, it may be advantageous to select homogeneous assessors who have been observed and/or tested to ensure they themselves are capable of recognizing and assessing effective technology integration in the classroom. The fact that there is only one reference to the use of technology in the classroom seems to indicate that technology is not important, which supports the findings of earlier studies (Ertmer & Ottenbreit-Leftwich, 2010; Ohio Department of Education, 2011a).
Seniors presented a higher percentage of “agree” scores than freshmen in the TK, TPK (significantly higher), and TPACK knowledge areas as shown in Table 7. In Table 8, a point-biserial correlation was used to show the measure of effect size (strength of relationship) that is recommended on page 34 in the 6th Edition APA manual (American Psychological Association, 2010). Point-biserial correlation and the eta coefficient is explained in detail in chapter 4, preceding Table 8. Table 8 shows that four of the five t tests were not significant based on the mean scores of freshmen as compared to the mean scores of seniors. Further, in the TK, TCK, TPACK and TPACK Modeling scale scores, the eta (or r) indicates little (weak) to no correlation of perceived technology capabilities as measured by the TPACK survey between students beginning the teacher education program (freshmen) and those finishing the teacher education program (seniors). As mentioned earlier in this section, the only statistically significant difference was the TPK knowledge area, where seniors (M = 4.08) had significantly higher TPK scores than did freshmen (M = 3.82) (Table 8). However, the correlation is weak, considering that only 3% of the variance could be attributed to class level (seniors versus freshmen).

In conclusion, the findings from this study showed little or no correlation between perceived TPACK knowledge area scores and whether students were beginning or ending the teacher education program. The limited teaching experience of the seniors, discussed earlier, may have contributed to a lower rating on the survey; however, a similar statement could be made about the freshmen. Most of the freshmen have no field experience, no experience with teaching classes or teaching methods courses, and limited
experience at the university. This lack of experience could have contributed to an over- or an under-evaluation of skills on the survey. Another reason for little or no correlation may be the use of the cross sectional study instead of a longitudinal study. The advantage of a longitudinal study would be the ability to track changes in individual students as they progress through the teacher education program. The cross sectional study, or this study, compares unrelated individuals who have a variety of backgrounds and experiences.

Changes During the Educational Technology Course

How students’ perceptions changed during their participation in the Educational Technology course was examined by this study. Students in the course took the TPACK survey as a pre- and post-test to track changes in perception over time. The pre-test was completed during the first two weeks of spring semester, 2012. The post-test was completed during the last two weeks of the same semester.

The required Educational Technology TAGs course at KSU encompasses the effective use of technology as an instructional resource in the classroom as related to the principles of learning and teaching. This course was established to meet desired technology knowledge outcomes as established by the Ohio Board of Regents (Ohio Board of Regents, 2011) and it serves as one of the few technology assessments mandated by state and federal policies. The only measure of whether preservice teachers possess the technology capabilities to satisfy the ISTE NETS•T standards comes down to
whether or not they successfully complete the Educational Technology course assignments and pass the course.

The findings from the current study supported the findings of several earlier studies (Collier et al., 2004; Vannatta & Banister, 2008) which showed an improvement in students’ perceptions of the use of technology as applied to teaching, after the completion of an educational technology course as a part of a teacher education program. Comparing the pre- and post-test technology-related knowledge area scores (Table 8) shows four (TCK, TPK, TPACK, and TPACK modeling) of the five scores to be significantly higher at post-test; but, Technology Knowledge (TK) was not significantly higher at post-test. Some of the reasons that TK was not significantly higher may be that the current generations of students are more technology-savvy (Brooks-Young, 2005; Rideout et al., 2010; Smith & Evans, 2010); or, more likely, the questions on the TPACK survey did not directly relate to what they were learning in the course.

The majority of students (75%) enrolled in the Educational Technology course were sophomores or juniors, most of whom (68%) did not yet have field experience, as shown in Table 3. Since the required Educational Technology course may be the students’ first exposure to NCATE and NETS•T standards, students may first become aware of the expectations for teachers regarding technology during this course. The technology currently associated with teaching, as implied by the 2011 fall syllabus of the Educational Technology course, includes the knowledge and application of the accepted standards (NCATE and NETS•T) and a basic knowledge of the following topics:
operating systems, file/folder management, file compression, networking, FTP,
troubleshooting, email and attachments, Internet and WWW, Word processing,
PowerPoint (linear and nonlinear), Excel, Desktop publishing, Adobe Acrobat (PDF),
visual literacy, instructional design (lesson planning), technology integration strategies,
media selection, social issues, human issues, ethical issues, legal issues, digital images,
digital audio, digital video and manipulation of images.

There are other factors which may have influenced the higher scores of the second
survey. The survey defined the term “technology” as digital technology and gave several
examples of digital tools, such as computers, laptops, iPods, software programs, and
others, but the students may not have read the survey instructions and the listed examples
of digital tools may have been unfamiliar to the students. Also, the Educational
Technology course may have provided a definition for specific technology tools used in
the course for the students as related to the second survey. The students took the same
survey twice, which may have influenced their responses, or the fact that they had just
completed a technology-based course in which they utilized technologies unfamiliar to
some of them. In other words, student scores may have been higher at the end of the
course (second survey) because the course defined technology for the students and they
were close to completing the course, which could account for students’ perceiving that
they were more technology-capable then when they started the course.
Limitations

Survey research has the potential to have issues which can affect the validity of the data collected, the main issues being: clarity of questions; honesty of respondents; and, response rates. Because the surveys were not conducted as a part of class in most cases, the chance of non-response was greatly increased. The data collected from the students contained incomplete responses and there was a possibility of dishonest responses. The responses were examined for any omitted data and it was found the only omissions occurred in incomplete surveys. Incomplete surveys were not included in the study. The TPACK survey for preservice teachers (Schmidt et al., 2009) does contain three methods of detecting dishonest responses: implausible frequency and extent of use, and unlikely response combinations. There were no events where any of these three methods were evident probably due to the online survey restrictions (tracked by unique identifier).

The clarity of the questions on the survey can be checked in several ways. Surveys can be administered to several groups and examined for consistency of responses – an indicator that the questions are clear – and/or the survey can be compared with another measurement instrument, such as a class assignment related to what the survey is intended to measure. The TPACK survey for preservice teachers (Schmidt at al., 2009) has been checked for consistency and has been compared against other instruments for accuracy (Appendix G). However, the TPACK survey for preservice teachers (Schmidt
at al., 2009) has been adapted for each environment; in the current study, the survey was adapted to the jargon of KSU and an additional question was added.

As mentioned earlier, the term “technology” was defined by the survey – but also defined by each individual who completed the survey. With minimal pre-survey guidance concerning the definition of technology, each student provided their own meaning and there is no way to determine individual meanings given the interpretive nature of the survey, such as allowing each student to supply individual definitions of technology rather than naming specific technology tools, and each student’s interpretation of each question and of individual perceived skills on the self-reporting survey about technology skills. Although the survey did define technology as digital technology and offer a few examples of digital technology tools, the current generation of students may not have been familiar with some of the technology tool examples (outdated technology) and the survey did not mention current technology tools, such as the tablet. There is also a possibility that the students did not read the survey instructions. Individual definitions of various components of the survey may have contributed to a wider variance in answers on the survey; freshmen have little experience at the university and no experience with teaching, so their interpretation of technology may vary greatly from seniors who near the completion of the program. To better track students’ definitions of technology, it may be advantageous to ask students to list what they consider as technology and/or what they consider as technology as applied to the teaching field.
Also, an earlier study (Chai, Koh, & Tsai, 2010) reported that the TPACK survey for preservice teachers (Schmidt et al., 2009) contained overlapping constructs, such as TCK, PCK, and TPK which were reported as problematic for participants in distinguishing between the TPACK categories. This did not seem to be a problem in the current study which found significant differences in the categories of TCK and TPK.

Other limitations include collecting data from a single location (Kent State University, College of Education, Kent, Ohio), for two of the courses in which the survey was administered, and using a fairly homogenous group of participants. The findings from the current study may not be generalizable beyond the current population. It would be advisable to compare the data from the current study with data collected in other parts of the country.

