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THE EFFECT OF INSTRUCTIONAL METHODOLOGY ON PRE-SERVICE

EDUCATORS' LEVEL OF TECHNOLOGICAL PEDAGOGICAL CONTENT

KNOWLEDGE

by

Shannon Haley-Mize

Abstract of a Dissertation
Submitted to the Graduate School
of The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy

August 2011

ABSTRACT

THE EFFECT OF INSTRUCTIONAL METHODOLOGY ON PRE-SERVICE

EDUCATORS' LEVEL OF TECHNOLOGICAL PEDAGOGICAL CONTENT

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by Shannon Haley-Mize

August 2011

Technological Pedagogical Content Knowledge (TPACK) is presented by Mishra and Koehler (2006) as a form of complex, situated knowledge that is a prerequisite to seamless and successful technology integration into educational spaces. This form of knowledge is believed necessary for technology use to transform classrooms into vibrant, collaborative spaces that build 21st century skills – a transformation that has been elusive in K-16 spaces. Preservice education programs are poised to develop this type of knowledge in future teachers to contribute to the development of educators that can act as change agents. This study used a quasi-experimental, pre/post-test design to evaluate three different course experiences on preservice educators' level of TPACK. Results indicated that candidates who participated in course design that explicitly modeled technology integration, created a digital space to extend the community of practice, challenged participants to create collaborative solutions using Web 2.0 platforms, and integrated content on Universal Design for Learning showed significant increases in Pedagogical Knowledge, Pedagogical Content Knowledge, Technological Content Knowledge, Pedagogical Technological

Knowledge, and Technological Pedagogical Content Knowledge when post

scores were compared with pre-test scores. Multivariate analysis of variance

between groups on each of the six TPACK subscales reviewed in this study

indicated that this group also showed significantly higher gains in TPACK when

compared to a fully online group and a face-to-face without technology-enhanced

learning on Pedagogical Content Knowledge, Technological Content Knowledge,

and Technological Pedagogical Knowledge.

The University of Southern Mississippi

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A Dissertation
Submitted to the Graduate School
of The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy

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August 2011

DEDICATION

This work is dedicated to my husband, Patrick, and our three amazing daughters:

Morgan Elizabeth, Sidney Rain, and Sophie Grace.

Every day each of you challenge me to continue becoming the very best person

that that I am capable of being. It is with a deep sense of gratitude that I

dedicate this step in the evolution to each of you.   Any accomplishment that I

realize is attributable to the love, support, tears, and laughter that give shape to

our family.

ACKNOWLEDGMENTS

I would also like to acknowledge Dr. Richard Mohn for his unfailing wisdom and guidance during this project. Dr. Mohn was pivotal to the success of this study and his good-natured, quick response to both my questions and occasional panic ensured that I remained diligent. Dr. Mohn made statistical methodology accessible and has contributed to a growing understanding of tools that will certainly be essential as I continue a career in academia.

I also wish to thank Dr. Sandra Manning, Dr. David Daves, and Dr. Joy Hines. Drs. Manning and Daves served on the committee for this work, provided insight and supervision, and have contributed to my experience beyond the dissertation. Dr. Manning has always brought a welcome optimism to our interactions and helped to instill confidence in my writing. Additionally, she was an active participant in data collection and invested valuable time describing her classroom practice to me. Dr. Daves has challenged me as a teacher educator and always been available for feedback. Dr. Joy Hines also gave of her time and support. Dr. Hines assisted with data collection and also shared a narrative and documents relative to her practice. Dr. Hines was always happy to help and responded to each and every request quickly and with eternal patience.

Lastly, I cannot conclude without attempting to express my appreciation to my parents. Over the course of the last three years, my mother and father have provided countless hours of entertainment for my children while I completed whatever project was due, arrived on my door step with soup when I was ill, and listened to me talk endlessly about work and school. Their influence transcends

logistical support, however. Their powerful example has molded my

determination and sense of responsibility by providing an enduring exemplar of

hard work, tenacity, and optimism – all with an abiding kindness to others. I am

so grateful for their influence on my life, but am also profoundly appreciative that

they share their time and unconditional love with my children.

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CHAPTER I

INTRODUCTION

Five stanzas changed Tasana Hardy's life.

Last year, a teacher in her alternative school asked students to write something personal for a short film project. Tasana dashed off a poem describing where she came from and threw it in a pile on the teacher's desk.
Written like a hybrid of Harlem Renaissance and hip-hop, the poem confronts hopelessness with hope as it describes her struggle to reach beyond a landscape of loss and violence.
Though the young ward of the state cared little about the assignment at the time, "Where I Come From" would change where she was going.
The poem, ultimately chosen to be the basis of the class film project, would sound the beat of her progress and backslides on the road to graduation.

> Because where I come from you're not a / person you're a label / A label that changes every time you make a mistake
> But where I come from is different / than where I'm going

- The Chicago Tribune, June 10, 2010

In the midst of ubiquitous technology use to support communicative and professional pursuits, the potential for digital tools to facilitate teaching and learning in the K-16 classroom has not been realized. The lack of technology integration in schools and universities has been illuminated in research and a growing number of scholars are calling not only for technology use in the classroom, but for exploitation of the tools available to change the climate of the classroom from one that is obsolete and irrelevant to one that is dynamic, collaborative, and student-centered (e.g., Belland, 2008; Ertmer & Ottenbreit-Leftwich, 2010; Leander, 2007). Preservice teacher education is poised to usher in an altered paradigm that addresses deficits in technology integration for teaching and learning in a vibrant classroom space by supporting and developing

a sophisticated, situated type of knowledge that is believed to be a precursor to efficient and effective technology integration into learning environments (Mishra & Koehler, 2005). At this juncture, researchers continue to wrestle with the most effective design of preservice experiences to facilitate this type of understanding in teachers and ultimately to realize the goal of seamless technology integration that fosters collaborative, student-centered learning.

This study contributes to the growing collective voice demanding a reconceptualization and transformation of education that both capitalizes on technology to recreate learning spaces and promotes student fluency with tools that empower students to be participatory citizens (Jenkins, Purushotma, Weigel, Clinton, & Robinson, 2009) and prepared for the 21st century workforce. These tools encourage students to assume the roles of active creators of content, creative problem solvers, and innovative collaborators. Specifically, the argument that is purported is that this transformation is dependent upon successful and seamless technology integration in K-12 schools, which in turn is reliant on a cadre of educators that posses a nuanced understanding of how students learn, digital tools and their affordances and limitations, and in depth understanding of the content to be taught. This argument uses Mishra and Koehler's (2006) theoretical framework that describes this required situated knowledge using the Technological Pedagogical Content Knowledge (TPACK) model. This framework is the cornerstone of current research examining technology integration and course experiences at the preservice level that provide preservice educators with opportunities to develop TPACK skills. While

several qualititative studies have been conducted, there are few quantitative investigations of the impact of specific instructional strategies integrated into university coursework on preservice educators' level of TPACK. This study will contribute to that sparse knowledge base by evaluating three different and distinct course experiences in a pre/post design using a recently developed survey that measures levels of TPACK in preservice teachers.

Despite the infiltration of technology into daily life, greater access in schools (National Center for Education Statistics [NCES], 2006), and the potential affordances of various technological tools for teaching and learning, recent research has demonstrated that technology has not been successfully integrated into K-12 classrooms (Albion & Ertmer, 2002; Barron, Kemker, Harmes, & Kalaydjian, 2003). Technology has the potential to support the transformation of learning experiences at all levels of the educational system. Depending upon the use of the wide array of tools afforded by innovation, integration into learning spaces could help empower teachers to address the needs of individual learners (Smith & Okolo, 2010), allow for flexible and engaging presentation of content (Rose & Meyer, 2002), and transform teacher-directed learning into student-centered facilitation (Becker & Ravitz, 1999). The above excerpt from The Chicago Tribune (2010) gives one example of technology integrated into a poetry lesson and provides a glimpse of how technology can be used, not for planning or skill and drill exercises, but to create opportunities for collaboration and knowledge construction. The poetry content was molded into a film project and empowered students to create a digital

representation of their voice – voices like Tasana Hardy's that have historically been marginalized. One has only to examine the academic achievement of students from low income backgrounds to recognize that this group are the players in the heralded literacy crisis that, as Gee (2008) points out, often shrouds "deeper and more complex social problems" (p. 32). This type of assignment is not, however, the norm. Much more common are uses that are "low level" (Maddux & Johnson, 2006, p. 2) and include strategies that perpetuate traditional, teacher-directed instruction.

Several contributing factors have been suggested for lack of K-12 technology integration and the reliance on outdated tools and teaching methods (Cuban, 2001) including the context of school environments, educators' beliefs related to technology (Ertmer, 2005), and prior educational experiences bereft of meaningful integration (Belland, 2009). Scholars have called upon teacher education programs to examine integration in preservice experiences to better arm educators with the knowledge and skills required to successfully integrate technology (Kay, 2006). According to Koehler and Mishra (2005), teacher education programs must strive to not only teach preservice educators how to use specific digital tools, but foreground the complex knowledge conceptualized by these authors as Technological Pedagogical Content Knowledge (TPACK) that is required to effectively use the available technological tools to teach content. How to best accomplish this and practices that impact this form of situated knowledge are areas of ongoing research and preliminary evidence from Preparing Tomorrow's Teachers to Teach with Technology (PT3) grants and

other research supports a multifaceted approach that includes preservice experiences that focus on specific technological skills within the context of discussions that make connections between pedagogy and technology, how the role of the teacher might be changed, and ways that introduction of technology tools make content more accessible to students (Angeli, 2010).

Preliminary work has examined the impact of participation in an instructional technology course on preservice teachers' TPACK. These studies investigated the impact of course experiences designed according to the TPACK model on participants' level of TPACK skill. This work has demonstrated significant gains in TPACK when course experiences included design activities (Mishra, 2005) or included ICT courses designed to teach future educators not just the technical components, but how to use the technology to teach (Chai, Koh, & Tsai, 2010). Despite this research, many questions remain about which tools and experiences best facilitate preservice TPACK. The studies that are available have built upon recommendations made from initiatives to increase integration at the preservice level like Preparing Tomorrow's Teachers to Use Technology (PT3) grants. Others have used and the TPACK framework to design course experiences. The work focused not so much on the specific tools that are integrated, but on integration across course experiences, modeling by teacher educators on teaching with technology, and capitalizing on the social affordances of digital spaces for deeper understanding. These guidelines lead to the integration of tools that both expose preservice teachers to the technological

skills required to use various tools and to examples of ways those tools can be incorporated to facilitate learning objectives.

The current research drew on this existing work to design course experiences for one group of preservice educators that model uses of technology to enhance learning and expose students to the types of tools readily available to support learning objectives in the classroom. The course experiences included creation of a digital space to extend face-to-face classroom time, weblogs authored by students and shared with the learning community, integration of Universal Design for Learning content in the course, and modeling of other digital tools appropriate for classroom activities. The changes in TPACK after several weeks was then compared to other groups of students either participating in a fully online version or a face-to-face version that did not included explicit technology experiences.

<div align="center">Background</div>

There are a plethora of technology tools that could be integrated in the classroom to facilitate teaching and learning. These include hardware devices such as interactive white boards, digital cameras, student response systems, and computers. Computers and other mobile technology devices allow teachers and students to access Web 2.0 tools such as wikis, blogs, microblogs, and streaming video in addition to providing communication tools such as text, social networking sites, and email. According to the National Center for Educational Statistics (Gray, 2010), computer access in the K-12 environment should no longer be an issue, however there were still relatively small percentages of

teachers that reported having access to other technologies like interactive white

boards or digital cameras on a daily basis. Of the surveyed teachers, 97% had

at least one computer in the classroom and 93% of those had internet access.

Interactive whiteboard technology was only available in the classrooms for 23%

of the respondents. Despite the increased access to some digital technologies,

earlier data had shown that only 53% of teachers with computer access in their

classrooms reported accessing the technology for instructional purposes (NCES,

2006). Of those that reported making use of the computer during instructional

time, most reported tasks such as word processing or using spreadsheets as the

primary function. Few educators reported that they access the technology in

order to facilitate higher-order tasks such as collaboration or multimedia projects.

More recent data showed that this has been consistent since the 2006 NCES

report. The authors of the 2010 *21st Century Classroom Report: Preparing

Students for The Present or the Past?* collected survey responses from students,

teachers, and administrators that indicated that teachers used technology to

teach, but only 26% of students reported that lessons incorporated student use of

technology (CDW, 2010). Teacher responses indicated that almost half of

respondents were not designing lesson plans to allow students to use technology

in class.

This is consistent with Palak and Walls' (2009) data that demonstrated

that teachers use technology, but it is not routinely used for student-centered

practices. Most often teachers use technology for preparation, management,

and administrative purposes. This lack of technology integration in learning

activities was true even for educators who teach in schools that are replete with technology. The authors concluded that future work should focus on providing training for educators on how to integrate technology using a student-centered pedagogy rather than to simply perpetuate teacher-directed learning tasks.

Reports generated by the authors of Project Tomorrow (2010) based on a large-scale survey of educators, students, and administrators reveal similar patterns in technology use. Educator use of technology has increased overall, however the descriptions of technology use in the classroom do not exemplify the flexible and creative use that fosters innovative collaborative learning experiences. Ertmer and Ottenbreit-Leftwich (2010) expressed concern about the consistent data that demonstrates that seamless technology use that facilitates student-centered learning is not occurring in K-12 schools. The authors argued that "it is time to shift our mindsets away from the notion that technology provides a supplemental teaching tool and assume, as with other professions, that technology is essential to successful performance outcomes. To put it simply, effective teaching requires effective technology use" (p. 256).