The findings in the current study are limited to one semester at the university. Without comparing data from other semesters over a long period of time, these findings will not be generalizable to other semesters at KSU. For example, in contrast to a longitudinal study, this study was not able to follow individual participants from the start to the finish of their teacher education program at Kent State University; therefore, the differences between perceptions of freshmen and perceptions of seniors may be attributed to other factors, such as different educational or socioeconomic backgrounds and individual experiences. Future studies could follow these participants through the educational program at KSU and compare them with other groups of participants from KSU or from other parts of the country. A longitudinal study would have allowed for
fewer participants to be used, would have eliminated between-subject variation, and could have provided information about individual changes over time. However, performing a longitudinal study would have been presented with difficulties due to rapidly changing technology, or due to potential changes in technology standards, state or federal policies, or even university course work. For those reasons, a cross-sectional population surveyed over a one-semester period (15 weeks) was used. A cross-sectional study allowed for the examination of technology capabilities of various levels of the student population using the same level of technology, the same survey, and the same standards. Although a cross-sectional study cannot be used for measuring change in individual students, the specific sub-study involving students in the Educational Technology course was used to measure changes in student perceptions that took place over the semester in which they participated in the course.

Also, the experiences of participants in their first course cannot be accurately compared with participants in their final course. Freshmen had little experience with the university and no teaching experience or courses. Seniors, nearing the end of their program, had more university experience, more life experience, completed teaching methodology courses, and had more field experience. The results from the current study are limited to understanding the differences in this particular group of participants’ perceptions, with the understanding that the differences in the perceived knowledge of these freshmen and these seniors may be attributed to other factors outside of school.
Response rates can be impacted by many different characteristics of the participants and the environment. In order to entice students to participate, the survey of the current study was introduced as a short survey which would take five to ten minutes to complete and may help improve the teacher education program by better preparing preservice teachers for classroom teaching. When permitted by the course instructor, the researcher appeared in person to introduce the study and explain the purpose and potential benefits of participating. When in-person appearances were not permitted, an email containing the same introduction information was sent to all potential participants.

The differences in the classroom environment included the cooperating instructor of the course section. Two of the cooperating instructors of the CULT sections, and one of the ITEC sections offered extra credit to their students who completed the survey. For the CULT course, there was only one section in which the cooperating instructor did not offer extra credit and the response rate was extremely low. In that particular section, an in-person appearance to introduce the study was possible, but the instructor did not obviously encourage the students to participate. The other sections of the CULT course, where extra credit was offered, resulted in a good response.

Similarly, the sections of ITEC (the required Educational Technology course) that offered extra credit had a good response and the sections that didn’t offer extra credit had a much lower response rate. The exception was the four sections of the course taught by Dr. Kuo. She encouraged the students to participate and underscored the importance of the study before the study was introduced in-person to the potential volunteers. Since it
was early in the semester, the students may have felt compelled to participate by the instructor’s encouragement during the class.

The second survey in the ITEC Educational Technology course had fewer respondents than the first survey even though the study was introduced with the fact that they would need to complete the same survey twice, once at the beginning of the semester and again at the end of the semester. Some of the reasons for the participants dropping out may include dropping the course, the novelty of participating wore off, some participants may not have liked the initial involvement of taking the survey (pretest sensitivity), and/or the participants were too busy with required assignments to afford time on the survey.

The lowest response rate (10%) occurred with the student teaching participants. There are probably several factors which contributed to the low response rate. The student teaching coordinator at the KSU campus sent out an email to the students asking that they consider participating in the study. There was no chance for an in-person appeal or extra credit. Another reason may be that it is the last semester for many of the students so they may feel less of a commitment to participate in a study which may improve the teacher education program. Or, it may be that they are in the field, in several school districts, performing the required student teaching, not in direct contact with an instructor regularly. To increase the likelihood of participation, at the request of the researcher, the student teacher coordinator send out several follow-up emails encouraging students to participate in the study, which increased the participation to 18 students (out of 173).
As far as other differences between responders and non-responders, gender did not seem to make a difference, but class level may have. Out of the total population of 683 students who were solicited to participate, the responders were 11% freshmen, 8% sophomores, 5% juniors, and 4% seniors.

**Implications of the Study**

There are several conclusions to be posited from the results of this study. First, the Educational Technology course seems to have a positive effect on students’ perceptions of technological ability as applied to the field of teaching and learning. Second, seniors perceive that they are prepared to integrate technology in the classroom. The findings in this study leading to these conclusions are the increased post-survey scores of the Educational Technology course students and possibly, the increased TPK knowledge area scores of seniors versus freshmen TPK knowledge area scores. Although a statistically significant difference was detected in the TPK scores of freshmen versus seniors, it is not educationally significant. In statistics, a result is called statistically significant if it is unlikely to have occurred by chance. Given a sufficiently large sample, extremely small and non-notable differences can be found to be statistically significant, but not educationally significant, so the effect size, which is size of the observed effect, must be examined. For results to be educationally or practically significant, $r$ should be .25 or greater (Wiersma, 1995). The effect size ($r = .21$) for the TPK scores of freshmen versus seniors indicates a weak correlation. Effect size is explained in detail earlier in the current study.
Therefore, one implication from the current study is to investigate how the Educational Technology course can be improved—which may be indicated by a larger difference between the pre- and post-survey scores in the Educational Technology course; and how the TPK scores of seniors can be improved—which may be indicated by increased TPK scores of seniors versus freshmen. One approach for improving the Educational Technology course and increasing the TPK scores of seniors may be to implement technology testing to all incoming freshmen of teacher education programs, to set a base technology standard that all freshmen must meet, and to provide courses or tutoring that would provide an opportunity for all freshmen to meet the established standard, similar to the practices of Bowling Green University (Vannatta & Banister, 2008). Of course, a prerequisite to implementing this practice would be to verify that there is an advantage.

An examination of incoming freshmen technology skills may also provide insight into the type of technology that must be taught so that, as future teachers, they are fully prepared to integrate technology into the classroom (as defined by the educational technology course). However, the establishment of an accurate assessment instrument would be of great importance. Considering the national push for technology integration and the widespread adoption of ISTE standards, an assessment instrument would have to accurately measure whether the standards related to technology integration in the classroom are being met. This type of study would be extremely difficult to coordinate and maintain, but if the differences it would quantify could become educationally
significant to future research and development of the teacher education program, the entire teacher education program at all Ohio universities would benefit from the shared TAGs course (Educational Technology), and Kent State University could become a recognized leader in teacher education programs.

Some conclusions from this study are limited by the timing of the survey. For example, the higher senior TPK score was recorded at the beginning of their student teaching experience; this score may have differed had the survey been administered near the end of their student teaching experience. For this study, the surveys were administered to the entire sample population (N = 193) at the same time in an effort to assess the perceptions of students at each class level, from little or no college experience to the last (or second to last) semester of the senior level. The survey was distributed in the first two weeks in an attempt to maximize the number of participants: student teachers take on more student teaching responsibility as the semester progresses, so the best chance of obtaining student teacher volunteers would be at the beginning of the semester.

Supporting the national push for technology integration in the classroom and in contrast to the documented current lack of widespread technology integration in the educational system (Johnson et al., 2010; Smith & Evans, 2010; United States Department of Education, 2010b; Wenglinsky, 2005), the findings from the current study indicate that preservice teachers (seniors) at Kent State University perceive themselves to be well-prepared to integrate technology into the classroom in a manner that it enhances
the teaching and learning experience. Because teachers tend to teach as they were taught (Johnson & Seagull, 1968), it is important that teacher education programs incorporate technology in all aspects of their program; however, this study found that the students’ perceptions of TPACK modeling (use of technology in teaching by KSU faculty) were not high. The results (Table 7) show that the majority of all levels (freshmen through seniors) selected 3 = “Neither agree nor disagree” when rating TPACK modeling. There is a possibility that students misunderstood the TPACK modeling section or were unable to recognize TPACK modeling; or, technology use may have been limited by hardware, software, Internet access, or other factors. The implications are that a study of current KSU teacher education classrooms be done in order to ascertain to what degree technology is currently integrated.