Belland (2008) defined technology integration as, "the sustainable and persistent change in the social system of K – 12 schools caused by the adoption of technology to help students construct knowledge (e.g., research and analyze information to solve problems)" (p. 354). By this definition, K – 12 schools have not achieved technology integration because according to the data, largely collected through self-report measures, technology is often not used to transform classrooms into collaborative learning environments. The authors of the 2010

National Education Technology Plan (NETP, 2010) also recognized both the inadequacies of current practice and the looming potential of technology to create different types of learning spaces, different pedagogical tools, and ultimately schools that empower rather than disempower students. As described by the plan's authors, "The model of 21st century learning … calls for engaging and empowering learning experiences for all learners" (p. vi). The plan's authors articulated priorities related to technology integration that extend well beyond use of projection equipment to reinforce traditional approaches to teaching and learning. Instead, the focus is on capitalizing on the affordances of technological tools to design, create, and implement flexible and engaging curriculum that is individualized rather than static and one-size-fits-all. The plan was organized around five goals. The first goal outlined states, "All learners will have engaging and empowering learning experiences both in and outside of school that prepare them to be active, creative, knowledgeable, and ethical participants in our globally networked society" (p. xii). In addition, the plan recommended specific objectives to catapult states, districts, and schools to this level of integration. The recommendations reflect the supposition that this level of integration to support this kind of environment has not occurred in schools.

The initial barrier, access, has conceivably been addressed in most K-12 environments (Gray, 2010). Because simply improving access has not changed teaching practices, additional factors have to be identified. The literature poses some compelling questions about the relative importance of possible contributors. Some of the likely suspects include the previous experiences that

shaped teachers' P–16 education (Belland, 2008), the values espoused by schools as institutions (Leander, 2007), and an individual's beliefs and self-efficacy related to technology (Ertmer, 2005). The current research is designed to look specifically at preservice experiences and current practices in the area of technology integration. It is assumed that these experiences impact the other factors as articulated by the literature including the value system of K-12 schools and teacher's self-efficacy with technology integration (Franklin, 2007; Preparing Tomorrow's Teachers to Use Technology, 2002)

The authors of previous studies (Ertmer, 2005; Kay, 2006) have consistently concluded that teacher candidates are not exposed to learning experiences in their preservice programs that would support development of skills necessary to use technology for teaching and learning in powerful ways. Not only do teacher educators often not model use of technology-enhanced instructional activities, but preservice candidates also have inadequate opportunities to design collaborative learning activities using the affordances of various technology tools (Gotkas, Yildirim, &Yildirim, 2009). To make recommendations to address this gap in preservice education, Kay (2006) conducted an extensive literature review to identify effective strategies for integration of technology into teacher education programs. After a review of 68 studies investigating the integration of technology into preservice education, the author identified ten strategies that were effective in impacting teachers' skills related to technology integration. The strategies included offering a single technology course, provision of mini workshops, infusing technology into all

courses, and employing multimedia. Other strategies included collaboration among students enrolled in the teacher education program, mentoring, hands on practice in the field, pairing preservice teachers with mentor teachers adept at technology, and improving access. The programs that proved most successful in affecting change in attitude, ability, and use were those that engaged in four or more of the identified strategies. Kay qualified this conclusion by acknowledging that most of the studies did not look at effects on attitude, ability, and use. Invariably the studies only probed one of these variables and often had significant limitations in design.

Reform of Teacher Education

Recently, scholars have acknowledged that educational reform that examines preservice teacher education will prove most effective. Linda Darling-Hammond (2010) has, in several recent writings, called upon the nation to take a long and hard look at teacher preparation programs in order to circumvent the continued decay of our educational system. According to Darling-Hammond, there has been no evidence that the achievement gap has changed since the mid 80s, the number of students enrolled in post-secondary education has declined, and inequity in resources is the norm. Darling-Hammond argued for a variety approaches to teacher education practice and often emphasized the importance of teaching K-12 students 21st century learning skills (Umphrey, 2010). In addition, one of the premises of Darling-Hammond's argument is that effective teacher education programs actively link theory to practice by providing authentic learning experiences such as curriculum planning and design. The

author supported this with research on effective program practices and this is certainly applicable to what the literature says about technology integration. Preservice teachers need solid models of technology integration in their course work and opportunities to use the tools themselves.

In order to better prepare K-12 teachers to effectively integrate technologies such as interactive whiteboards, online Web 2.0 applications, computer-based programs such as READ 180, preservice education curricula should incorporate the practice of these technologies using a variety of pedagogical methods. In addition to the lack of experience in their preservice programs, most current teachers did not "experience, or even observe, the use of technology in their own K-12 schooling" (Ertmer, 2005, p. 30). This lack of experience means that most are ill prepared to meet the National Educational Technology Standards for Teachers (NETST, 2008). These standards include: facilitate and inspire student learning and creativity, design and develop digital age learning experience and assessments, model digital-age work and learning, promote and model digital citizenship and responsibility and engage in professional growth and leadership

Once in their own classrooms, other contextual factors affect if and how the teachers use technology tools. Well over a decade ago, Hodas (1993) made the provocative argument that technology integration that supports a collaborative and engaging learning space is thwarted by the very organizational structure of schools and institutional rigidity. This structure and the milieu are defined by the values embedded in school culture. The author states, "the

failures of technology to alter the look-and-feel of schools more generally results from a mismatch between the values of school organization and those embedded within the contested technology" (p. 1). According to Hodas, the only tools that will be embraced are those that perpetuate the current, hierarchical power structure of the schools. To further define those tools that he viewed as ones that would not be resisted he stated the following:

> The blackboard, the duplicating machine, and the overhead projector come immediately to mind. All enhance the teacher's authoritative position as information source, and reduce the physical effort required to communicate written information so that more energy can be devoted to the non-didactic tasks of supervision, arbitration, and administration. This type of technology seldom poses a threat to any of the teacher's functions, is fundamentally supportive of the school-values mentioned earlier, and reproduces locally the same types of power and information relationships through which the teacher herself engages her administrators. (p. 10)

In the decade since Hodas argued that schools were fulfilling their institutional tendency to perpetuate themselves through technology refusal, other authors have echoed the lack of support for technology integration in schools. As Alvermann (2008) stated in the forward of *New Literacies: Changing Knowledge and Classroom Learning*, those scholars that embrace new literacies that harness Web 2.0 tools to foster a different type of learning space, "pull us into spaces beyond the proverbial school door and into different arenas … the stuff that formal education (and traditional schooling in particular) is yet to

welcome" (n.p.). This shortcoming on the part of formal institutions of learning is a grave concern if one believes, like Lankshear and Knobel (2007), that "the entire epistemological base on which school approaches to knowledge and learning are founded is seriously challenged and … made obsolete by the intense digitization of daily life" (p. 155).

Transforming Pedagogy

Kalantzis, Cope, and Cloonan (2010) further the argument that the availability of new technologies does not always involve "pedagogical innovation" (p. 63). As these tools are introduced in educational spaces, they do not create "instructional or epistemological breakthroughs" (p. 63). These tools are rarely exploited to their full potential despite the fact that there are numerous advantages to moving beyond the conventional way of teaching and learning. Capitalizing on all affordances of the emerging technologies to create a different sort of learning space is one such advantage. Three other benefits are particularly important to the topic of preservice experiences as related to arming future educators with the knowledge needed to usher in a new era of teaching and learning and to realize the NETS standard of "facilitating and inspiring student learning and creativity" (n.p.). The first is that arguably modeling of the participatory and collaborative capacity of new digital technologies will allow teacher educators to transform their own learning spaces and solidify the content for their students through engagement and knowledge construction. Second, it follows that if the candidates then perpetuate these learning activities in their own classroom as were modeled and practiced in their preservice programs the K-12

environment will be altered. Because this cadre of educators have been supported in developing a nuanced understanding of pedagogy, content, and technology, ineffective educational reform will be eclipsed and a new kind of 21st century educational experience that values empowerment, participation, and the knowledge of the collective will be crafted. This type of space, by its very nature, will support a diverse population of students and engage the new generation of "digital natives" (Prensky, 2001, n.p.) in a manner that, to use a slight play on words, computes.

This type of space can be created in and supported by preservice learning environments, but current researchers and scholars agree that changes are needed on all levels. Cochran-Smith and Power (2010) stated that the United States and other countries are "witnessing an unprecedented emphasis on teacher preparation and teacher quality" (p. 7) and this national conversation is intertwined with the rhetoric and efforts surrounding K-12 educational change (Futrell, 2010). Futurell posed the provocative question "Do we want to reform or transform our system of education?" (p. 432). How that question is answered has implications for teacher education programs and Futrell hypothesized that the nation is at a juncture where transformation is more prudent than reformation.

The third compelling argument found in the literature for ensuring that preservice programs improve teachers' ability to harness technology for teaching and learning is that students need "access to … opportunities for participation and the development of cultural competencies and social skills needed for full involvement" (Jenkins, Purushotma, Weigel, Clinton, & Robison, 2009, p. xiii).

Educators have a responsibility to provide students with a learning environment that facilitates acquisition of new literacy skills so they can be successful, full participants of society. The essence of success in the 21st Century is the ability to engage in lifelong learning because the nature of work and communication is constantly changing based on emerging technologies. These innovative tools transform communication, access to information, and workplace demands. Individuals that are successful in such an environment have the ability to constantly adapt to new situations and become fluent in a variety of tools that require a different type of literacy. Scholars have introduced an entire field of study related to this expanded notion of literacy (Gee, 2008). In this view, literacy is no longer only applicable to reading and writing traditional texts. It now incorporates the ability to fluently navigate a wide variety of multi-modal texts using a plethora of technology tools including the handheld devices such as cell phones and iPods.

New literacy studies challenge teacher educators and teacher education programs to examine how teachers are prepared to integrate technology into the classroom learning space. It is true that teaching K-12 students to be both fluent in available technology and able to wield skills necessary to learn new tools as innovation marches forward is vital, but the imperative is actually larger than bequeathing students with such knowledge. The 21st century demands that those skills be seamlessly integrated into a different type of learning space.

Conclusion

The issue of technology integration in educational spaces has been referred to as the "wicked problem" (Borko, Whitcomb, & Liston, 2009, p. 3) because it is multi-faceted and complex. Preservice programs are situated to provide experiences that equip candidates to alter the learning spaces of K-12 classrooms through the infusion of technology for student-centered learning and collaboration. This research evaluated course experiences using the TPACK framework to contribute to the growing knowledge base regarding practices that are most effective in supporting future teachers to be innovative and fluent users of digital tools for teaching and learning.

Theoretical Framework

Mishra and Koehler (2006) have urged that scholars and practitioners expand the way that teacher technology knowledge is viewed. The researchers maintain that stand-alone educational technology courses are not sufficient to parlay into meaningful technological innovation in the K-12 classroom. Rather, Mishra and Koehler posit that this seamless integration will not occur unless teachers develop a complex, situated knowledge that brings together three different types of knowledge – content, pedagogy, and technology skills. It is only through the development of these three overlapping areas of expertise that educators will effectively utilize technology for teaching and learning in a manner that transcends technology for teacher-directed presentation, planning, and mere communication purposes. To this end, the authors outlined a framework for teacher knowledge of pedagogy, content area information, and technology skills.

The cornerstone of the Technological Pedagogical and Content Knowledge (TPACK) framework is "the understanding that teaching is a highly complex activity that draws on many kinds of knowledge" (Mishra & Koehler, 2006, p. 1020). The authors conceptualize necessary teacher knowledge as a combination of these three areas of understanding. The model refutes the notion that technology skills should be considered separate from pedagogy and content knowledge. Previous work (Shulman, 1986) identified the overlap between pedagogical knowledge and content area knowledge as pedagogical content knowledge (PCK). This overlap of two bodies of knowledge represented the understanding that teachers' possessed about how to use pedagogy to teach content. Mishra and Koehler (2006) built on this foundation to discuss another body of knowledge that teachers possess – knowledge of technology. The authors posit that this body of knowledge should be accessed as a pedagogical tool to facilitate content area learning and thus the three types of knowledge culminate in an intuitive understanding. The authors described the nuanced understanding of content, knowledge of pedagogy, and knowledge of technology as "central for developing good teaching. However, rather than treating these as separate bodies of knowledge, this model additionally emphasizes the "complex interplay of these three bodies of knowledge" (p. 1025). Thus, the theoretical framework, depicted in Figure 1, is a tool to plan and evaluate preservice course experiences to facilitate skills to ensure effective K-12 technology integration and to measure skills levels in individual preservice educators.
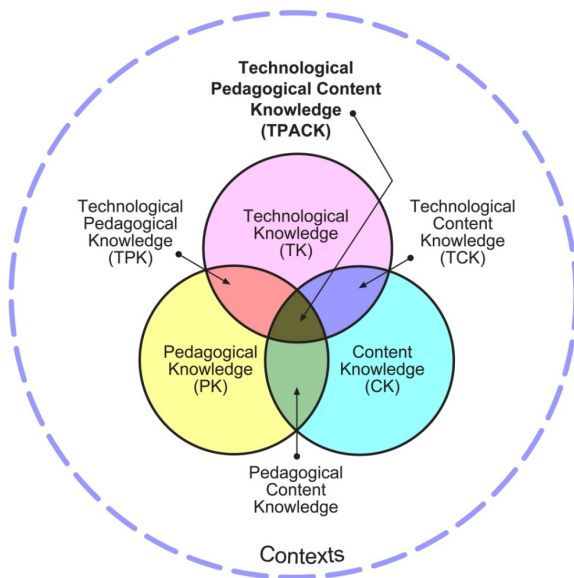
Figure 1. TPACK Framework. TPACK = Technological Pedagogical Content Knowledge. Adapted from www.tpack.org, 2010.

Problem Statement

Kay (2006), in a review of the literature on technology integration at a preservice level to facilitate candidates' skills, charged that "future research needs to … employ a pre-post test or experimental design to assess the effect of various strategies on introducing technology to preservice teachers" (p. 387). In order to fulfill that gap in the literature, the present study used a quasi-experiemental, pre/post design to examine the impact of instructional methods incorporated into a preservice course.

Preservice educators are embarking on careers in the K-12 classroom ill-prepared to wield technological tools to transform the learning environment into an engaging learning space that relies on flexible curriculum tools and a variety of representational materials to provide access for all students and impart the skills necessary to succeed in the 21st century society (Ermer, 2005; Ertmer &

Ottenbreit-Leftwich, 2010; NETP, 2010). These skills include fluency with multimodal texts and writing as well as an attitude of life-long learning, collaboration, and empowerment to navigate an ever changing and fast-paced work and school environment (Darling-Hammond, 2010). K-12 students are not being supported by enthused and inspired teachers that were taught to act as facilitators of knowledge construction by the example set by their professors in educator programs (Alvermann, 2008; Belland, 2008).

The current study evaluated different types of instructional methodology to compare the impact of online course instruction and face-to-face explicit modeling and technology content on preservice educators' level of TPACK. This work is important to address concerns raised by existing literature that states this integration into preservice programming is inadequate by measuring the impact of different methods of instruction and content. In addition, the study contributed to the small but growing number of studies looking specifically at Technological, Pedagogical, and Content Area Knowledge (TPACK) as a way to conceptualize a type of situational knowledge required for teachers to be successful in integrating technology for teaching and learning.

Additionally, this study answered the call issued by Polly, Mims, Shepherd, and Inan (2010) after review of numerous large-scale initiatives designed to improve technology integration. Polly et al. articulated a need for instructional practices that focus on the integration of technology and pedagogy. This direction for future work was based on the authors' conclusion that efforts to boost integration at preservice and K-12 levels would be more successful if the

concentration was on integrating technology into education coursework rather than solely on boosting the technical skills of faculty and candidates. As Koehler and Mishra (2005) posited – acquiring technology skills simply is not sufficient to effect change in terms of persistent and substantive technology integration for teaching and learning. In this study, efforts to address this deficit in practice and research were centered on the instructional methods used to facilitate candidates' TPACK.

The literature on developing TPACK in pre-service teachers does not outline a specific set of accepted practices that best facilitate the acquisition of this situated form of knowledge. This is an area of burgeoning study, but even the studies that have been reported often lack substantial detail in regard to the specific tools that were integrated in the courses. For example, in a paper presented on the first pre/post-data collection of a longitudinal study examining preservice educators' development of TPACK, the authors say only that participants were enrolled in an instructional technology course that was redesigned "using TPACK as an organizing framework" and that the course "is specifically designed to prepare preservice teachers to teach with – not just about – technology" (n.p.). Other work has used what Koehler & Mishra (2005) term a "design approach" (p. 131). This course experience included small group work in response to a real pedagogical issue. While initial investigation has demonstrated the effectiveness of this approach in facilitating TPACK, the design teams were graduate level teams completing a course of study in instructional technology.

Purpose of the Study

In a recent discussion of future research directions, Schmidt, Baran, Thompson, Mishra, Koehler, and Shin (2009) encouraged research that delves into the development of TPACK in preservice educators in order to inform the integration of strategies that are shown to be effective into preservice education programs. Many questions remain about how to best facilitate acquisition of this specialized, situational knowledge and whether or not TPACK scores predict future classroom instructional behavior. While this study did not look at classroom instruction, it did investigate the impact of specific pedagogical and modeling strategies in the preservice classroom and fully online instruction to assess the effectiveness of these practices in facilitating candidates' TPACK.

Although several qualitative studies have been conducted, few studies have measured preservice candidates' TPACK using quantitative methods. To this end, the current study used quantitative methods to explore the following research questions.

Research Questions

1. Does instructional methodology and the use of technology tools for collaborative learning increase preservice teacher candidates' level of the complex knowledge (TPACK) required to successfully integrate technology in the K-12 classroom?

2. Are there differences between groups of preservice teacher candidates' level of TPACK as a result of group membership in a technology-infused course experience, a fully online course experience, or students that participate in the comparison group?

Hypotheses

H1: There will be an increase in post- test scores on Technology Knowledge (TK), Pedagogical Knowledge (PK), Technology Content Knowledge (TCK), Technology Pedagogical Knowledge (TPK), and Technology Pedagogical Content Knowledge (TPACK) for those students that participate in the face-to-face section that systemically incorporates and models use of technology and presents content on UDL and Web 2.0 (Group 1).

H2: Students that participate in technology-infused course experiences (Group 1) will have higher scores on Technology Knowledge (TK), Pedagogical Knowledge (PK), Technology Content Knowledge (TCK), Technology Pedagogical Knowledge (TPK), and Technology Pedagogical Content Knowledge (TPACK) when compared to students enrolled in a face-to-face section that does not systematically incorporate and model use of technology.

H3: There will be a difference in TPACK scores between candidates that participate in a fully online class (Group 2) and those that participate in the face-to-face comparison group (Group 3).

H4: There will be no difference in pre- and post- TPACK scores for students enrolled in the comparison group (Group 3).

Limitations and Delimitations

There are several limitations to the current study that should be recognized and acknowledged. Efforts were made to minimize these threats to

internal validity and these are articulated below with each of the perceived

threats – self-report bias, maturation, differences in faculty teaching styles, and

testing. Additionally, there were also delimitations that may have implications to

external validity or the generalizability of the results to other populations. These

delimitations include subject population and reactive effects.

According to Kopcha and Sullivan (2007), self-report surveys are the most

commonly employed assessment of technology integration and instructional

design practices of teachers. The authors and other researchers (Bielefeldt,

2002) have noted that this may lend to self-presentation bias or a tendency for

participants to answer survey questions in a way that they perceive would reflect

favorably on their teaching practice. There is some evidence that teacher

candidates view technology integration as inherently "good" (Haley-Mize &

Bishop, 2010) and thus may want to answer survey questions in a manner that

they would consider socially acceptable. Efforts to reduce this threat included an

informed consent form that assured participants of the anonymity of their survey

responses and directions to answer questions according to their true

understanding of the skill.

Another possible limitation of the study was maturation or participant

acquisition of knowledge that is not related to the instruction in the SPE 400

groups. This possible limitation was addressed by administering the post-test in

a relatively short time frame – 8 weeks after pre-test. This could possibly have

affected another threat to internal validity that might occur because participants

had been previously exposed to the test. While this may result in the subjects

being somewhat familiar with survey items, the survey is not designed to have a correct or incorrect response. Because of this, the testing limitation is not overly concerning in consideration of the results.

The final known limitation was possible differences in faculty teaching styles. Differences in teaching might serve as a confounding variable when considering pre and post test scores. In order to limit the effect of differences in teaching styles between faculty, the design employed a comparison group. This reduces the threat of this confounding factor. The researcher also met with each of the other two faculty members and discussed course format, typical activities, and content.

Several delimitations were applied to narrow the scope of the research. These could have implications for generalizability so care should be taken when applying the results to other groups.

1. The subject population was limited to preservice education candidates enrolled in SPE 400 at one university.

2. Only those candidates enrolled in SPE 400 during the Spring, 2011 semester were included in the analysis.

3. The study did not evaluate participants self-efficacy with technology.

4. The study did not evaluate subjects' ability to design lesson plans using technology or classroom practice that integrated technology.

5. The study was limited to a self-reported survey measure.

Definition of Key Terms

The dependent variables in this study are six of the seven subscales on the Survey of Preservice Teachers' Knowledge of Teaching and Technology and the knowledge domain assessed by each of those subscales is defined below. Schmidt et al. (2009) provided definitions for each of the skills assessed by the subscales, but definitions also include other researchers' ideas as appropriate and indicated by citation. Definitions for each of the variables and the predictor variable of group membership are provided.

Technology - As defined by the survey, "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" (Schmidt et al., 2009, p. 4).

Technology Knowledge (TK) - knowledge on various technology tools that include pencil and paper and other low-tech tools to digital tools like the use of digital video, Web 2.0 tools (Google docs, Flickr, Twitter, etc.), interactive whiteboard technology, and use of software programs (Cox & Graham, 2009; Schmidt et al., 2009).

Pedagogical Knowledge (PK)– understanding of the process and methods of teaching and includes classroom management, assessment, lesson plan development and student learning (Schmidt et al., 2009). This domain is comprised of general pedagogical activities that might be used for general or content-specific learning activities (Cox & Graham, 2009)

Content Knowledge (CK)– "knowledge about actual subject matter that is to be learned or taught" (Mishra & Koehler, 2006, p. 1026).

Pedagogical Content Knowledge (PCK) –PCK is the content knowledge that is related to the teaching process (Shulman, 1986).

Technological Pedagogical Knowledge (TPK) - Schmidt defines TPK as the knowledge of how to employ a variety of technological tools to teach and to facilitate understanding. Cox and Graham (2009) expanded this definition with the term "emerging" to recognize that the tools represent a variety of new digital media and that this domain of knowledge also encompasses the understanding of how to motivate and engage students in collaborative learning tasks with technology.

Technological Pedagogical Content Knowledge (TPACK) – TPACK is both the theoretical framework that describes the intersection of teachers' knowledge in three areas: technology, pedagogy and content area and the level of this situated knowledge that an individual has as measured by the TPACK subscale. TPACK is, according to Schmidt et al (2009), the knowledge that is a prerequisite to integrating technology as a content teaching tool in a manner that exemplifies the intuitive understanding of the complex interplay between the three basic components of knowledge.

Technology integration – use of digital media and tools such as Interactive whiteboard, wireless computers, mp3 players, cell phones, etc in the classroom to facilitate participatory, collaborative learning activities

Summary

This chapter provided an introduction to the study and situated the topic in the current data supporting lack of technology integration in K-12 schools and preservice education programs to support teaching and learning. A statement of the problem, the research questions, and the hypotheses were provided. In addition, the limitations and delimitations were outlined and pertinent terms were defined.

CHAPTER II

REVIEW OF THE LITERATURE

The first task of this chapter is to define technology and technology integration. The relevance of these terms is briefly described in terms of the current agenda in the United States, the Universal Design for Learning framework and Multiple Intelligence Theory – all supporting the significance of the issue under scrutiny in this study. This chapter reviews the literature on technology integration in the K-12 classroom, in preservice education programs, and relates the topics to the subscales that are measured by the TPACK instrument.

Technology, Integration, and Diverse Learners

The term "technology" is used differently depending upon the context. Tools such as pencils can be termed technology, but it is evident from the language of the National Education Technology Plan (NETP, 2010) and the literature on new literacies that it is the integration of digital technologies and Web 2.0 tools that has the potential to transform learning spaces. New literacies constitutes new "technical stuff" and new "ethos stuff" which "enables people to build and participate in literacy practices that involve different kinds of values, sensibilities, norms and procedures and so on" (Lankshear & Knobel, 2007, p. 7).

The term Web 2.0 is used to describe those emerging tools and web based services that propelled the web from an information source to a platform for user-created content (O'Reilly, 2005). Albion (2008) refers to Web 2.0 tools as "more participative and potentially paradigm-changing environment for building

and sharing knowledge" (p. 181). As mentioned previously, Belland (2008) wrestled with the lack of a definition in the literature for technology integration and put for the idea that integration could be termed as "the sustainable and persistent change in the social system of the K-12 schools caused by the adoption of technology to help students construct knowledge" (p. 354).

Evidence of this rhetoric is echoed in the newly minted National Education Technology Plan (NETP, 2010). The plan highlights the importance of educational technology integration that goes well beyond using new technology to perpetuate traditional approaches to instruction. The language found within the plan, designed to support the Obama administrations' educational priorities, includes words like "revolutionary," "transformation," "engaging," and "empowering." This discourse is markedly different from more traditional language describing the modes of learning prioritized in education. According to de Freitas and Conole (2010), traditional modes of learning emphasized individual modes, expertise of the teacher, and "static/passive models of the learner" (p. 28). In contrast, the outcomes in the current plan are categorized by goals and priorities organized in three areas and infused with "new modes" (de Freitas & Conole, 2010, p. 28) of learning: learning, assessment, and teaching. Alluding to technology's central role in daily life, the learning portion of the plan proposed that leveraging technology will "provide engaging and powerful learning experiences, content, and resources and assessments that measure student achievement in more complete, authentic, and meaningful ways" (NETP, p. v). The text called for not only learning objectives dealing specifically with 21st

century skills, but the use of technology to reach all learners. The plan stated, "learning no longer has to be one size fits all" (p.11) and highlighted the capabilities for technologies to offer individualized learning experiences driven by students' interests in addition to common core instruction. The plan also made connections to the Universal Design for Learning (UDL) framework with a focus on how technology can support and enhance each of the three principles outlined by UDL to support diverse learners.

UDL, a concept that originated in the field of architecture, includes three principles that can be applied to learning objectives, teaching strategies, materials in the classroom, and to assessments of student learning (Rose & Meyer, 2002). UDL encourages educators to evaluate and plan in the areas of representation, expression, and engagement. Technology supports each of the three UDL principles by providing powerful tools and options to allow multiple means of representation so that students can access the content in a variety of ways. Technology also enables innovative ways to engage learners and assess their acquisition of the content. UDL, consistent with the NETP (2010), provided a framework for transforming a rigid curriculum into an individualized, flexible tool that empowers the students to learn in a variety of ways and supports diverse learners in the general education classroom. This approach to curriculum development can change the learning space into a supportive environment for a diverse student population and challenge educators to think in a manner that allows creative and flexible planning and assessment. This provision of multiple and flexible formats during representation of content increases the likelihood that

students will learn the content because it is accessible via several pathways rather than just through printed text.   Technology tools such as digitized text provide an alternative to the print method of presentation and addresses barriers in the learning plan that might be experienced by students with special needs or those that struggle with text. Digitized text allows for supports not otherwise provided in textbooks. These supports include screen reader technology, access to a glossary, and allowances that some programs provide that allow the teacher to incorporate other learning tools that support the student's comprehension (see UDL Book Builder at www.cast.org). Technology and other flexible options are incorporated that also address barriers in expression. Allowing students to demonstrate knowledge in a variety of ways enables all students to showcase their understanding.

UDL is proactive method of planning that enables careful consideration of potential barriers based on the unique needs of all students rather than retroactively responding to an individual student's needs by making accommodations. This approach to lesson planning is facilitated by access and nimble use of digital technology tools. While this type of planning supports students with special needs, it also provides all students multiple ways to access and learn the content information for all students. UDL provides a framework for thoughtful consideration of lessons and anticipation of where barriers might exist. A UDL framework enables one method of planning that showcases technology as a way to remove barriers.