**Recommendations for Future Research**

If the TPACK survey for preservice teachers (Schmidt et al., 2009) is used in future surveys at KSU, there are several change considerations which may increase the accuracy of the data; one being to change the selection choices for the question asking where participants’ technology skills were predominantly learned. This question is not a part of the original survey. In this study, students were asked to rate six potential sources from “Unimportant” to “Very Important,” and were also given the option of selecting “Other” and filling in text to describe their source. Participants had the option of selecting all that apply, which resulted in an inconsistent number of answers. Many students who selected the “Other” category did not fill in text describing the source. The
results were difficult to interpret. A better option for this question may have been to have students rank the choices (comparing the choices against each other) from most important to unimportant. The choices should remain the same as they are in the current survey, including the “Other” category, but participants should be mandated to enter text after “Other” is chosen unless it is marked unimportant.

The second recommended change for future research is to survey students enrolled in student teaching near the end of their student teaching for a more accurate view of their perceived ability to integrate technology into the classroom with the addition of good incentives for participating. Ideally, a longitudinal study could be one of the ways to follow preservice teachers into their roles as beginning teachers to investigate their activity in advocating for and integrating technology into the classrooms during the initial years of their teaching careers. If a longitudinal study is not feasible, a combination of the TPACK survey and observation of the student teachers in the classroom near the end of the semester may assist in the understanding of what is considered technology integration in the classroom by students, cooperating teachers, and KSU.

As mentioned earlier, the structure of the current study has no method of verifying the accuracy of the perceptions of the students. To test the accuracy of the student teachers’ perceptions, a study of student teachers in current Ohio classrooms could be conducted for the duration of their student teaching course to reveal whether the students’ perceptions were accurate, and/or whether the school districts hinder the effective
integration of technology through lack of administrative support or through available hardware, or if there are other factors which prevent the effective integration of technology. An example of a study to verify the accuracy of the students may be an observational study examining inservice teachers’ technology integration in the classroom.

Again, a longitudinal study following preservice teachers from the start of the program through to the initial years of their teaching careers could be advantageous in tracking starting technology skills, as related to teaching, and the development of teaching-related technology skills to the application of technology in the classroom. In addition, it would also provide information about the integration of technology within the teacher education program by the faculty. Future studies may be needed to address the issue of college faculty members who do not integrate technology into the classroom. A study of this magnitude would be difficult to perform because of the time involved and the task of tracking each participant.

Earlier, the lack of importance placed on technology was discussed. Another suggestion for future research would be a study of states with and without technology mandates as a part of their teacher licensing procedures. The study could be structured to answer the questions: Do these states have more technology integration present in the classrooms? Which preservice teachers are more able to integrate technology after completing the teacher education programs at universities within the state? Are current classroom teachers more technology savvy, and how do we know?
On a smaller scale, another topic for future research may be a study of universities with preservice teacher technology skills testing. Some universities—such as Bowling Green, mandate technical testing for all incoming students (Vannatta & Banister, 2008). Thus, future research may include a study of the preservice teacher graduates at these universities to ascertain whether or not their graduates are better prepared to integrate technology into the classroom and/or if they have more success at integrating technology into the classroom as beginning teachers.

The precise reasons that technology is not now equally integrated into the classrooms across districts are unknown. Therefore, future research should address the following questions: First, what specifically prevents the effective integration of technology into the classroom/school/district; and, second, how can these reasons be overcome so that all schools can attain the national vision of technology integration in the classroom? Other questions to consider for future research are: What can teacher education programs do to promote technology integration in the classroom? How can current teachers effectively integrate technology in the classroom? And, how can teacher education programs ensure that their faculty is modeling effective integration of technology in the classroom?

**Practitioner Recommendations**

The findings from this study indicate that the Educational Technology course is beneficial to students in so far as the post-survey scores in technology-related knowledge areas were higher than pre-survey scores. The curriculum of the Educational Technology
course, developed largely by Dr. Kuo, covers basic technology skills, accepted technology standards, and widely used applications. The findings from this study also indicated that seniors perceived that they were ready to apply technology in the classroom to enhance teaching and learning. As discussed earlier, the higher post-survey scores and the higher TPK scores of the seniors are statistically significant, but not educationally significant.

The lack of educational significance suggests that both the Educational Technology course and the teacher education program at Kent State University could be examined and possibly improved so that the differences between the scores are greater and the students (preservice teachers) are better prepared to integrate technology in the classroom. Potential future research in this area was discussed earlier.

**Summary**

How and why technology has yet to be effectively integrated into the teaching and learning process within the United States education system is discussed in this paper. Teachers comprise an integral factor in the effective incorporation of technology into classroom activities, and yet many current teachers remain unable or unwilling to employ technology fully or effectively. The reasons teachers do not effectively use technology in the classroom include differences among generations, lack of knowledge, lack of technology mandates within districts, or the lack of technology within districts. To ensure the effective integration of technology in the educational system, future teachers
must be prepared, technology must be available, and there must be consistent, enforceable mandates and assessments.

The current study examined preservice teachers’ perceptions of their technology capabilities as related to teaching. Despite limitations, the current study chose to use a cross sectional, one-semester data collection using a survey. The cross sectional study allowed for the exploration of the entire program through students’ levels and perceptions in one semester. The advantages of the cross sectional study were the short time commitment on the part of the participants (students and faculty) and the researcher as well as the broad amount of information collected in a short period of time. Earlier studies (Ertmer & Ottenbreit-Leftwich, 2010; Johnson et al., 2010; Lei, 2009; Rideout et al., 2010; Smith & Evans, 2010; United States Department of Education, 2010b; Wenglinsky, 2005) indicated that technology integration is not equal among school districts. The findings from the current study (Table 10) support the inequity of technology integration through the different levels of perception of technology ability with a fairly homogenous sample. Lei (2009) stated that the digital divide, even with a homogeneous group, could be a reason for the wide variance in perception of technology ability.

Earlier studies indicated that preservice teachers must have the ability to integrate technology into the classroom (Ertmer & Ottenbreit-Leftwich, 2010; Johnson et al., 2010; Lei, 2009; Rideout et al., 2010; Smith & Evans, 2010; United States Department of Education, 2010b; Wenglinsky, 2005), and preservice teachers at KSU perceive they
possess the ability to integrate technology into the classroom. The findings from this study indicated that students perceived themselves to have better technological abilities after completing the Educational Technology course and as seniors near the end of the teacher education program. However, this perception will not necessarily lead to a change in practice once students become inservice teachers.

The results of this study should challenge teacher education faculty to consider two major areas: How their beliefs, attitudes, and use of technology in teaching and learning are transmitted to their students through the instructional decisions and actions they take; and, what actions would allow them to improve the TPACK knowledge area scores of students. The actions may be additional research or a change in curriculum.
APPENDIX A

LETTER OF CONSENT
APPENDIX A

LETTER OF CONSENT

From: KIEHL, LAURIE <lkiehl@kent.edu>
Date: Fri, Jan 20, 2012 at 3:30 PM
Subject: IRB approval for Protocol application #12-030 - please retain this email for your records
To: "vcoffman@kent.edu" <vcoffman@kent.edu>
Cc: "INGRAM, ALBERT" <aingram@kent.edu>

RE: Protocol #12-030 entitled “The Perceived Technology Proficiency of Students of Teacher Education Programs”

I am pleased to inform you that the Kent State University Institutional Review Board has reviewed and approved your Application for Approval to Use Human Research Participants as Level I/Exempt research. This application was approved on January 20, 2012. Your research project involves minimal risk to human subjects and meets the criteria for the following category of exemption under federal regulations:

- Exemption 2: Research involving the use of educational tests, surveys, interviews, or observation of public behavior.

***Submission of annual review reports is not required for Level I/Exempt projects.

If any modifications are made in research design, methodology, or procedures that increase the risks to subjects or includes activities that do not fall within the approved exemption category, those modifications must be submitted to and approved by the IRB before implementation. Please contact the IRB administrator to discuss the changes and whether a new application must be submitted. It is important for you to also keep an unstamped text copy (i.e., Microsoft Word version) of your consent form for subsequent submissions.

Kent State University has a Federal Wide Assurance on file with the Office for Human Research Protections (OHRP): FWA Number 00001853.

If you have any questions or concerns, please contact me by phone at 330-672-2704 or by email at Pwashko@kent.edu.

Respectfully,

Kent State University Office of Research Compliance
224 Cartwright Hall | fax 330.672.2658
Kevin McCready | Research Compliance Coordinator | 330.672.8058 | kmccrea1@kent.edu
Laurie Kiehl | Research Compliance Assistant | 330.672.0837 | lkiehl@kent.edu
Paulette Washko | Manager, Research Compliance | 330.672.2704 | Pwashko@kent.edu

For links to obtain general information, access forms, and complete required training, visit our website at www.kent.edu/research.

171
APPENDIX B

EDUCATIONAL TECHNOLOGY SYLLABUS
APPENDIX B

EDUCATIONAL TECHNOLOGY SYLLABUS

Educational Technology ITEC 19525-006
Fall 2011 – Room 301 Moulton Hall | Mondays 4:25-7:05pm
Instructor: Jason Piatt, M.Ed.
Office: 212 White Hall
E-mail: jpiatt@kent.edu
Phone: 330-672-0543
Office Hours: Mondays 3-4pm or by appointment

Course Description
Welcome to the College of Education, Health, and Human Services at Kent State University and Educational Technology. Educational Tech is the second in a sequence of courses designed to help you understand the role of teachers in developing challenging and effective learning environments. In this course, you will develop the necessary technological competencies to successfully support the teaching profession. This course is very demanding and it is expected that appropriate amount of time will be given to the completion of projects.

Course Objectives

- **NCATE/NETST Standards.**
  This course is designed to meet the National Educational Technology Standards for Teachers (NETST) developed by the International Society for Technology in Education. The NETST are organized into five categories as noted below. All candidates in teacher education programs are expected to meet the NETST standards and performance indicators. See the last page for a complete list of performance indicators.
  I. Facilitate and Inspire Student Learning and Creativity
  II. Design and Develop Digital-Age Learning Experiences and Assessments
  III. Model Digital-Age Work and Learning
  IV. Promote and Model Digital Citizenship and Responsibility
  V. Engage in Professional Growth and Leadership (iste.org, 2008)

- **Transfer Assurance Guidelines (TAG)**
  To ensure students are guaranteed the transfer of applicable credits among any of Ohio’s public institutions of higher education and equitable treatment in the application of credits to admissions and degree requirements, this course also meets the TAG for Educational Technology. Candidates are expected to:
  1. develop basic technology competencies through the effective use of multiple operating systems.
  2. develop the basic understanding of productivity and utility software applications.
3. develop basic understanding of using existing and emergent educational technologies in achieving curricular goals including classroom management, curricular design, and instructional strategies.

4. develop an understanding of copyright law, use of copyrighted materials, software licensing, and other ethical issues.

5. develop the ability to align curricular goals, instructional objectives, and the capabilities of electronic media through the principles of effective visual design, specification of clear instructional objectives and the production of electronic media in various digital and non-digital formats.

Topics Covered

ISTE Standards
Ohio Academic content standards
Electronic Portfolio
Basic technology competencies
  Operating systems
  File and folder management
  File compression
  Networking
  FTP
  Troubleshooting
Productivity tools
  Email and attachment
  Internet and WWW
  Word processing
  PowerPoint (liner and non-linear)
  Excel
  Desktop publishing
Adobe Acrobat (PDF)
Teaching with Technology
  Visual literacy
  Instructional design (Lesson planning)
  Technology integration strategies
  Media selection
Social, Ethical, Legal, and Human issues
  Ethical, cultural, and societal issues related to technology use
  Responsible use of technology
  Positive dispositions
  Electronic research and references
  Information literacy standards
Multimedia
  Digital photography, digital images, and image manipulation
  Digital video
Required Materials

1. USB/Jump drive (1GB or higher)
2. Microsoft Office 2007 or 2010 (we will use Word, PowerPoint, etc.)
3. Windows Movie Maker, iMovie, or any other movie creation program for the movie assignment
4. Microphone (will use for multimedia project)

* Note: you can check out microphone, digital camera, digital camcorder in Instructional Resource Center (http://www.kent.edu/ehhs/centers/irc/index.cfm) in 221 White Hall, Kent campus or KSU Student Multimedia Studio (http://www.library.kent.edu/page/10016).

Text
An E-text, Educational Technology Primer, has been posted in the Blackboard Learn site. Students are required to read the text and complete assigned activities.

List of Assignments (520 points)
Detailed descriptions for each assignment can be found in the Blackboard Learn site. The nature of the course demands that students keep up to date with their work. It is recommended that students use their time wisely and make sure to turn all work in on time.

1. Technology proficiency assessments (2@10pts, 20pts total)
   a. Take the technology proficiency assessment at the beginning and end of the semester.

2. Electronic portfolio (100pts)
   a. Create an electronic portfolio in Google Sites.

3. E-text learning activities (3@10pts, 30pts total)
   a. Complete assigned activities in the e-text

4. Instructional graphic (50pts)
   a. In MS Word create an instructional graphic combining images and text into a visual representation

5. Non-linear PowerPoint (50pts)
   a. In MS PowerPoint create a non-linear PowerPoint as a learning module

6. Movie assignment (80pts)
   a. Create a movie that could be used in support of a lesson you would teach in your content area and grade-level
7. **WebQuest or technology integration lesson plan (50pts)**  
   a. Create a WebQuest or technology integration lesson plan

8. **AT&T classroom observation and written reflection (30pts)**  
   a. Observe in the AT&T classroom and write a two-page reflection paper

9. **Online professional development community and written reflection (30 pts)**  
   a. Participate in an online professional development community and write a two-page reflection paper

10. **New technology presentation (50 pts)**  
    a. Introduce/teach a technology tool that can be used in the classroom or integrated into learning and teaching.

11. **New technology learning reflection (30 pts)**  
    a. Reflect on three new technology tools of your choice learned from the new technology presentations.

**Attendance Policy**

Attendance is required. If you miss class, please e-mail your instructor prior to your class time and bring a university documented excuse to the next class. I give students **TWO** sick days with no excuses required. In other words, I do not start counting absences until the 3rd unexcused absence. Your final course grade will be lowered by **2 points** for each unexcused absence beyond two days.

According to the Kent State University Policy, legitimate reasons for absence include, for example, illness, death in the immediate family, religious observance, academic field trips, and participation in an approved concert or athletic event, and direct participation in university disciplinary hearings. An official letter documenting this participation must be presented to your instructor. Any attempt at falsifying attendance records will be treated as an act of academic dishonesty.

**Absences from any classes for any reason will not excuse you from completing the assigned work on time.**

Repetitive late entry and early departure from class will be counted as an absence. Furthermore, late entry is discourteous and disruptive.

**Late Assignments**

Late assignments are not accepted and will result in zero points.

**Cell Phone Policy**

In order to provide all students in the class with a productive learning experience, use of cell phones during class is **prohibited**. Failure to comply with this policy may result in the student being asked to leave the classroom.
Grading Policy
It is the student’s responsibility to correctly submit assignments in Blackboard Learn or post them on the Web by the requested date and time. Students who complete each assignment should not assume full credit will be given. The assignments will be graded on their instructional value and visual layout as well as demonstration of technical proficiency. All assignments are grading using the supplied rubrics.

Checking Grades
All grades will be posted in Blackboard Learn. If you are having trouble logging in, please call the KSU Helpdesk at 330-672-HELP (2-HELP on Kent campus) or email helpdesk@kent.edu.

The final course grade will be determined using the standard scale: 94-100% = A; 90-93 = A-; 86-89 = B+; 83-85 = B; 80-82 = B-; 76-79 = C+; 73-75 = C; 70-72 = C-; 66-69 = D+; 63-65 = D; less than 63 = F

According to University grading policy, the letter grade of "A" is reserved for students whose work is significantly above average and represents a level of excellence beyond the norm. "B" grades are awarded to students who show a good level of performance. "C" grades and lower denotes fair or average performance. As per University policy, incompletes can only be awarded in extreme emergencies (subject to verification), such as death in the immediate family and grave personal illness. All work must be up-to-date at the time the incomplete is requested. All students are responsible for monitoring their own progress in the course and ensuring that all assignments have been properly posted and are fully functional online. If a project is misnamed, missing, or posted incorrectly, it will not be graded. Please note that this warning is especially applicable at the end of the term when there are fewer opportunities to correct technical problems. No changes in the final course grade will be issued after final grades are submitted unless a clerical or procedural error was made by the staff. Therefore, please make sure all assignments are available, named correctly, and fully functional.