UDL and technology integration align with other educational approaches that inform instruction such as Howard Gardner's multiple intelligences (MI) approach (Gardner, 2000). MI application in the classroom encourages educators to broaden the view of traditional intelligence as defined by IQ tests. By doing so, educators can then plan and implement teaching strategies that incorporate many different types of activities to appeal to the eight different multiple intelligences. McGoog (2007) provided some guidance for technology use that is aligned with the different types of intelligences. The author suggested specific strategies that incorporate technology for each type of learner. Linguistic students are strong in the area of written and oral language. Integration of and access to computers with word processing software can allow students that are linguistically inclined to capitalize on their inherent language abilities while also practicing skills required in the 21st century workplace. McGoog suggested that students that are high in logical-mathematical intelligence would have an affinity for and benefit from activities that involve databases and spreadsheet programs, while those displaying musical strength could access music through a variety of applications and technology-supported music integration across the curriculum. Bodily-kinesthetic modes of learning can be incorporated through movement activities facilitated by presentation software and audio. In addition, students that have a strong spatial intelligence are visual learners and McGroog highlighted projects that incorporate elements of creativity such as video and multimedia projects. McGroog made the argument that all of these technological tools, when employed in the classroom, can buoy the performance of all students through the

opportunities to engage with the content in a variety of ways and build on the foundation of each student's MI.

Another advantage of technology integration that is highlighted in the literature is the potential support for a shift in the classroom climate from teacher-directed activities to a more constructivist, student-centered approach to education. Constructivism, as conceptualized by Schweitzer and Stephenson (2008), is a collection of theories that are built upon the work of theorists that all espouse the common theme of the learner actively participating in the social construction of knowledge. Rakes, Fields, and Cox (2006) drew from the constructivist ideas found in the work of Dewey, Piaget, and Vygotsky and examined the relationship of technology-supported, student-centered activities that are designed to facilitate the creation of knowledge by the student and the educators' comfort with technology. After examining both the instructional practices of teachers using the Levels of Technology Integration Scale (Moersch, 1995) and their aptitude with technologies, the researchers concluded that greater comfort with technology and more complex use of technology tools was predictive of more self-reported constructivist principles.

Sharpe, Beetham, and Freitas (2010) further examined the relationship between technology use and constructivism through a series of edited contributions from authors that share the common theme of integration going well beyond the action of teachers using and integrating technology in the confines of the classroom. The authors state in the introduction to *Rethinking Learning for Digital Age: How learners are Shaping Their Own Experiences* that the

"reorganization is being driven by learners now, in a way that places a great deal more emphasis upon designing learning from their perspective" (p. 3).

Technology and Pedagogy

The field of educational technology has exploded over the last decade, but new tools and excitement surrounding the potential for educational use is not new (Mishra, Koehler, & Kereluik, 2009). The introduction of the overhead projector, television, or video was couched in revolutionary rhetoric (see Reiser, 2007 for a review of educational technology). Ultimately, none of the technologies revolutionized education and changed the modes of learning drastically. Mishra, Koehler, and Kereluik (2009) posited that these tools fail to transform the classroom primarily for three reasons. The first reason that these advances fall short is that using innovative tools in a manner that supports instruction demands a "specific knowledge of how the technology can be used for pedagogical purposes" (p. 49). Additionally, educators often believe that the drawbacks outweigh any advantage provided by new tools. The other factor that Mishra, Koehler, and Kereluik (2010) believe erects barriers to change facilitated by novel tools is that rather than focusing on the technology itself, successful integration and change in traditional approaches requires a focus on how to teach with the tool. As the authors state, "learning technical skills alone is not sufficient – learning how to integrate technologies into teaching is equally important" (p. 50). Interestingly the authors believe that this is best accomplished by teaching preservice teachers to employ flexibility in thinking and instill a

willingness to experiment with different methods of employing technology to teach content in potent ways.

As the TPACK model suggests, knowledge of new technology tools is not sufficient and does not support successful integration in the classroom. Instead, efficient integration requires that teachers and teacher educators design environments and learning experiences that use technology to teach content in creative and flexible ways. Educators have to understand not just the technology, but how the technology can be harnessed to facilitate acquisition of content. Table 1 and Figure 1 both demonstrate how digital tools connect to pedagogical use.

Table 1

New Tools Mapped onto Pedagogic Usage

Applications and tools	Pedagogic drive
Web 2.0 Practices	From individual to social
Location-aware technologies	Contextualized and situated
Adaptation and customization	Personalized learning
Virtual and immersive 3-D worlds	Experiential learning
Google it!	Inquiry learning
User-generated content	Open educational resources
Badges, World of Warcraft	Peer Learning
Blogging, peer critique	Reflection

Table 1 (continued).

New Tools Mapped onto Pedagogic Usage

Applications and tools	Pedagogic drive
Cloud computing	Distributed cognition

Note. Adapted from de Freitas and Conole (2010). The Influence of Pervasive and Integrative Tools on Learners' Experiences and Expectations of Study. In Eds.R. Sharpe, H. Beetham, &S. de Freitas. *Rethinking learning for a digital age* (pp. 15-30). New York, NY: Routledge.
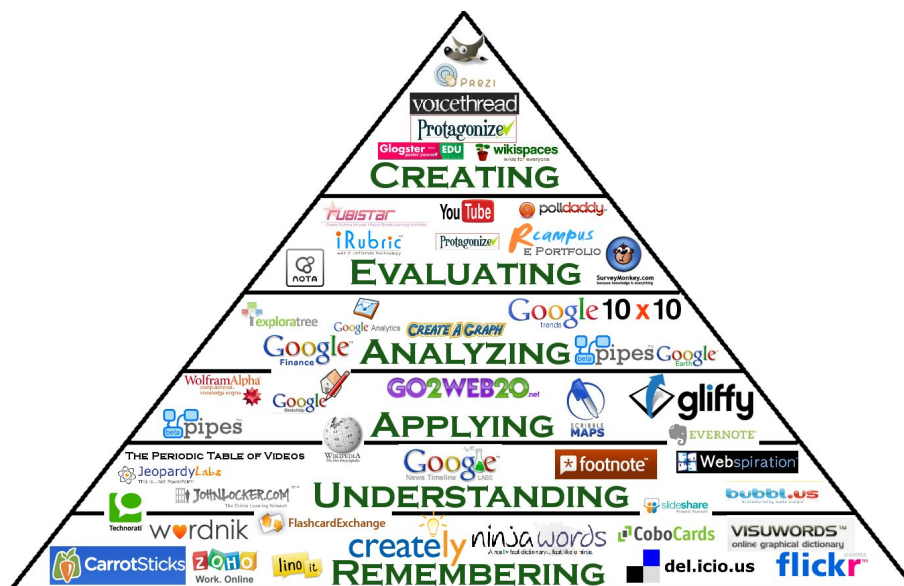
Figure 2. Bloom's Digital Pyramid Penney, S. (2010). Bloom's digital pyramid. Retrieved from http://www.usi.edu/distance/bdt.htm

K-12 Technology Integration

Despite the evidence that supports technology integration in the K-12 classroom as a means to increase student engagement and deepen understanding (Kay, 2006), use of technology in the K-12 environment is limited.

Historically, one barrier that contributed to this lack of integration was access however, according to the National Center for Educational Statistics, (NCES, 2005) access to technology should no longer be an issue as 97% of schools and 94% of instructional rooms have computers with broadband internet access (NCES, 2006). Despite this greatly improved access and data that supports more frequent use of technology by educators (CDW-G, 2006; Project Tomorrow, 2010), scholars like Ertmer and Ottenbreit-Leftwich (2010) charge that the use continues to be low-level (Maddux & Johnson, 2006). Low-level technology use is considered methods that perpetuate teacher-directed instruction. As an example, 51% of participating educators reported that their primary use of technology to facilitate student learning was homework completion using the computer and practice work on the computer (Project Tomorrow, 2010, n.p.). This data is consistent with the historical NCES data (2006) that found that educators that reported making use of the computer during instructional time employed tasks such as word processing or using spreadsheets as the primary function.

Few educators reported in the NCES (2006) or the Project Tomorrow (2010) survey accessing technology in order to facilitate higher-order tasks such as collaboration or multimedia projects and this was true despite the fact that in Project Tomorrow's (2010) survey that included responses from 38,642 educators. Of the educator participants, 51% indicated that students were more motivated to learn when technology was employed in the classroom. Smaller, but still significant, percentages of educators identified other benefits for students

including: application of knowledge to real-world problems (30%), seizing ownership of learning (23%), and acquisition of 21st century skills including creativity (39%), collaboration (30%) and proficiency in problem solving and critical thinking (27%).

Another survey conducted as a component of the same project by Project Tomorrow solicited input from K-12 students in order to ascertain what their thoughts were related to technology use in the classroom. The learning priorities according to the 299,677 students, as summarized by the Project Tomorrow's reports (2010), are organized into three themes: socially-based, "un-tethered" or "technology-enabled learning experiences that transcend the classroom walls" (Project Tomorrow, 2010, p. 1), and digitally-rich.

These three themes form the foundation of the report on teacher responses. The themes are used as a framework to organize the results of the teacher and administration survey to assess progress in addressing the priorities outlined by the students. While the themes were defined based on student responses, the rhetoric echoes current scholarship and policy recommendations, including the NTEP (2010) that challenges the system to engage in reform efforts that allow what the Project Tomorrow's report terms "un-tethered learning," digitally-rich environments, and socially-constructed knowledge. In assessing these areas, the Project Tomorrow's report finds discrepancies in the benefits of technology integration indicated by the responses and the types of activities that are described. The educators and administrators profess benefits, but descriptions of learning activities that incorporate technology and the

percentages that feel that tools like blogs, wikis, and social networking have a place in the classroom does not indicate robust use of the tools. The primary use of technology is to aid in teacher instruction and to allow students to practice skills using software. Percentages of use reported for digital media tools are indicated in Figure 3.
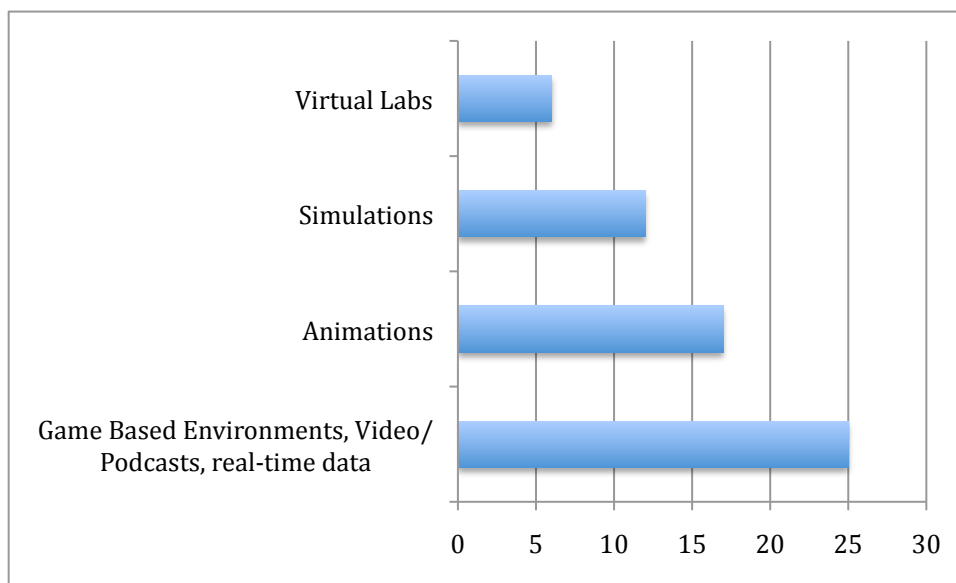
Figure 3. Percentage of use reported by educators for various digital tools (Project Tomorrow, 2010).

Technology for Transformation

The historical data from NCES, the data gathered by CDW-G, information from Project Tomorrow's survey results, and the current literature all point to the conclusion that technology integration in the K-12 environment has not reached the level of use that is required to fully realize the potential of these tools. Projects that capitalize on the affordances of technology facilitate collaboration and support acquisition of 21st skills need to compete in today's job market. Tools and collaborative activities such as powerful use of wikis, blogs, social

networking and other digital media have the potential to transform the traditional

classroom in much the same vein that Web 2.0 tools have completely redefined

the use of digital space (O'Reilly, 2005). While it is not generally accepted to use

Wikipedia entries as references, the information provided to describe Web 2.0

tools is particularly relevant. The usage of this definition is more poignant in the

context of this discussion because it provides an example of a user-created

definition. The Wikipedia definition illustrates the point thusly:

> The term "Web 2.0" (2004–present) is commonly associated with web
>
> applications that *facilitate interactive information sharing, interoperability,*
>
> *user-centered design, and collaboration* [emphasis added] on the World
>
> Wide Web. Examples of Web 2.0 include web-based communities, hosted
>
> services, web applications, social-networking sites, video-sharing sites,
>
> wikis, blogs, mashups, and folksonomies. A Web 2.0 site allows its users
>
> to interact with each other as contributors to the website's content, in
>
> contrast to non-interactive websites where users are limited to the passive
>
> viewing of information that is provided to them. (Web 2.0, n.d., n.p.)

To further demonstrate the parallel between the possibilities of an altered

learning space and Web 2.0 tools, Lankshear and Knobel (2007) describe the

difference between Web 1.0 and Web 2.0 tools in terms of the end user. The

authors point out that when using Web 1.0 tools, "users are not positioned as

controllers of their own data" and go on to say that "the logic is of use rather than

participation; of reception and/or consumption rather than interactivity and

agency" (p.16). The same could be said of classroom instruction that relies on

the teacher to share expertise and casts the students in the role of inert recipients. While technology in and of itself does not have transformational value, when wielded correctly it can support the creation of a different type of learning space much as Web 2.0 tools have catapulted the end user from a role characterized by passivity to collaborative contribution and construction.

If technology integration is useful in creating classroom learning spaces that improve outcomes and create opportunities for students to actively construct knowledge and research supports the conclusion that integration has not been successful, it follows that future research should be concerned with identifying and addressing the barriers to technology implementation. Research thus far has led to the conclusion that technology integration in K-12 classrooms is correlated to the beliefs that the educator holds related to technology and pedagogy, as well as their feelings of self-efficacy in employing technology in an instructional capacity (Ertmer, 2005). Pajares (1992) described teacher beliefs as a "messy construct" that are difficult to study due to "definitional problems, poor conceptualizations, and differing understanding of beliefs and belief structures" (p. 307). Despite the fact that the author believed that the study of teacher beliefs is a challenging endeavor, it is important to confront the task because "the beliefs that teachers hold influence their perceptions and judgments, which in turn, affect their behavior in the classroom" (p. 307).