*Note: Some degree plans require a "B" or higher for successful completion of this course. Check with your advisor if you are uncertain (VACCA Office of Student Services, http://www.kent.edu/ehhs/services/voss/).

Students with Disabilities
University policy 3342-3-01.3 requires that students with disabilities be provided reasonable accommodations to ensure their equal access to course content. If you have a documented disability and require accommodations, please contact the instructor at the beginning of the semester to make arrangements for necessary classroom adjustments. Please note, you must first verify your eligibility for these through Student Accessibility Services (contact 330-672-3391 or visit http://www.registrar.kent.edu/disability/ for more information on registration procedures).

Course Registration
It is the policy of Kent State University that students are not permitted to attend classes for which they are not officially enrolled. It is the student’s responsibility to ensure proper
enrollment in classes. You are advised to review your official class schedule during the first two weeks of the semester to ensure proper enrollment. Should you find an error in your class schedule, you have until Friday of the second week of classes to correct it. If registration errors are not corrected by that date and you continue to attend and participate in classes for which you are not officially enrolled, you are advised now that you will not receive a grade at the conclusion of the semester.

Electronic Communications Policy For Students

Purpose
Kent State University is committed to using the most advanced technology available to communicate with students and recognizes an expanding reliance on electronic communication among students, faculty, staff, and the administration due to the convenience, speed, cost-effectiveness, and environmental advantages of using electronic communication. Therefore, the Electronic Communications Student Policy will provide procedures and regulations to govern the use of electronic communications between the University and the students. Electronic communications may include, but are not limited to, electronic mail, electronic bulletin boards, and information portals. Please refer to the Kent State University Responsible Use of Information Technology Policy for additional information and guidelines regarding electronic communication.

Policy
A University-assigned student email account shall be an official University means of communication with all students at Kent State University. Students are responsible for all information sent to them via their University assigned email account. If a student chooses to forward their University email account, he or she is responsible for all information, including attachments, sent to any other email account.

Student Support
Your successful completion of Educational Technology and ultimately the completion of your intended degree plan here at KSU is held in high regard by faculty and staff. If you are having difficulties with the content you are encouraged to talk with your instructor ASAP for extra assistance. There are a number of additional resources available to students across campus as well:

Instructional Resource Center (http://www.kent.edu/ehhs/centers/irc/index.cfm)
An open lab along with one-on-one assistance is available for all students in White Hall 221.

Academic Success Center (http://www.kent.edu/asc/index.cfm)
Tutoring, study groups, and computer instruction is available to all students in 207 Michael Schwartz Center.

The Help Desk (http://www.kent.edu/is/helpdesk/index.cfm)
Support for e-mail, web, and various software applications.

Writing Commons (http://www.kent.edu/writingcommons/index.cfm)
Works with all students on various writing endeavors. Located in 4th Floor KSU main Library.

Student Multimedia Studio (http://www.library.kent.edu/page/10016)
Provides KSU students with a wide range of multimedia equipment.
APPENDIX C

NETS-T
APPENDIX C

NETS-T

The ISTE NETS and Performance Indicators for Teachers (NETS-T)

Efficient teachers model and apply the National Educational Technology Standards for Students (NETS-S) as they design, implement, and assess learning experiences to engage students and improve learning; enrich professional practice; and provide positive models for students, colleagues, and the community. All teachers should meet the following standards and performance indicators. Teachers:

1. Facilitate and Inspire Student Learning and Creativity
   Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments. Teachers:
   a. promote, support, and model creative and innovative thinking and innovation
   b. engage students in exploring real-world issues and solving authentic problems using digital tools and resources
   c. promote student reflection using collaborative tools to reveal and clarify students' conceptual understanding and thinking, planning, and creative processes
   d. model collaborative knowledge construction by engaging in learning with students, colleagues, and others in 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 assessments incorporating contemporary tools and resources to maximize content learning in content and to develop the knowledge, skills, and attitudes identified in the NETS-T. Teachers:
   a. design or adapt relevant learning experiences that incorporate digital tools and resources to promote student learning and creativity
   b. develop technology-enhanced learning environments that enable all students to pursue their individual interests and become active participants in setting their own educational goals, managing their own learning, and assessing their own progress
   c. personalize and provide learning activities to address students' diverse learning styles, working strategies, and abilities using digital tools and resources
   d. provide students with multiple and varied formative and summative assessments aligned with current and technology standards and use resulting data to inform learning and teaching

3. Model Digital-Age Work and Learning
   Teachers exhibit knowledge, skills, and work processes representative of an innovative professional in a global and digital society. Teachers:
   a. demonstrate fluency in technology systems and the transfer of current knowledge to new technologies and situations
   b. collaborate with students, peers, parents, and community members using digital tools and resources to support student success and innovation
   c. communicate relevant information and ideas effectively to students, parents, and peers using a variety of digital-age media and formats
   d. model and facilitate effective use of current and emerging digital tools to locate, analyze, evaluate, and use information resources to support research and learning

4. Promote and Model Digital Citizenship and Responsibility
   Teachers understand local and global societal issues and responsibilities in an evolving digital culture and exhibit legal and ethical behavior in their professional practices. Teachers:
   a. advocate, model, and teach safe, legal, and ethical use of digital information and technology, including respect for copyright, intellectual property, and the appropriate distribution of resources
   b. address the diverse needs of all learners by using learner-centered strategies and providing equitable access to appropriate digital tools and resources
   c. promote and model digital citizenship and responsible social interactions related to the use of technology and information
   d. develop and model cultural understanding and global awareness by engaging with colleagues and students of other cultures using digital-age communication and collaboration tools

5. Engage in Professional Growth and Leadership
   Teachers continuously improve their professional practice, model lifelong learning, and exhibit leadership in their school and professional community by facilitating and demonstrating the effective use of digital tools and resources. Teachers:
   a. participate in local and global learning communities to explore creative applications of technology to improve student learning
   b. exhibit leadership by demonstrating a vision of technology infusion, participating in shared decision making and community building, and developing the leadership and technology skills of others
   c. evaluate and reflect on current research and professional practice on a regular basis to make effective use of existing and emerging digital tools and resources in support of student learning
   d. contribute to the effectiveness, vitality, and self-renewal of the teaching profession and of their school and community
APPENDIX D

NETS-S
APPENDIX D

NETS-S

The ISTE NETS and Performance Indicators for Students (NETS-S)

1. Creativity and Innovation
   Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students:
   a. apply existing knowledge to generate new ideas, products, or processes
   b. create original works as a means of personal or group expression
   c. use models and simulations to explore complex systems and issues
   d. identify trends and forecast possibilities

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. Students:
   a. interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media
   b. communicate information and ideas effectively to multiple audiences using a variety of media and formats
   c. develop cultural understanding and global awareness by engaging with learners of other cultures
   d. contribute to project teams to produce original works or solve problems

3. Research and Information Fluency
   Students apply digital tools to gather, evaluate, and use information. Students:
   a. plan strategies to guide inquiry
   b. locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media
   c. evaluate and select information sources and digital tools based on the appropriateness to specific tasks
   d. process data and report results

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. Students:
   a. identify and define authentic problems and significant questions for investigation
   b. plan and manage activities to develop a solution or complete a project
   c. collect and analyze data to identify solutions and/or make informed decisions
   d. use multiple processes and diverse perspectives to explore alternative solutions

5. Digital Citizenship
   Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students:
   a. advocate and practice safe, legal, and responsible use of information and technology
   b. exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity
   c. demonstrate personal responsibility for lifelong learning
   d. exhibit leadership for digital citizenship

6. Technology Operations and Concepts
   Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:
   a. understand and use technology systems
   b. select and use applications effectively and productively
   c. troubleshoot systems and applications
   d. transfer current knowledge to learning of new technologies

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APPENDIX E

TPACK SURVEY
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 individual name or identification number will not at any time be associated with your responses. Your responses will be kept completely confidential and will not influence your course grade.