Teachers may not have preconceived notions of how technology should be used to facilitate student learning. Ertmer (2005) argued that because teachers' educational histories usually lack experiences with technology, they are

likely to think about technology as they think about teaching and learning in more general terms. It follows then that those teachers that hold more constructivist views about student learning may be more likely to believe that technology, or any other tool, can be used to support student-centered learning. Niederhauser and Stoddard (2001) arrived at the same conclusion - educators employ technology according to their personal beliefs surrounding instructional practice and curricula. The studies that were analyzed for this review situate their research questions around the possible interaction between educator beliefs and their intended use of technology in the classroom.   Those studies that implemented a treatment did so with the intent to affect teacher beliefs related to technology and technology integration as well as their views about how students learn.

As information collected by NCES reveals, technology that is believed essential by classroom teachers are not those tools that facilitate acquisition of content or employ technology to solve problems. Instead data gathered during the 2000 – 1 school year, revealed that teachers considered some tools as essential to classroom instruction, but those tools were not necessarily those that help students construct knowledge. Rather the tools that were identified provide reference information or support communication for the educator. Sixty-eight percent of participants viewed a teacher workstation with a computer and access to email as essential to teaching. Other elements of technology that were reported frequently include access to the internet and a telephone in the

classroom, reference works on CD-ROM, and at least one computer for every four students.

Barron, Kemker, Harmes, and Kalaydjian (2003) developed and administered a survey based on the NETS standards in a large U.S. school district. According to responses from 2,156 participants, the results echoed the percentages found several years earlier by the National Center for Educational Statistics. The findings indicated that only 27% of teachers used technology to facilitate problem solving and data analysis to a moderate or large extent. Only 8% reported using technology to facilitate problem solving/analyzing data. In the more recent data, 12% teachers reported using technology for internet research activities. The study also supported previous research that found elementary school teachers were more likely to use computers on a regular basis and were also more apt to use the technology as a problem-solving or communication device (Becker, Ravitz, & Wong, 1999).

Based on a survey of over 200 practicing teachers enrolled in a graduate program, Banas (2010) reported that 52% of participants reported that they had positive feelings about and currently integrating technology in their classrooms. Another 28% reported that positive feelings related to integration but felt that barriers to integration existed including confidence, knowledge and skills, and time. Only 13% of respondents were integrating technology fully.

After analyzing the results of a survey of teachers in Massachusetts, Russell, Bebell, O'Dwyer, and O'Conner (2003) also reported that teachers most often employ technology for communication purposes. The other frequently

reported practice was use of technology for planning purposes. The researchers also reported differences between experienced teachers and those that were new to the field. Despite the fact that newer teachers reported greater comfort with technology, more experienced teachers related using technology more frequently in classroom instruction and activities.

Even though the use of Web 2.0 applications in the classroom illustrates compelling ways to create a "rich and exciting technological environment to support learning, with a multitude of mechanisms for rendering content, distributing information and communicating" (de Freitas & Conole, 2010, p. 19) these environments are not being actively created in classrooms. Conole (2009) concluded that there is little evidence of educators harnessing new technology in innovative ways. In addition, despite terms such as "digital natives" (Prensky, 2001, n.p.) and "net generation" (Oblinger & Oblinger, 2005, p. 1.2), many students are not familiar or do not grasp how to use Web 2.0 tools for academic endeavors.

In an effort to look at the relationship between technological innovation and pedagogy, Snider and Roehl (2007) examined teachers' pedagogical beliefs and found that most teachers reported that they believed in practices consistent with constructivism. As defined by the authors, constructivism is "based on the premise that learners construct knowledge based on their own experiences and prior beliefs" (p. 874). Classroom practices that enable the construction of knowledge include activities that allow authentic exploration, engage the learner, and provide opportunities for interactive group work.

In a qualitative study, Inan, Lowther, Ross, and Strahl (2010) collected data from direct observation that demonstrated a positive relationship between technology integration and student-centered classroom activities. During the direct observations, the researchers noted that the use of software for skill and drill practice was not indicative of a change of teacher role to facilitator, project-based learning or independent inquiry.

The importance of classrooms that provide rich experiences with the latest innovative tools is reiterated by other scholars. Goldin and Katz (2008) acknowledged the rapid pace of change, but charged education to keep pace with the rapidly changing technology landscape in order to support a citizenry that has equal access to jobs that increasingly require a fluency with technology skills. Goldin and Katz believe that when education progress lags behind technological advances, inequity widens. This argument reflects Gee's (2008) notion outlined in *Social Linguistics and Literacies* that schools often replicate the social hierarchy because students that do not have opportunities to learn and use new technology will then be relegated to specific types of jobs. Although Gee is speaking of literacy in more general terms, he stated "Schools have historically failed the non-elite populations and have thereby replicated the social hierarchy. This has ensured that large numbers of lower socioeconomic people and minority people engage in the lowest-level and least satisfying jobs in society" (p. 34).

Preservice Integration

Few scholars reserve their critique of technology integration, or lack thereof, to K-12 programs. Provision of powerful experiences that shape candidates'

TPACK skills has been the subject of much literature (Kay, 2006). According to a study conducted by the U.S. Department of Education, "nearly all institutions with teacher education programs for initial licensure taught candidates to use technology tools for enhancing and enriching classroom instruction" (pp. 10-11), but the report also highlighted numerous barriers to this practice. These barriers included lack of time on the part of faculty and little training and/or interest.

Kay (2006) provided an extensive look at how preservice programs are attempting to address these barriers in a review of 68 studies focused on technology integration at a preservice level. The result of this analysis revealed ten strategies that are being employed by institutions including delivering a single technology course, offering workshops, integration technology into all coursework, modeling how to use technology and using multimedia. Other strategies that were being used included improving access to technology and/or support, providing mentors, and opportunities for candidates to practice in the field.

A more recent article (Lambert, Gong, & Cuper, 2010) not included in Kay's review outlined efforts to redesign an educational technology course to facilitate acquisition of a "21st century skill set" (p. 54) rather than simply boosting technical skills of participants. This program showed improvements in candidates' attitudes and self-efficacy with technology. Participants' values and beliefs regarding technology integration showed significant improvement. The authors make a compelling argument for preservice programs to go beyond teaching isolated technology skills and instead provide rich opportunities and

examples of how to use those skills and tools to support pedagogy. The authors

state:

> We wonder how far current teacher preparation programs are telling pre-
>
> service teachers what an educational technology is rather than empowering
>
> them to experiment and create their own. A new focus needs to take root, one
>
> characterized by creativity and flexibility of thought and experimentation by
>
> educators with their own educational technology designed to meet specific,
>
> immediate needs. If technology is truly to be beneficial to education, the
>
> power and potential of educational technology must be acknowledged to
>
> reside within educators and not within objects. We must foster in future
>
> educators new skills designed to harness the potential of our "unbounded"
>
> world (p. 52).

In spite of this demand in the literature for these types of preservice

experiences, studies routinely demonstrate that recent graduates do not have the

skills necessary for successful integration. Following analysis of qualitative

results using a case study methodology, Clausen (2007) indicated that the

concept development related to using technology for instruction of two first-year

teacher participants appeared to be lacking. As such, the author recommended

that institutions examine the effects of efforts to arm preservice teachers with an

understanding of how to use technology to support pedagogical goals in the

classroom.

The International Society for Technology in Education (ISTE, 2008) joined the

chorus of demand for preservice programs to reevaluate how preservice

educators are prepared when the organization outlined five technology competencies for teachers. These standards include the following:

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; and

5. Engage in professional growth and leadership.

The National Council for Accreditation of Teacher Education Programs (NCATE) also interweaves technology components into the standards outlined for teacher education programs. Despite the NCATE standard that professional faculty should "integrate diversity and technology throughout coursework, field experiences, and clinical practices," Donovan and Green (2009) charge that "teacher education programs across the United States are lagging in the way that they prepare teacher candidates for working in technology-rich environments" (p. 45).

More recently, President Obama's administration outlined the priorities for educational technology in the NETP (2010). The technology plan articulated five major goals for the nation and issued a call for "deep transformation of teaching" and acknowledged that "these transformations must begin in the places where our education system is preparing new professionals: colleges of education" (p. 60). Drawing from recent research, the plan concluded that teachers are not adequately prepared to use technology in the classroom for teaching and learning. The plan issued a call for all preservice programs to provided learning

experiences replete with opportunities for future teacher to use technology across the curriculum.

Gotkas, Yildirim, and Yildirim (2009) state that integration of information and communication technologies (ICTs) into the K-12 setting is dependent upon the integration of these technologies at the pre-service teacher level. Pre-service education programs are not currently providing future educators with the competencies and skills they will need to be successful in technology integration. The authors summarized the research of the last few years in order to determine what barriers are present. The barriers that the authors identified include the following:

- Lack of in-service training;

- Lack of appropriate software/materials;

- Lack of basic knowledge/skills for ICTs;

- Lack of hardware;

- Lack of knowledge/skills for ICT integration;

- Lack of technical support;

- Lack of appropriate course content and instructional programs;

- Lack of time; and

- Lack of appropriate administrative support.

Georgina and Hosford (2009) researched one of these barriers: lack of basic knowledge and skills on the part of faculty. The data collection supported a significant correlation between technology literacy and pedagogical practice. Georgina and Olson (2008) found that most faculty surveyed preferred to teach

in a technology-enhanced classroom and 71% reported employing technology during instruction.

McPherson, Wang, Hsu, and Tsuei (2007) discussed the advantages of web based ICTs and the advantages of providing pre-service educators with quality instruction on technology tools. The authors advocated for use of blogs and wikis, virtual literature circles, internet workshop model, digital concept mapping and online chats and video conferences as potentially powerful web-based tools to facilitate literacy instruction. The tools have educational value for preservice and inservice teachers, not only to facilitate acquisition of content, but also to further innovation and understanding of ways to use technology as a pedagogical tool.

Other research has demonstrated that a multifaceted approach to faculty training can result in an increase in technology skills of faculty and students and more successful integration into the courses. Judge and O'Bannon (2008) documented the efforts of the Preparing Tomorrow's Teachers to Use Technology (PT3) initiative at The University of Tennessee. The program provided faculty members with a laptop computer and wireless access in the classrooms. In addition, faculty members and students had access to two computer labs with various technologies such as computers and digital cameras. Assistive technology was made available for check out for use in the classroom or in the field and mobile technology was supported by three mobile multimedia labs on carts for classroom use. The project also addressed the training needs of faculty by providing technology lunches and workshops. Support was

integrated into the program through faculty advisors and project staff. Mini-grants were also provided to participating faculty. Changes to practice included more frequent use of technology in courses both in required student assignments and to facilitate instruction. Judge and O'Bannon conclude their discussion with several recommendations that reflect continued concerns about the frequency of technology use to prepare future educators. These recommendations include addressing the lack of technology access in methods classrooms, providing time release and incentives for faculty to develop technology components, and creation of "communities of practice" (p. 26) that encourages meaningful dialogue.

Friel et al. (2009) also tackled faculty technology training and support with an effective, multifaceted model. The project was implemented by updating the classrooms with interactive whiteboards and other presentation media. Once accessibility issues were addressed, the project began training faculty. Faculty participants were first given pre-training readings dealing with constructivism and the Seven Principles of Good Practice in Undergraduate Education (Chickering & Gamson, 1999). These practices include:

1 Encourage contact between students and faculty.

2 Develop reciprocity and cooperation among students.

3 Use active learning techniques.

4 Give prompt feedback.

5 Emphasize time on task.

6 Communicate high expectations.

7   Respect diverse talents and ways of learning.

The project espoused the assumption that technology integration in the college

classroom could facilitate these principles of good practice by transforming

lecture into dialogue and interactive learning activities (Friel et al., 2009). The

data collected in a pre- and post-test design indicated that the training sessions,

which modeled constructivist principles and active learning, increased the faculty

participants' knowledge and comfort level with the technology.

Donovan and Green (2009) created a preservice program that infused

technology into every aspect of the preservice teacher experience and created

opportunities for the students to practice the technology skills that were modeled

in their coursework. Another important factor was the collaboration with schools

with technology infused in the classroom and teachers that integrated the

technology into teaching. Student teachers that experienced preservice

modeling in their coursework and in their K-12 classroom experiences integrated

technology during their student teaching.

Studies also support the use of technology as a tool in preservice

education settings to improve understanding and reflection on course content.

For example, researchers in Taiwan collected qualitative data to assess the use

of blogs as a tool for candidates to reflect and to dialogue with peers (Yang,

2009). Many of the candidates incorporated critical reflection into their writing

and to demonstrate thinking through comments on peers' blog writings. The

authors concluded that the use of the blog for writing and online dialogue

supported a "community of practice" (p. 18) for the candidates that allowed them

to actively discuss the academic content. Another tool that has shown promise is

Twitter - a micro blogging forum. In a qualitative investigation of use of Twitter to encourage reflection during clinical experiences, Wright (2010) reported that candidates used the tools to support one another and to reflect on experiences.

These methods appear to be attempts for university programs to answer the call of scholars like Belland (2008) who insist that the preservice opportunities that teachers have play a major role in whether or not successful integration will occur in the K-12 classroom. Belland identified preservice experiences as one way to effect candidates' habitus. Habitus includes the values and beliefs that are instilled through the individuals' life experiences, and outlines an individual's schema which have implications for actions. Belland drew from previous work to apply the theory of habitus to explain why teachers do not integrate. In Belland's view, teachers have not been exposed to successful and meaningful teaching and learning that integrates technology and have thus not formed a habitus or schema for the process.

Teacher Educators' Pedagogy

There is some literature that has called for changes in way teacher educators are prepared and for a review of the pedagogical tools used by teacher educators to exemplify a learner-centered environment. As Harris and Cullen (2008) state, this shift would support "an emphasis on the scholarship of teaching and learning" (p. 58). Other scholars, like Bain (2004) have identified characteristics of effective professors that include a deep understanding of the content which allows variation in explanation and representation of material, investment in student learning, and creation of spaces that foster trust. These

professors are willing and able to relinquish some control that allows the environment to be more learning-centered. Filene (2005) added that effective university teachers nudge students out of their comfort zones and confront them with "unsettling ideas, set high standards, demand introspection and hard work – and all the while, heeding how the students are responding" (p. 3).