DEMographic INFORMATION

1. Gender
   a. Female
   b. Male

2. Age range
   a. 18-22
   b. 23-26
   c. 27-32
   d. 32+

3. Major
   a. Early Childhood Education (ECED)
   b. Middle Childhood Education (MCED)
   c. Other, please list: ______________________

4. Area of Specialization
   a. Art
   b. Early Childhood Education Unified with Special Education
   c. English and Language Arts
   d. Foreign Language
   e. Health
   f. History
   g. Instructional Strategist: Mild/Moderate (K8) Endorsement
   h. Mathematics
   i. Music
   j. Science-Basic
   k. Social Studies
   l. Speech/Theater
   m. Other, please list: ______________________

5. Year in College
   a. Freshman
   b. Sophomore
   c. Junior
   d. Senior
6. Are you currently enrolled or have you completed any field experience in a classroom, any grade level from PreK through 12?
   a. Yes
   b. No

7. What semester and year (e.g. Spring 2012) do you plan to take the following? If you are currently enrolled in or have already taken one of these Advanced Study Course Work blocks, please list semester and year completed.

   Block-I (usually 2000- and/or 3000-level courses)
   Block-II (3000- and 4000-level courses)
   Block III (mostly 4000-level courses)
   Block IV (not all programs have this Block)
   Student teaching

Technology is a broad concept that can mean a lot of different things. For the purpose of this questionnaire, technology is referring to digital technology/technologies. That is, the digital tools we use such as computers, laptops, iPods, handhelds, interactive whiteboards, software programs, etc. Please answer all of the questions and if you are uncertain of or neutral about your response you may always select "Neither Agree or Disagree"

<table>
<thead>
<tr>
<th>TK (Technology Knowledge)</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Agree or Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. I know how to solve my own technical problems.</td>
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<tr>
<td>9. I can learn technology easily.</td>
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<td>10. I keep up with important new technologies.</td>
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<tr>
<td>11. I frequently play around the technology.</td>
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<tr>
<td>12. I know about a lot of different technologies.</td>
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<tr>
<td>13. I have the technical skills I need to use technology.</td>
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<td></td>
</tr>
</tbody>
</table>

CK (Content Knowledge)

Mathematics

14. I have sufficient knowledge about mathematics.
15. I can use a mathematical way of thinking.
16. I have various ways and strategies of developing my understanding of mathematics.

Social Studies

17. I have sufficient knowledge about social studies.
18. I can use a historical way of thinking.
19. I have various ways and strategies of developing my understanding of social studies.

Science

20. I have sufficient knowledge about science.
21. I can use a scientific way of thinking.
22. I have various ways and strategies of developing my understanding of science.

**Literacy**
23. I have sufficient knowledge about literacy (reading & writing, lang. & lit.).
24. I can use a literary way of thinking.
25. I have various ways and strategies of developing my understanding of literacy.

**PK (Pedagogical Knowledge)**
26. I know how to assess student performance in a classroom.
27. I can adapt my teaching based-upon what students currently understand or do not understand.
28. I can adapt my teaching style to different learners.
29. I can assess student learning in multiple ways.
30. I can use a wide range of teaching approaches in a classroom setting.
31. I am familiar with common student understandings and misconceptions.
32. I know how to organize and maintain classroom management.

**PCK (Pedagogical Content Knowledge)**
33. I can select effective teaching approaches to guide student thinking and learning in mathematics.
34. I can select effective teaching approaches to guide student thinking and learning in literacy (reading & writing, lang. & lit.).
35. I can select effective teaching approaches to guide student thinking and learning in science.

**TCK (Technological Content Knowledge)**
36. I can select effective teaching approaches to guide student thinking and learning in social studies.
37. I know about technologies that I can use for understanding and doing mathematics.
38. I know about technologies that I can use for understanding and doing literacy.
39. I know about technologies that I can use for understanding and doing science.
40. I know about technologies that I can use for understanding and doing social studies.

**TPK (Technological Pedagogical Knowledge)**
41. I can choose technologies that enhance the teaching approaches for a lesson.
42. I can choose technologies that enhance students' learning for a lesson.
43. My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.

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

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

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

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

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

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

TPACK (Technology Pedagogy and Content Knowledge)

50. I can teach lessons that appropriately combine mathematics, technologies and teaching approaches.

51. I can teach lessons that appropriately combine literacy (reading & writing, lang. & lit.), technologies and teaching approaches.

52. I can teach lessons that appropriately combine science, technologies and teaching approaches.

53. I can teach lessons that appropriately combine social studies, technologies and teaching approaches.

Models of TPACK (Faculty)

54. My mathematics education professors appropriately model combining content, technologies and teaching approaches in their teaching.

55. My literacy (reading & writing, lang. & lit.) education professors appropriately model combining content, technologies and teaching approaches in their teaching.

56. My science education professors appropriately model combining content, technologies and teaching approaches in their teaching.
57. My social studies education professors appropriately model combining content, technologies and teaching approaches in their teaching.

58. My educational technology professors appropriately model combining content, technologies and teaching approaches in their teaching.

59. My educational psychology professors appropriately model combining content, technologies and teaching approaches in their teaching.

60. My cooperating teachers (during field experience or student teaching) appropriately model combining content, technologies and teaching approaches in their teaching.

61. 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?

62. 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?

63. In general, approximately what percentage of the cooperating teachers have provided an effective model of combining content, technologies and teaching approaches in their teaching?

64. Predominantly, where did you learn your technology skills?
The following information pertains to scoring and will not be included as a part of the survey administered online to students:

**Survey of Preservice Teachers' Knowledge of Teaching and Technology**

Denise A. Schmidt, Evrim Baran, and Ann D. Thompson  
Center for Technology in Learning and Teaching  
Iowa State University  
Matthew J. Koehler, Punya Mishra, and Tae Shin  
Michigan State University

**Usage Terms:** Researchers are free to use the TPACK survey, provided they contact Dr. Denise Schmidt ([dschmidt@iastate.edu](mailto:dschmidt@iastate.edu)) with a description of their intended usage (research questions, population, etc.), and the site locations for their research. The goal is to maintain a database of how the survey is being used, and keep track of any translations of the survey that exist.

**Version 1.1:** (updated September 1, 2009). This survey was revised to reflect research results obtained from its administration during the 2008-2009 and 2009-2010 academic years. This document provides the latest version of the survey and reports the reliability scores for each TPACK domain. (This document will be updated as the survey is further developed).

The following papers and presentations highlight the development process of this survey:


Society for the Information and Technology & Teacher Education. March 2-6, Charleston, SC.

**How do I use the survey?** The questions you want are most likely questions 1-46 starting under the header “TK (Technology Knowledge)”. In the papers cited above, these categories were removed so that participants were not oriented to the constructs when answering the survey questions. The items were presented in order from 1 through 46, however. The other items are more particular to individual study and teacher education context to better understand results found on questions 1-46. You are free to use them, or modify them. However, they are not the core items used to measure the components of TPACK.

**How do score the survey.** Each item response is scored with a value of 1 assigned to strongly disagree, all the way to 5 for strongly agree. For each construct the participant’s responses are averaged. For example, the 6 questions under TK (Technology Knowledge) are averaged to produce one TK (Technology Knowledge) Score.

**Reliability of the Scores (from Schmidt et al, 2009).**

<table>
<thead>
<tr>
<th>TPACK Domain</th>
<th>Internal Consistency (alpha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology Knowledge (TK)</td>
<td>.86</td>
</tr>
<tr>
<td>Content Knowledge (CK)</td>
<td></td>
</tr>
<tr>
<td>Social Studies</td>
<td>.82</td>
</tr>
<tr>
<td>Mathematics</td>
<td>.83</td>
</tr>
<tr>
<td>Science</td>
<td>.78</td>
</tr>
<tr>
<td>Literacy</td>
<td>.83</td>
</tr>
<tr>
<td>Pedagogy Knowledge (PK)</td>
<td></td>
</tr>
<tr>
<td>Pedagogical Content Knowledge (PCK)</td>
<td>.87</td>
</tr>
<tr>
<td>Technological Pedagogical Knowledge (TPK)</td>
<td>.93</td>
</tr>
<tr>
<td>Technological Content Knowledge (TCK)</td>
<td>.86</td>
</tr>
<tr>
<td>Technological Pedagogical Content Knowledge (TPACK)</td>
<td>.89</td>
</tr>
</tbody>
</table>
APPENDIX F
STUDENT TEACHING ASSESSMENT

Kent State University
College of Education, Health, and Human Services
Student Teaching Assessment

Instructions: Please select the rating that best describes the candidate for each item. Please select only one response per item.