In a survey of university educators, Rieg and Wilson (2009) found that the tools that were rated by professors as most effective were not the tools that were most frequently used in the classroom. The authors did find, however, that according to their results lecture is not the most effective or most frequently used method of lesson delivery. Teacher educators reported that they often employ strategies that encourage students to think and apply and small group discussions.

Facilitating TPACK

There is a small but growing body of work that delves specifically into the situated knowledge that is framed in the TPACK model. The TPACK model is based on the earlier work of Shulman (1986). In 1986, Shulman described a form of knowledge that is distinct from content or pedagogical knowledge. The author viewed pedagogical content knowledge (PCK) as the knowledge that teachers use to design learning experiences that facilitate student understanding of content. This type of knowledge allowed flexibility in representation of content and thus increased the likelihood that students would grasp the material. This is contrasted with "explicit instruction" (p. 874) which supports the notion the most effective instruction involves presenting content material in a logical and

organized fashion. Pedagogical strategies that are often used in this type of environment include systematic application and independent practice.

Historically, research had demonstrated a weak relationship between teacher pedagogical beliefs and practice (Duffy & Anderson, 1984). The determining factors in decisions about classroom instructional strategies appeared to be largely determined by contextual factors. Other research linked a teachers' constructivism tendencies to the age group that was taught with elementary school teachers scoring higher on constructivism than secondary educators (Ravitz, Becker, & Wong, 2000). In reviewing work on teachers' pedagogical beliefs, Snider and Roehl (2007) came to the conclusion that "teachers are not particularly ideological. They base decisions on learner characteristics and classroom constraints, relying on intuition and experience to make instructional decisions" (p. 875). To examine this further, the authors conducted a survey of 600 K-12 teachers across three states. Responses indicated that teachers were consistent in reporting beliefs consistent with a constructivism philosophy of teaching, but were also that teachers were "atheoretical" (p. 881).

Mishra and Kohler (2006) extended Shulman's work to incorporate another type of knowledge that teachers possess in varying levels: technology knowledge. The authors conceptualized the three areas of knowledge as overlapping and forming intersections that include TPK, TCK, and TPCK. Recent work on the development of teachers' TPACK has focused on ways to increase the situated knowledge required to design and teach effectively using technology

at a preservice level. One example of this type of work employed what the authors called a learning by design approach (Koehler & Mishra, 2005). In order to go beyond what teachers need to know about technology, the researchers began the conversation about specific techniques that teacher educators could employ to facilitated acquisition of TPACK in education coursework. The process described engaged teams of students in addressing authentic education problems and issues through a design process that incorporated technology. In this fashion, students were not passive recipients of technology-related skill content, but were actively involved in learning both the technology and the limitations and affordances of specific technologies in facilitating content acquisition.

The literature on developing TPACK in pre-service teachers does not outline a specific set of accepted practices that best facilitate the acquisition of this situated form of knowledge. This is an area of burgeoning study, but even the studies that have been reported often lack substantial detail in regard to the specific tools that were integrated in the courses. For example, in a paper presented on the first pre/post data collection of a longitudinal study examining preservice educators' development of TPACK, the authors say only that participants were enrolled in an instructional technology course that was redesigned "using TPACK as an organizing framework" and that the course "is specifically designed to prepare preservice teachers to teach with – not just about – technology" (n.p.). Other work has used what Koehler & Mishra (2005) term a "design approach" (p.131). This course experience included small group

work in response to a real pedagogical issue. While initial investigation has demonstrated the effectiveness of this approach in facilitating TPACK, the design teams were graduate level teams completing a course of study in instructional technology.

Brupbacher and Wilson (2009) argue that the best way to facilitate TPACK for preservice teachers is to actively involve them in exploration of ways to use technology to facilitate learning in content areas. This is best accomplished by projects and instructional design activities. These types of activities should be situated in a program where exposure to use of technology for teaching is ubiquitous rather than confined to a stand-alone technology skill based course.

More recently, Jang and Chen (2010) relied on a qualitative design to examine the impact of "transformative model" (p. 553) and peer coaching to develop preservice educators' level of TPACK. Though the sample size was limited to 12 participants, the authors gathered data from a variety of sources including artifacts like written assignments and reflective journals, videotapes, and interviews. Based on the triangulated data, the authors concluded that the redesign of the course was a model that could help candidates develop TPACK.

Scholars have made some recommendations for practices that should be integrated into preservice course experiences in order to facilitate and support candidates' acquisition of the skills required for using technology to transform learning spaces. These recommendations are based on studies conducted to assess the impact of various strategies and the instructional design component of the current study is based on these examinations and Kay's (2006) large-scale

meta analysis that reviewed numerous studies and made some specific recommendations based on the findings. There appears to be consensus that preservice education experiences are one way to bolster educators' capacity to use technology as a tool for transformation (Belland, 2008; Park & Ertmer, 2007; Wang, Ermer, & Newby, 2004), so the tools were identified and integrated into an undergraduate education course.

Blogging for Reflection and Community

Albion (2008) highlighted Web 2.0 as "a more participative and potentially paradigm-changing environment for building and sharing knowledge" and recommended that Web 2.0 tools be used to develop learning communities for candidates and that preservice teachers also have a wealth of experiences that showcase Web 2.0 tools in authentic practice (p. 181). There is also some support in the literature for use of wikis and blogs, two examples of Web 2.0 tools, to encourage active knowledge construction. A weblog, or blog, is one of these tools and can be used for communication, informal reflection, and for information sharing (Wang, & Hsua, 2008). Wopereis, Sloep, and Porrtman (2010) found that when preservice teachers were asked to use blog, the tool was used to reflect and to "stimulate interconnectivity" (p. 245) among the students. This finding echoed earlier research that found that blogs supported the development of an online community (Dickey, 2004). Top, Yukselturk, and Inan (2010) also concluded that use of blogs contributed to a sense of learning community. After reviewing survey data, these authors also found that without explicit guidance candidates used the forum as information sharing rather than

as a reflective practice tool. Yang (2010) found that the preservice teachers that

participated in a qualitative study used blogs to actively discuss theories related

to teaching and the implications for the classroom when the instructors

commented on posts and challenged their thinking. When Cheng and Chau

(2011) compared blogs to wikis, the authors found that both allowed users to

actively create knowledge through collaboration.

Wiki for Collaborative Learning Activities

   There is also emerging evidence that use of wikis can be an effective learning

tool for preservice educators. Feng and Beaumont (2010) analyzed the use of a

wiki to facilitate collaborative learning using a case study design. Results

suggested that a wiki can facilitate valuable collaborative learning. According to

the authors, the tool had several affordances including swift feedback, learning

by accessing peer contributions, ease in navigation and the ability to track

changes in the document.   In another qualitative look at preservice experience

with wikis Nicholas and Ng (2009) found that wiki use supported construction of

knowledge and that candidates had positive attitudes about participation in the

projects.

Measuring TPACK

       Measuring this situated form of knowledge, or TPACK, has proven to be a

challenge for researchers. In 2005, Koehler and Mishra conducted a qualitative

study with 13 participants. Analysis of responses after students had completed

an instructional activity that involved creating an online course demonstrated

more complex thinking that reflected the development of TPACK. These results were replicated by the same authors in a similar study with 24 participants.

Cavin and Fernández (2007) evaluated the effect on TPACK as a result of participation in a preservice education course that used two primary components to impact change: modeling use of technology in preservice and use of microteaching lesson study. Using qualitative analysis that included triangulation of interview, observation, and artifact data, the researchers concluded that participants' level of TPACK had improved.

Brush and Saye (2009) designed and implemented activities in preservice education to improve TPACK that included the following:

1. Viewing, critiquing, and discussing authentic cases of social studies teachers utilizing various technology resources to implement inquiry-based learning activities in their classrooms.

2. Providing preservice social studies teachers with opportunities to explore innovative, emerging technologies and to integrate those technologies into rich learning activities within the context of their teacher education programs.

3. Providing preservice social studies teachers with opportunities to implement activities that effectively utilize technology in authentic classroom settings.

In 2009, Cox and Graham conducted a conceptual analysis in an effort to further TPACK to facilitate research and understanding. The authors' primary goal was to, "create a précising definition – one which draws from typical usage

of the term and to clarify the meaning of that term – for each of the TPACK constructs" (p. 60). The result of the analysis was to define pedagogical knowledge as the "general pedagogical activities" (p. 62) that might be used and that are not specific to any particular topic. According to this definition, the PK dimension of TPACK encompasses strategies for facilitating learning that may include motivation and engaging students, communicating with parents and students, and different types of learning such as discovery, collaborative, and problem-based.

Also in 2009, Angeli and Valanides conducted a study with 215 preservice teachers to assess the impact of two design tasks on participants' level of TPACK. Using self-report and expert and peer review these researchers found that levels of TPACK increased significantly between the two tasks.

Building on the initial attempts to quantify and measures TPACK, Archambault and Crippen (2009) developed a survey that included 24 items drawn from the TPACK framework. The authors studied the reliability and validity of the instrument through expert review and a pilot to ensure consistent interpretation of the items. The survey was designed specifically for candidates participating in online course work and thus is not suitable for other environments.

Simultaneous to these initial efforts to measure TPACK, scholars were struggling to operationalize the skills within the model. Pedagogical content knowledge (PCK) was first articulated by Shulman (1986, 1987) and is further defined by Cox and Graham (2009) as the pedagogical tools and knowledge that

is situated within an individual's content specialty area. The authors further define PCK into two categories - those activities that are content-specific and activities that are topic-related. The knowledge of how to employ emerging technologies is technological knowledge (TK) and technological content knowledge is "a knowledge of the topic-specific representations in a given content domain that utilize emerging technologies" (Cox & Graham, 2009, p. 64). TPACK is also conceptualized as the knowledge of how to engage and prompt students to use technology in innovative, collaborative ways.

Conclusion

This chapter presented a review of the literature relevant to the current study. The text drew from existing work to conclude that technology can be used to support diverse learners and a student-centered learning environment. Data on levels of integration at a K-12 and preservice level were presented to higlight the important of the current work. Finally, the recent work on facilitating TPACK was reviewed.

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

Recent research investigating the extent of technology integration in K-12 settings has supported the conclusion that schools have not achieved integration despite the potential benefits to teaching and learning (Ertmer, 2005; Eteokleous, 2008; Hew & Brush, 2007). Further examination (Ertmer & Ottenbreit-Leftwich, 2010; Kay, 2006) of this issue has identified teacher preservice education as a potentially powerful arena to model use of and to facilitate frequent opportunities for candidates to practice successful integration of technology for teaching and learning. This exposure and practice may result in teachers who are prepared to increase the level of integration in K-12 schools (Kay, 2006). The purpose of this study was to evaluate the impact of specific teaching methodologies at the preservice level on candidates' level of TPACK. Preservice experiences were tailored according to emerging research (Kay, 2006; Polly, Mims, Shepherd, & Inan, 2010) on effective strategies to facilitate TPACK. The study reflected Mishra and Koehler's (2006) TPACK framework that espouses a form of situated knowledge that includes technology, content, and pedagogical expertise as a prerequisite for successful integration.

Research Questions

This study examined the impact on TPACK scores for preservice teacher candidates based on their enrollment in one of three course-related groups: face-to-face technology-enhanced, fully online, and a face-to-face comparison group. All three of the groups were participants in an introductory special

education course that was designed to introduce characteristics of exceptionality and teaching strategies that facilitate participation of all students in the general education curriculum. Because the content of the course was not discipline-specific, the primary aim was to provide participants with general classroom instructional strategies that support learning characteristics associated with a variety of exceptionality criteria. The analysis evaluated the impact of the course design on candidates' familiarity with technology, effective pedagogical tools, and how to efficiently wield technology to support learning objectives. Further, the study compared the impact of technology-infused modeling, explicit instruction, and participation in fully online coursework. The face-to-face comparison and technology-infused groups were evaluated in relation to a comparison group that received the content without explicit technology-related modules or fully online course completion. Specifically, the study sought to determine if Technology Enhanced Experiences (TELs) and explicit technology instruction were associated with increased subscale scores on the Technological Pedagogical Content Knowledge (TPACK) instrument that includes the following: Technology Knowledge (TK), the Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technology Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), and the full scale score on the Technological Pedagogical Content Knowledge (TPACK) subscales when compared to the fully online and comparison groups. Specific research questions that were addressed include the following:

1. Does instructional methodology and the use of technology tools for collaborative learning increase preservice teacher candidates' level of the complex knowledge (TPACK) required to successfully integrate technology in the K-12 classroom?

2. Are there differences between groups of in preservice teacher candidates' level of TPACK as a result of group membership in a technology-infused course experience, a fully online course experience, or students that participate in the comparison group?

Statement of Hypotheses

H1: There will be an increase in post- test scores on Technology Knowledge (TK), Pedagogical Knowledge (PK), Technology Content Knowledge (TCK), Technology Pedagogical Knowledge (TPK), and Technology Pedagogical Content Knowledge (TPACK) for those students that participate in the face-to-face section that systemically incorporates and models use of technology and presents content on UDL and Web 2.0 (Group 1).

H2: Students that participate in technology-infused course experiences (Group 1) will have higher scores on Technology Knowledge (TK), Pedagogical Knowledge (PK), Technology Content Knowledge (TCK), Technology Pedagogical Knowledge (TPK), and Technology Pedagogical Content Knowledge (TPACK) when compared to students enrolled in a face-to-face section that does not systematically incorporate and model use of technology.

H3: There will be a difference in TPACK scores between candidates that participate in a fully online class (Group 2) and those that participate in the face-to-face comparison group (Group 3).

H4: There will be no difference in pre- and post- TPACK scores for students enrolled in the comparison group (Group 3).

Subjects

Subjects in this study included preservice teacher candidates enrolled in any of five sections of a required introductory special education course. One hundred fifty-six preservice teacher candidates participated in the first survey administration and 138 also completed the second survey administration. For Group 1, there was no mortality of subjects between administrations. Mortality between administrations for Group 2 and 3 were 28% and 11% respectively. All participants were teacher education candidates across multiple education-related disciplines enrolled in SPE 400 in the Department of Curriculum, Instruction, and Special Education at The University of Southern Mississippi during the spring 2011 semester. The sample size was over 120 participants, the number required to meet the criteria determined by power analysis. The power of a statistical test is "the probability that it will yield statistically significant results" (Cohen, 1988, p. 1). The power of a statistical test is profoundly impacted by the sample size and thus a power analysis is useful in determining the minimum sample size for any proposed study that will use inferential statistics to generalize the findings to a population. Power analysis can be used to calculate minimum sample size using an estimated effect size based on previous work and the set alpha level. The goal is to decrease the probability of making a Type II error due to the impact of

sample size on the sensitivity effects of the statistical measure. This is also the

rationale for using *p*<.05 as a critical statistic to make a decision regarding the

hypothesis in the current study. Using the less stringent of the two commonly

used test statistics (i.e., 01 or .05) will also decrease the probability of a Type II

error. This decision was made based on the relative rare occurrence of Type I

errors (Murphey & Myors, 1998) and the negligible risk associated with the

unlikely event of a Type I error. In addition, Field (2009) reported an alpha of .05

as a standard level. Using the values given, the power analysis was based on

Cohen's (1988) extensive work that yielded a minimum sample size of 85 for

attaining a power of .80 and estimating a medium effect size. Participants were

students enrolled in either the face-to-face and fully online sections of the course.

Participant group assignment and course design were determined by the section

of SPE 400 that the students enrolled in rather than by random assignment.

Participants were selected for inclusion based on their enrollment in SPE

400. Participants were advised of the general nature of the study and the

requirements for participation. Prior to data collection, the project was reviewed

by and received approval from the Institutional Review Board (IRB) at The

University of Southern Mississippi. Additionally, participants were advised that

participation was voluntary and of any risks and benefits associated with

participation (see Appendix A for informed consent and IRB approval letter).

Participants were first presented with informed consent information before

accessing the online survey and were advised that participation is not required

and that there will be no penalty if they chose not to complete the survey.

Because the survey was available online, it was not necessary to provide alternative activities for course members that did not wish to participate. Participants were asked to generate a unique code according to given specifications in order to associate pre and post test performance, participants responding to the survey will generate a number that will be consistent between administrations yet the association to the participants' identity will be unknown to the researcher. During data analysis, it became apparent that these codes were not reliable in matching participant responses, so the codes were not used and the groups were treated as independent.

Technology-Enhanced Learning Experiences (TEL)

In designing the TELs for the current study, consideration was given to those digital tools that would allow students to build a collaborative, digital environment for knowledge construction that served as an extension to the face-to-face sessions. Research on the specific tools and/or experiences that are effective in facilitating preservice educators' level of TPACK is sparse and even the studies that do exist do not fully describe the instructional methods employed. So while the design did draw from existing work and borrowed Chai, Koh, and Tsai's (2010) term "TEL," the selection of specific tools was guided more directly by the understanding that regardless of the digital tool, it is the individual that must be the change agent. In this vein, the intent behind the design was three-fold: (a) to expose students to a variety of tools that could be integrated into K-12 classrooms to enhance teaching and learning; (b) to model integration of a variety of tools in teaching course content, and (c) to create a student-centered,

collaborative learning environment that would model how learning spaces could be transformed and ensure that the students acquired the skills required to teach a diverse student population (see Appendix B for the TEL Instructional Sequence and Appendix C for the TEL Course Calendar).

Participants in the TELs face-to-face group included those students enrolled in a section taught through in-person, bi-weekly meetings. These students were engaged in a series of authentic learning tasks specifically designed to incorporate use of technology into the course. These learning experiences included the following:

1. Development of a digital space to support a community of practice (see Appendix D for Ning Assignment Description).

2. Blogging for critical reflection on content and course topics.

3. Activities that require students to integrate use of technology into lesson plans (see Appendix E for Planning Matrix Assignment Description and Rubric).

4. Collaborative participation in Wiki creation (see Appendix F for Wiki Assignment Description and UDL Educator Checklist).

5. Instruction and activities including the educator checklist on Universal Design for Learning (UDL).

6. Modeling of digital tools including UDL Book Builder, integration of IRIS modules on a variety of course topics, cell phones for participation, streaming video for authentic classroom experiences.

Communities of practice. The Ning platform was selected as a digital tool to integrate into Group 1's experiences to extend and support the community of practice beyond the physical classroom space. Ning was selected for this purpose for several reasons. First, Ning is an online learning space that is user-created and allows the course to model participatory and student-centered pedagogy believed to be facilitated by TPACK. The instructor worked to create an "architecture of participation" (O'Reilly, 2004) and to encourage the students to find their voices and contribute to the collective intelligence. The integration of this type of social platform was also informed by Wenger (1998). Wenger believed, much like Vygotsky (1978), that learning was ultimately a social activity and could be supported by creating communities of practice. Second, the instructor had used the Web 2.0 tool in the course prior to the spring 2011 semester and the experience of that digital space had received favorable comments from students that had participated. The students had reported finding the environment easy to navigate and useful for creating and sustaining a sense of community among course participants. In previous semesters, the instructor had learned to use and model all of the features of the Ning platform and could easily answer questions and deal effectively with issues generated by students new to the platform. Third, the Ning platform was integrated into Group 1's course experience because the platform mirrors Facebook – a social networking site that has become ubiquitous. The primary benefit of the similarities between the two tools was that there would not be as much of a learning curve for most of the students. The similarities themselves allowed the

type of environment that the instructor wished to create – one that allowed members to share personal and professional information; personalize their experience through photos, videos, and page design; post status updates and easily share links; use of a discussion board; and could easily be linked to other social media sites such as Twitter for more advanced users. The fourth reason that Ning was incorporated was that it met all of the criteria for the assignments and embodied the technology best suited for the course experience and learning goals.

In order to facilitate creation of the online space, each student received a hard copy of the Ning assignment description. This description was discussed during class and also provided in digital format in the Blackboard course shell. During the class discussion, the Ning site was projected and the instructor demonstrated how to navigate the site, how to upload videos, and the links to follow to access blogs. Students had the opportunity to ask questions regarding the space and were encouraged to use the site for discussions and to share resources above and beyond what was required for the assignments. The first assignment was for participants to join the community, create a user page, and to upload a recent photo. Participants were also encouraged to share other photos and links on their individual pages. The site was then used throughout the semester as a platform for student blog posts; wiki participation; and sharing of photos, links, and discussions. The assignment description is included as Appendix D and includes the description of the site provided to participants, a screenshot of the layout, and the blog assignments.

Blogging. The Ning platform allowed a digital space for students to maintain individual blogs. There are many different tools for self-publishing, or blogging, and many environments incorporate a blogging feature. Ning allows members to compose, edit, and publish blog posts to individual pages and maintains a running feed of recent posts on the main page of the community. Members can also peruse other participants' writing, make comments on posts, and continue conversations in the discussion area of the Ning platform. In addition to exposing students to a digital tool, blogging was incorporated into the course experiences for Group 1 to meet the goal of encouraging and practicing reflective practice and dialogue with peers for preservice teachers. SPE 400 is a course that brings together a diverse group of majors that will play a variety of roles in education including secondary-education majors, music majors, speech-language pathologist majors, elementary education majors, and special education majors. The blogging assignments were designed to allow each of the students to make connections between their major and the content being discussed. It also provided a platform so candidates could wrestle with current educational issues related to special needs, reform efforts, and inclusion. .

The blogging component followed some of the recommendations suggested by Wang and Hsua (2008) to facilitate successful blogging experiences. First, class discussions were linked to the blog topics and supplemental resources on the topics were provided. Second, navigating and posting using the Ning blogging tool was modeled. The authors concluded

based on their own qualitative research that blogging was effective in facilitating

in-depth discussion and expression of opinions by course participants

      Wiki. Course participants also accessed PrimaryPad through Ning to

complete a course activity using a wiki. The wiki component of the course

experience had several learning goals. At the most fundamental level, the Wiki

activity exposed students to a digital tool that is free, readily available, and easily

integrated into existing digital spaces – in this case into the Ning platform. The

activity also modeled effective use of technology to create learning experiences

that require student collaboration to construct knowledge. The Wiki activity also

facilitated the learning objectives for the course content and prompted students

to use their knowledge of Universal Design for Learning principles to evaluate

and improve upon an existing lesson plan.

      Universal design for learning. Students in Group 1 also participated in a

course module on UDL. While the two other instructors did report touching on

UDL and UDL topics, neither devoted an entire course module to the topic.

Universal Design for Learning, or UDL, is an approach to curriculum planning

that reduces barriers to learning by providing access to content for a diverse

group of learners (Rose & Meyer, 2002). Inherent to UDL is the idea that

technology plays a prominent role in providing access to content for all learners

and the UDL tools include technology that includes multiple means of

representation, engagement, and expression – the three principles of UDL.

Other UDL tools encourage educators to evaluate existing lesson plans and

design new experiences according to the educator checklist that incorporates

flexible and creative use of technology to enhance the content of the lesson.

The UDL module for Group 1 included the following:

1. Class discussion providing an overview of UDL and the three principles.

2. Connecting to YouTube during the discussion to view an animated video describing UDL and the three principles (http://www.youtube.com/watch?v=bDvKnY0g6e4).

3. Accessing the UDL book builder during the face-to-face discussion and perusing a model book while highlighting the digital text features and build-in, graduated levels of support (http://bookbuilder.cast.org/).

4. Completion of the Wiki activity on Ning that required students to use the UDL Educator Checklist to evaluate an existing lesson plan according to the checkpoints under each of the three principles. Each student also practiced design by adding materials, activities, or assessment components that could be added to enhance the lesson according to UDL standards and the checklist.

5. Instructor scaffolded participation in the wiki activity by evaluating the lesson that had been presented on UDL in the whole group discussion according to the three UDL principles.

Additionally, a screen cast was created and made available in the

Blackboard course shell, on the class Ning, and on YouTube that described the

expectations of the assignment, demonstrated how to navigate to the resources

and required components, and gave examples of the first principle – multiple means of representation. The students could access the screen cast at any time and from any place with internet access (http://www.youtube.com/watch?v=vPnjS-H3pP4).

Planning matrix assignment. One of two major assignments for the course required students to provide adaptations and supports for an individual student with special needs. The student description and IEP goals are given in the assignment and all students are required to use a technology component. For the TEL, however, the rubric was designed to require that the student use a Web 2.0 tool that supported the student or increased participation and/or learning. The original assignment did not require that the technology component provide extensive student support or facilitate student-centered learning, but the revised rubric required a higher level use of technology. The revised rubric is provided as Appendix E.

Modeling digital tools for participation and learning. Several tools and discussions that focused on digital technology and the affordances for teaching and learning were included in the TEL. These discussions were in the context of use of technology to facilitate the course content. One technology that was modeled was use of cell phones. The instructor used www.pollanywhere.com to present different types of questions on the content to review and prepare for an upcoming exam. Students used their cell phones to respond to open-ended and multiple-choice questions. Answers appeared on the display in real time and generated discussion related to the material that would be on the exam. This

activity modeled use of a common technology – the cell phone – to facilitate a learning activity in the classroom.

Video was used throughout the course experiences and in a variety of ways. The instructor made use of streaming video readily available online to reinforce and enhance the content of the course. Several of the videos featured technology as a support for learners with special needs and these examples were always highlighted in the discussions following the film. For example, in the documentary "Including Samuel," Dan Habib documents his families' experiences supporting his young son Samuel in all aspects of the community and school. Samuel has cerebral palsy which affects his mobility and communication. Students were able to see how technology was harnessed through use of communication boards, joy sticks, computers, and power chairs to reduce barriers to Samuel's full participation in school and society. Samuel's story was one that the group returned to repeatedly to discuss issues of inclusion and ways that technology can support diverse learners.

Other video employed during the course included short, informal shots of students in inclusive classrooms. The use of these videos reinforced the course content by allowing participants to view a real student in a real classroom. These videos were used repeatedly as fodder to provide examples of behaviors, instructional strategies, and diagnostic categories. The inclusion of this component of the TELs modeled for the preservice teachers how integration of video technology could enhance teaching and learning.

The course also integrated other media and content that is readily available online. These tools reinforced the course content, facilitated discussion about how technology can support learners with diverse needs, and provided interactive media for the classroom experiences. Two of the tools that were included were IRIS modules (http://iris.peabody.vanderbilt.edu/resources.html) and UDL Book Builder (http://bookbuilder.cast.org/).

Fully Online Group (Group 2)

Participants in the fully online group were enrolled in the same introductory course that was offered in a fully online format and received instruction in the same content, using the same text. The course modules were centered on the same topics as the face-to-face course, but the activities did not include specific instruction in UDL principles or activities requiring students to incorporate or reflect on the use of technology. The pedagogical tools of the course, however, were web based.

Comparison Group

The comparison group included one section of the same introductory course that was taught in a face-to-face format. This section did include a supplemental Blackboard 8 course shell, but did not incorporate collaborative, technology-enhanced approach to teaching and learning. Syllabi for each section were reviewed to determine similarities and differences in course content and experiences. Further descriptions of the groups are depicted in Table 2.

Table 2

Descriptions of the Three Groups

Group	Group Similarities	Group Differences
1	Course content Text Blackboard shell	Technology enhanced learning activities UDL content Modeling of technology
2	Course content Blackboard shell	Fully online course format
3	Course content Text	Face to face format without technology enhanced components

Instrumentation

This study used the Survey of Preservice Teachers' Knowledge of Teaching and Technology (Schmidt et al., 2009). This instrument was designed specifically for use with preservice education teacher candidates and is a self-report measure (see Appendix G for survey items). Items are Likert-style questions divided into seven subscales: 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 (TPCK).

The survey was developed to assess preservice teachers' self-assessments of the domains of the seven subscales in the TPACK instrument. Content validity was supported through item review by three nationally

recognized TPACK researchers. After rating each of the domains, these experts

convened to revise items that were identified. At the end of this process, the

survey contained 75 items over the seven domains measured. There were eight

Technology Knowledge (TK) items. Seventeen items were included in the

Content Knowledge (CK) domain and 10 questions were in the Pedagogical

Knowledge (PK) domain. The Pedagogical Content Knowledge (PCK) and the

Technological Content Knowledge (TCK) sections each contained eight survey

items. The Technological Pedagogical Knowledge (TPK) consisted of 15

questions and the Technological Pedagogical Content Knowledge (TPACK)

section was comprised on nine items. Each domain was assessed using a five-

point Likert scale. Other items included in the survey are demographic questions

and open-ended questions pertaining to faculty integration of technology.