Candidate Name:

Observer (please select one):  ☐ Cooperating Teacher  ☐ Supervisor

Standard 1. Students:
Teachers understand student learning and development and respect the diversity of the students they teach.

<table>
<thead>
<tr>
<th></th>
<th>Not Observed</th>
<th>Strongly Disagree</th>
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Standard 2. Content:
Teachers know and understand the content area for which they have instructional responsibility.

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<th></th>
<th>Not Observed</th>
<th>Strongly Disagree</th>
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Please continue to next page.
### Standard 3. Assessment:
*Teachers understand and use varied assessment to inform instruction, evaluate, and ensure student learning.*

<table>
<thead>
<tr>
<th>Candidate consistently understands varied types of assessments (including diagnostic, formative, and summative), their purposes, and the data they generate.</th>
<th>Not Observed</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
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</thead>
<tbody>
<tr>
<td>b. Candidate consistently selects, develops, and uses a variety of diagnostic, formative, and summative assessments.</td>
<td></td>
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<td>c. Candidate consistently analyzes data to monitor students' progress and learning, and to plan, differentiate, and modify instruction.</td>
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<td>d. Candidate consistently collaborates and communicates student progress with students, parents, and colleagues.</td>
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<td>e. Candidate consistently involves learners in self-assessment and goal setting to address gaps between performance and potential.</td>
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</table>

### Standard 4. Instruction:
*Teachers plan and deliver effective instruction that advances the learning of each individual student.*

<table>
<thead>
<tr>
<th>Candidate consistently aligns instructional goals and activities with school and district priorities and with Ohio's Academic Content Standards.</th>
<th>Not Observed</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
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<tbody>
<tr>
<td>b. Candidate consistently uses assessment data to plan and carry out appropriate instruction.</td>
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<tr>
<td>c. Candidate consistently communicates clear learning goals and links learning activities to those goals.</td>
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<td>d. Candidate consistently applies knowledge of how students think and learn to planning and instruction.</td>
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<td>e. Candidate consistently differentiates instruction to meet the needs of all students, including gifted students, students with disabilities, and at-risk students.</td>
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<td>f. Candidate consistently creates and selects activities that are designed to help students develop as independent learners and complex problem solvers.</td>
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<td>g. Candidate effectively uses resources, including technology, to enhance student learning on a consistent basis.</td>
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*Please continue to next page.*
Standard 5. Learning Environment:
Teachers create learning environments that promote high levels of learning and achievement for all students.

<table>
<thead>
<tr>
<th></th>
<th>Not Observed</th>
<th>Strongly Disagree</th>
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<tbody>
<tr>
<td>a. Candidate consistently treats all students fairly and establishes a classroom environment that is respectful, supportive, and caring.</td>
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<td>b. Candidate consistently creates a classroom environment that is physically and emotionally safe, responding appropriately to disruptive behavior.</td>
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<td>c. Candidate consistently uses strategies to motivate students to work productively and to take responsibility for their own learning.</td>
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<td>d. Candidate consistently creates learning situations in which students work independently, collaboratively, and/or as a whole class, articulating an appropriate rationale for each choice.</td>
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<td>e. Candidate consistently maintains an environment that is conducive to learning for all students.</td>
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Standard 6. Collaboration and Communication:
Teachers collaborate and communicate with students, parents, other educators, administrators, and the community to support student learning.

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<th></th>
<th>Not Observed</th>
<th>Strongly Disagree</th>
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<th>Strongly Agree</th>
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<tbody>
<tr>
<td>a. Candidate consistently uses clear, correct, and effective written and spoken language.</td>
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<td>b. Candidate effectively communicates student learning with parents and care givers on a consistent basis.</td>
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<td>c. Candidate consistently collaborates with cooperating teachers and other educators at the school/district/university.</td>
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<td>d. Candidate can identify community resources that promote a positive environment for student learning on a consistent basis.</td>
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Standard 7. Professional Responsibility and Growth:
Teachers assume responsibility for professional growth, performance, and involvement as an individual and member of a learning community.

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<th></th>
<th>Not Observed</th>
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<th>Strongly Agree</th>
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<tbody>
<tr>
<td>a. Candidate consistently understands, upholds, and follows professional ethics, policies, and legal codes of professional conduct.</td>
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<td>b. Candidate can identify areas for continued growth on a consistent basis.</td>
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<td>c. Candidate consistently seeks opportunities to improve her/his own teaching by using a variety of school/district/university resources.</td>
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Thank You!
APPENDIX G

TABLE OF TPACK RESEARCH STUDIES
Research relating to the validity of survey measurement of TPACK or to preservice teacher perceptions of their technical capability as related to teaching are listed in year of publication order. An asterisk (*) next to the year indicates the use of the TPACK survey for preservice teachers (Schmidt et al., 2009) in the listed study.

<table>
<thead>
<tr>
<th>Year</th>
<th>Study Title. Author/Publication</th>
<th>Purpose/Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009*</td>
<td>Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers. Denise Schmidt, Evrim Baran, Ann Thompson, Punya Mishra, Matthew Koehler, Tae Shin in Journal of Research on Technology in Education</td>
<td>The purpose was to develop and validate a survey which would measure preservice teachers’ self-assessment of their TPACK knowledge. Results suggested that the final survey (after tweaking and re-testing) is a reliable and valid instrument specifically designed to examine preservice teachers’ development of TPACK (Schmidt et al., 2009). Participants had just completed an educational technology class based on the TPACK framework; although it is not clear, the study seems to imply they compared the results of the survey to the assignments for the course (Schmidt et al., 2009).</td>
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<tr>
<td>2009</td>
<td>A Qualitative Approach to Assessing Technological Pedagogical Content Knowledge. Groth, R., Spickler, D., Bergner, J., &amp; Bardzell, M. published in the Contemporary Issues In Technology And Teacher Education (CITE Journal), 9(4), 392-411.</td>
<td>Purpose: The development of an assessment instrument that captures the development of TPACK. The assessment instrument is based on qualitative data, in particular, lesson study (LS), a teacher education method which utilizes the collaborative development of lessons plans. Results: The concepts of LS and TPACK (LS-TPACK) are used as the foundation for assessing the TPACK exhibited by groups of teachers, but cannot measure individual TPACK knowledge. The participants are Math teachers and the technology used was a graphing calculator. The Lesson Study Group’s (LSG) lessons were collaboratively developed and</td>
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were reviewed by university faculty who provided feedback to the group that the calculator had greater capabilities than used by the lesson plan. Final lessons were taught by one member of the group, which was video-taped and reviewed by university faculty and the LSG. Again, in each case, faculty noted that the teachers did use and did not push their students to use all functions of a calculator for better math enrichment. The LSG attributed this to the short allotted time for class and the fact that state testing did not mandate the use of any but the basic functions on the calculator. (Groth, Spickler, Bergner, & Bartzelle, 2009).