The reliability of the survey for use with preservice elementary education

majors was supported with administration and analysis of responses with an

initial group of 124 preservice teacher candidates (Schmidt et al., 2009). The

majority of respondents in this study were elementary education majors. Data

analysis procedures included Cronbach's alpha and factor analysis on each of

the domains included in the survey (see Table 3 for Cronbach's alphas for each

of the subscales). As a result of the initial analysis, 28 survey items were

removed from the original survey leaving those items that showed strong internal

consistency reliability. Internal consistency ratings for each subscale are

reported in Table 3. The resulting survey is comprised of 47 items and the

internal consistency reliability ranged from .75 to .92 for the seven scales

included in the revised version. Finally, the relationship between the scales was examined with TPACK significantly correlated with the subscales at the .001 level.

Table 3

Internal Consistency (Alpha) For Subscales

Subscale	Internal consistency (alpha)
Technology Knowledge (TK)	.82
Content Knowledge (CK)	
Math	.85
Social Studies	.84
Science	.82
Literacy	.75
Pedagogical Knowledge (PK)	.84
Pedagogical Content Knowledge (PCK)	.85
Technological Content Knowledge (TCK)	.80
Technological Pedagogical Knowledge (TPK)	.86
Technological Pedagogical Content Knowledge (TPACK)	.92

Data Collection

The survey was administered online. Participants accessed the survey from a link in the Blackboard course shell and no personal identifying information

was included. Surveys were coded according to group membership and demographic questions were general in nature to protect participant identity. Participants were asked to code survey responses with the month of their birth, the month of their mother's birth, and the first two letters of their city of birth. These codes were included in order to match pre-post test survey results for individual participants, but were not used because few participants coded the surveys correctly. Survey Monkey does have the capacity to pair IP addresses with specific responses, but this information was not collected from participants so confidentiality was maintained.

<div align="center">Data Analysis</div>

SPSS was used to analyze the differences in the group means according to the hypotheses to determine if there was a difference between the three groups and in pre/post test scores for the TEL group (Group 1). In order to determine if a significant difference existed between pre and post test scores for Group 1, a MANOVA was used with only the data from Group 1. A MANOVA assessed overall differences on the seven subscales between all three groups, however the hypotheses dealt specifically with only six of the subscales. The two independent variables included in the analysis were group and time – with time being either the pre or post test survey completion. Participants were coded according to group and pre or post survey response. A factorial MANOVA is appropriate when the study design includes more than one independent and dependent variables. Line graphs of the data were used to interpret interaction effects. The MANOVA was followed by *post hoc* analysis on the group variable*.*

Post hoc tests included Bonferroni and Tukey (Field, 2009). Lavene's test was also used to test the assumption of homogeneity of variance. This test is helpful in detecting significant variance between groups and to determine if the data set has violated the assumption of homogeneity of variance that is inherent to MANOVA. If this test is significant for any of the subscales, then it is assumed that the assumption of homogeneity of variance has been violated. Because this test is quite sensitive to differences between groups, especially in larger sample sizes, Hartley's F-Max was also used for more information on the differences between groups (Field, 2009).

<div align="center">Summary</div>

This chapter gave information on the methods used to complete this research. Each component of the study was described in detail including the subjects, instrumentation, data collection, and data analysis. The procedures for data collection and statistical analysis were described. The following chapters will provide a description of the results as well as a discussion of the findings.

CHAPTER IV

RESULTS

This study examined the impact of instructional strategies and format of course experiences on preservice educators' level of TPACK. TPACK is presented by Mishra and Koehler (2005) as the complex and situated knowledge that includes three distinct types of knowledge: pedagogical knowledge, technological knowledge, and content knowledge. This type of knowledge is considered a prerequisite to effective technology integration and is used as a framework to examine course experiences and the impact on design in preservice teachers' level of knowledge.

Participants' level of TPACK was measured using the Survey of Preservice Teachers' Knowledge of Teaching and Technology. This instrument is a 147-item, self-report measure. The relationship between group membership in three different sections and designs of the same introduction to special education course and pre/post levels of TPACK was investigated. This chapter describes the analysis employed and reports the findings. Therefore, Chapter IV includes the organization of data analysis, presentation of descriptive characteristics of participants, research questions and hypotheses with analysis of data, and summary.

Organization of Data Analysis

The data was analyzed in several steps. First, descriptive statistics were obtained and inspected for any outliers, improbable scores, or missing data. Based on this analysis, five responses required investigation in the original data

source and three were averaged by hand. Two of these were incomplete and not included in the analysis and three required averaging. These three occurrences were simple issues with data import from Excel to SPSS. Second, the subscale data was transformed into new variables that represented each participant's mean for each of the subscales. Next, a one way MANOVA was used to analyze the differences between Group 1 pre and post test scores and then a two way MANOVA was used to examine the differences between all three of the groups according to the group of the respondent and the time of survey administration. Finally, one way MANOVAs were used to follow-up and further investigate the differences between groups. Plots were also visually inspected to provide additional information on the differences between groups.

Presentation of Descriptive Characteristics of Participants

Survey responses were collected from 159 participants during pre-survey data collection, with 140 of those also participating in post-survey data collection. The breakdown of number of participants per group for both pre and post survey is presented in Table 4.

Table 4

Number of Participants in Groups 1, 2, and 3

	Group 1	Group 2	Group 3	N
Time 1	66	65	28	
Time 2	68	47	25	

Table 4 (continued).

	Group 1	Group 2	Group 3	N
Total	134	112	53	
				299

Of the participants that completed the pre-survey, 61% reported taking at least

one technology course.   A little over 87% percent of respondents were female

and 12.6% were male. Of those completing the initial survey, 51.6% reported

being in the fourth year of post-secondary study, 37.7% were in the third year,

9.4% were in the second year of study, and 1.3% were enrolled in their first year

of course study. The majority of participants were Elementary Education majors

(59.1%). The percentage breakdown for all participating majors is presented in

Table 5.

Table 5

Percentage of Participants According to Major

Major	Percentage of Participants
Elementary Education	59.1
Special Education	9.4

Table 5 (continued).

Major	Percentage of Participants
Speech Pathology & Audiology	8.2
Music Ed.	3.8
Human Performance and Recreation	3.1
Technology Ed.	1.3
English	5.7
History	.6
Mathematics	4.4
Other	2.3
Total	96.6

Participants were assigned a group based on the section of the course in which they were enrolled. Group 1 included participants enrolled in the face-to-face section that included Technology-Enhanced Learning (TEL). Group 2 participants were enrolled in the fully online sections of the course and Group 3 participants included those students enrolled in the face-to-face comparison group that did not include TEL. The numbers of participants in each of the groups, the number of responses for pre/post, the means, and standard deviation for each subscale is presented in Table 6.

Table 6

Pre/Post Means and Standard Deviations by Group and Time

Subscale	Time	Group	Mean	Standard Deviation	N
TK	1	1	3.59	.81	66
		2	3.46	.70	65
		3	3.65	.66	28
		Total	3.55	.74	159
	2	1	3.68	.59	68
		2	3.53	.74	47
		3	3.55	.54	25
		Total	3.60	.63	140
CK	1	1	3.68	.54	66
		2	3.72	.47	65
		3	3.70	.60	28
		Total	3.70	.52	159
	2	1	3.85	.50	68
		2	3.69	.53	47
		3	3.70	.60	28
		Total	3.8	.52	140
PK	1	1	3.74	.52	66
		2	3.89	.68	65
		3	3.92	.63	28
		Total	3.8	.64	159
	2	1	4.02	.42	68

Table 6 (continued).

Subscale	Time	Group	Mean	Standard Deviation	N
		2	3.86	.70	47
		3	3.86	.59	25
		Total	3.88	.60	140
PCK	1	1	3.39	.65	66
		2	3.58	.54	65
		3	3.60	.76	28
		Total	3.51	.63	159
PCK	2	1	3.80	.51	68
		2	3.65	.59	47
		3	3.65	.54	25
		Total	3.73	.54	140
TCK	1	1	3.31	.77	66
		2	3.53	.56	65
		3	3.50	.62	28
		Total	3.44	.67	159
	2	1	3.89	.61	68
		2	3.70	.63	47
		3	3.76	.53	25
		Total	3.80	.60	140
TPK	1	1	3.86	.77	66
		3	3.87	.56	28

Table 6 (continued).

Subscale	Time	Group	Mean	Standard Deviation	N
		Total	3.92	.64	159
	2	1	4.22	.47	68
		2	3.97	.56	47
		3	3.94	.63	25
		Total	4.09	.54	140
TPACK	1	1	3.65	.63	66
		2	3.77	.48	65
		3	3.59	.58	28
		Total	3.69	.56	159
	2	1	3.98	.48	68
		2	3.78	.49	47
		3	3.77	.68	25
		Total	3.87	.53	140

Analysis of Assumptions

The assumptions of ANOVA, as with all parametric tests, include homogeneity of variance, normal distribution of scores within groups, and independent observations (Field, 2009). To determine if the assumption of

homogeneity of variance was violated, Levene's test was conducted. Using a $p<$

.05 value for the determination of significance, this analysis yielded non-

significant values for the overall model for all subscales except the pedagogical

knowledge scale $F(5, 293) = .025$. Levene's test is sensitive to variance

between groups, so this significant value was followed up with a Hartley Fmax

test. According to Field (2009), the critical value for sample sizes over 60 is

below 1.85 and the ratio of the variances between groups was below this 1.6,

which is below the critical value. This additional information supports the

conclusion that the threat of inflated Type I error due to a significant Levene's

test is not concerning.

Research Questions and Hypotheses

The research examined the following research questions:

1. Is there a relationship between instructional methodology and activities
   using technology tools for collaborative learning and preservice teacher
   candidates' level of the complex knowledge (TPACK) required to
   successfully integrate technology in the K-12 classroom?

2. Are there differences between groups of in preservice teacher candidates'
   level of TPACK as a result of group membership in either a technology-
   infused course experience, a fully online course experience, or students
   that participate in the comparison group?

Statement of Hypotheses

H1: There will be an increase in post- test scores on Technology

Knowledge (TK), Pedagogical Knowledge (PK), Technology Content

Knowledge (TCK), Technology Pedagogical Knowledge (TPK), and

Technology Pedagogical Content Knowledge (TPACK) for those students

that participate in the face-to-face section that systemically incorporates

and models use of technology and presents content on UDL and Web 2.0

(Group 1).

A MANOVA was used to compare the mean for each subscale for Group 1 on

pre and post test results. The results indicated a significant difference between

scores on the pre and post test scores on the pedagogical knowledge subscale

$F(1, 132) = 10.04$, $p = .002$, $\eta^2 = .071$; the pedagogical content knowledge

subscale $F(1, 132) = 16.76$, $p<.001$, $\eta^2 = .113$; the technological content subscale

$F(1, 132) = 23.51$, $p< .001$, $\eta^2 = .151$; the technological pedagogical knowledge

scale $F(1, 132) = 11.03$, $p = .001$, $\eta^2 = .078$; and the technological pedagogical

content subscale $F(1, 132) = 10.90$, $p = .001$, $\eta^2 = .076$. The means and

standard deviations for this analysis are presented in Table 7.

Table 7

Group 1 Pre- and Post-Test Means and Standard Deviations for Subscales

Subscale	Time	Mean	Standard Deviation	N
TK	1	3.5931	.81016	66
	2	3.6823	.58556	68

Table 7 (continued).

Subscale	Time	Mean	Standard Deviation	N
CK	1	3.6818	.49789	68
	2	3.8517	.49789	68
PK	1	3.7403	.58817	66
	2	4.0189	.41807	68
PCK	1	3.3939	.65348	66
	2	3.8088	.62022	68
TCK	1	3.3106	.76719	66
	2	3.8897	.75713	68
TPK	1	3.8576	.75713	66
	2	4.2206	.46890	68
TPACK	1	3.6537	.62850	66
	2	3.9727	.48257	68

H2: Students that participate in TEL course experiences (Group 1) will

have higher scores on Technology Knowledge (TK), Pedagogical

Knowledge (PK), Technology Content Knowledge (TCK), Technology

Pedagogical Knowledge (TPK), and Technology Pedagogical Content

Knowledge (TPACK) when compared to students enrolled in a face-to-

face section that does not systematically incorporate and model use of

technology.

H3: There will be a difference in TPACK scores between candidates that

participate in a fully online class (Group 2) and those that participate in the

face-to-face comparison group (Group 3).

The graphed means (presented in Figures 2 – 4) of the groups according

to the pre and post survey administration demonstrate that the scores on the

survey increased and, when time 1 is compared with time 2 in an analysis that

includes all 3 groups, the variance attributable to the interaction does reach

significance for three of the subscales:

pedagogical content knowledge $F(2, 293) = 3.231$, $p = .041$, $\eta^2 = .022$,

technological content knowledge $F(2, 293) = 3.534$, $p = .029$, $\eta^2 = .024$, and

technological pedagogical content knowledge $F(2, 293) = 3.42$, $p = .034$, $\eta^2 =$

.023. The means and standard deviations for the significant subscales are

depicted in Table 8.

Table 8

Means and Standard Deviations for Significant Dependent Variables in Factorial

MANOVA.

Subscale	Time	Group	Mean	Standard Deviation
PCK	1	1	3.39	.65
		2	3.58	.54
		3	3.60	.76
	2	1	3.80	.51
		2	3.65	.59
		3	3.65	.54
TCK	1	1	3.31	.77
		2	3.53	.56
		3	3.50	.62
	2	1	3.89	.61
		2	3.69	.63
		3	3.75	.53
TPK	1	1	3.86	.76
		2	4.00	.52
		3	3.87	.56
	2	1	4.21	.47
		2	3.97	.56
		3	3.94	.63

Note. PCK = Pedagogical Content Knowledge, TCK = Technological Content Knowledge, and TPK = Technological

Pedagogical Knowledge.

There was not a significant interaction between group and time on the technological knowledge, pedagogical knowledge, or the technological pedagogical knowledge subscales. Complete factorial MANOVA results are presented in Table 9.

Table 9

Factorial MANOVA for Groups 1, 2, and 3 on Pre/Post-Test

Source	Subscale	F	Sig.	Partial Eta