<table>
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<tr>
<th>Year</th>
<th>Title</th>
<th>Purpose</th>
<th>Results</th>
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<tbody>
<tr>
<td>2010*</td>
<td>Facilitating Preservice Teachers' Development of Technological, Pedagogical, and Content Knowledge (TPACK)</td>
<td>Purpose: To effectively assess TPACK in preservice teachers before and after a university Information and Communication Technologies (ICT) course; to assess for preparedness to integrate ICT into the classroom.</td>
<td>Results: The ICT course was restructured using the TPACK framework. The study examined several instruments and adapted the TPACK survey for preservice teachers (Schmidt et al., 2009) to administer a pre- and post-survey to 365 participants. The researchers used factor analysis to validate the survey instrument. Results revealed statically significant gains after completing the course with good effect sizes. Regression analysis further reveals that technological knowledge, pedagogical knowledge and content knowledge are all significant predictors of preservice teachers TPACK (Chai, Koh, &amp; Tsai, 2010).</td>
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<tr>
<td>2010</td>
<td>Framing the Assessment of Educational Technology Professional Development in a Culture of Learning.</td>
<td>Purpose: The development of an ETPD assessment model that merges three theoretical constructs: (a) TPACK, (b) organizational learning, and (c) participant research and inquiry.</td>
<td>Results: Model was developed based on already accepted theories on teaching and learning, but has not been applied to any subjects (Pierson &amp; Borthwick, 2010).</td>
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<tr>
<td>Year</td>
<td>Title</td>
<td>Authors</td>
<td>Purpose</td>
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<tr>
<td>2010*</td>
<td>Impact of a new curriculum on preservice teachers' Technical, Pedagogical and Content Knowledge (TPACK).</td>
<td>C Hu, V Fyfe</td>
<td>Address the shortcomings of the mandatory Information Technology in Education course at the University of Sydney by redesigning the curriculum to facilitate a move from skills-based training to the development of TPACK in preservice teachers. Shortcomings included a course focus on technology skills that were presumably needed by preservice teachers and did not meet the latest local or national governmental push for technology skills. The new curriculum adhered to four design principles: Problem-centered learning tasks, developing skills via learning by design approach, using collaborative design tasks, and learners engaging in reflective practice.</td>
</tr>
<tr>
<td>2011*</td>
<td>An Investigation of the Relationship between Self-Efficacy Beliefs about Technology Integration and Technological Pedagogical Content Knowledge (TPACK) among Preservice Teachers.</td>
<td>Abbitt, J. T.</td>
<td>To investigate the relationship between perceived TPACK and the self-efficacy beliefs of preservice teachers about technology integration.</td>
</tr>
<tr>
<td>2011*</td>
<td>Measuring Technological Pedagogical Content Knowledge in Preservice Teacher Education: A Review of</td>
<td>Abbitt, J. T. (2011).</td>
<td>assess the TPACK of preservice teachers; specifically, the paper focuses on the efforts to develop valid and reliable tools for assessing teacher knowledge as represented by the TPACK framework that are promising in terms of evaluating teacher preparation experiences (Abbitt, 2011a). Perceived knowledge and provides insight into both the development of</td>
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<tr>
<td>Year</td>
<td>Study Title</td>
<td>Purpose</td>
<td>Methods and Instruments</td>
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<tr>
<td>2011*</td>
<td>Development of Survey of Technological Pedagogical and Content Knowledge (TPACK). Sahin, I., published in Turkish Online Journal Of Educational Technology - TOJET, 10(1), 97-105.</td>
<td>Purpose: Develop a valid survey which reliably measures TPACK. The survey was developed in English and Turkish to examine language equivalence. Note: The survey is similar to the TPACK survey for preservice teachers (Schmidt et al., 2009) as it uses seven subscales aligned with the TPACK domains. The questions contained in each subscale contain the reworded questions of the TPACK survey for preservice teachers (Schmidt et al., 2009) with additional questions in some of the subscales, such as TK added hardware specific questions. In the content subscales (PCK, TCK, CK, TPACK), the word “content” was used in place of the individual subjects listed in the TPACK survey for preservice teachers (Schmidt et al., 2009). Results: Seventy-six preservice teachers took this online survey which was analyzed for validity and found to be reliable. The participants’ grades in technology, pedagogy, and area-specific classes were obtained and matched with the survey data. Each subscale score (similar to the TPACK scale scores) is compared with corresponding grades and analyzed for any correlation. Each of the TPACK subscale scores was found to be statistically and significantly related to its corresponding grade (Sahin, 2011).</td>
<td>Current Methods and Instruments. <em>Journal Of Research On Technology In Education</em>, 43(4), 281-300. Knowledge in TPACK domains as well as how students think about the connections among these areas of knowledge. The author recommends using the TPACK survey (Schmidt, 2009) in conjunction with another method and limited the application to early childhood or elementary education teacher programs due to the design of the TPACK survey (Abbitt, 2011a).</td>
</tr>
<tr>
<td>2011</td>
<td>The Development of an Instrument to Assess Preservice Teacher's Technological Pedagogical Content Knowledge.</td>
<td>Purpose: To develop and validate the Pre-service Teacher-Technological Pedagogical Content Knowledge Survey (PT-TPACK) instrument which will provide information to faculty of teacher education programs concerning the ability of preservice teachers to integrate technology into the classroom.</td>
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<tr>
<td>Year</td>
<td>Title</td>
<td>Purpose</td>
<td>Results</td>
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<tr>
<td>2011*</td>
<td>Exploring the factor structure of the constructs of technological, pedagogical, content knowledge (TPACK).</td>
<td>Purpose: To explore how using TPACK in a constructivist-oriented, university Information and Communication Technologies (ICT) course for self-directed and collaborative learning improved the construct validity of the TPACK survey.</td>
<td>Results: The survey used was an adaptation of the TPACK survey for preservice teachers (Schmidt et al., 2009). This survey was administered on 214 Singaporean pre-service teachers after they had been introduced to the concept of meaningful learning with ICT (integration in the classroom). The survey was found to be valid and reliable. This research focused on producing a more valid survey instrument for specific use at this university in Singapore, which the authors claim they did after running Exploratory Factor Analysis and Confirmatory Factor Analysis (Chai, Koh, &amp; Tsai, 2011).</td>
</tr>
<tr>
<td>2012</td>
<td>Hechter, R. P. (2012). Pre-Service Teachers' Maturing Perceptions of a TPACK-Framed</td>
<td>Purpose: “The purpose of the author in this study was to determine the changes in pre-service teachers’ perceptions of the signature pedagogy related to the interactive relationship between technological,</td>
<td></td>
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<tr>
<td>2012</td>
<td>Graham, C. R., Borup, J. J., &amp; Smith, N. B. (2012). Using TPACK as a Framework to Understand Teacher Candidates' Technology Integration Decisions. <em>Journal Of Computer Assisted Learning</em>, 28(6), 530-546.</td>
<td>Purpose: To highlight the differences between general and content-specific rationales for integrating technology into the classroom. Results: Preservice teachers enrolled in an educational technology course took two surveys containing open-ended questions concerning designing a lesson with technology, once at the beginning of the course and again at the end. Results included a decrease in using the general rationale (technology knowledge) for including technology into the lesson (Graham, Borup, &amp; Smith, 2012).</td>
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| 2012 | Graham, C. R., Borup, J. J., & Smith, N. B. (2012). Using TPACK as a Framework to Understand Teacher Candidates' Technology Integration Decisions. *Journal Of Computer Assisted Learning*, 28(6), 530-546. | Purpose: To highlight the differences between general and content-specific rationales for integrating technology into the classroom. Results: Preservice teachers enrolled in an educational technology course took two surveys containing open-ended questions concerning designing a lesson with technology, once at the beginning of the course and again at the end. Results included a decrease in using the general rationale (technology knowledge) for including technology into the lesson (Graham, Borup, & Smith, 2012). |

| 2012 | Graham, C. R., Borup, J. J., & Smith, N. B. (2012). Using TPACK as a Framework to Understand Teacher Candidates' Technology Integration Decisions. *Journal Of Computer Assisted Learning*, 28(6), 530-546. | Purpose: To highlight the differences between general and content-specific rationales for integrating technology into the classroom. Results: Preservice teachers enrolled in an educational technology course took two surveys containing open-ended questions concerning designing a lesson with technology, once at the beginning of the course and again at the end. Results included a decrease in using the general rationale (technology knowledge) for including technology into the lesson (Graham, Borup, & Smith, 2012). |

**Purpose:** To extend the TPACK development literature to provide insight on the development of TPACK in a typical three-semester teacher preparation program (Master’s level). The required educational technology course is taught during the second semester.

**Results:** The TPACK survey for preservice teachers (Schmidt et al., 2009) was used as well as a reflection assignment (including technology integrated lessons plans) at four different times during the program: at the beginning of the students’ first summer course, at the beginning of the fall semester, at the end of the fall semester, and at the end of the spring semester. TPACK knowledge increased over the course of the program according the surveys and the assignments of the seventeen participants. The most remarkable increase occurred in the fall semester when participants were enrolled in the educational technology course as well as their first teaching methods course. Applying the TPACK framework to the lessons plans and comparing them to the survey assisted in validating the accuracy of the TPACK survey (Hofer & Grandgenett, 2012).
REFERENCES


Educational Lab., Oak Brook, IL; North Central Regional Tech. in Education Consortium; Metiri Group, Los Angeles, CA, 1-32.


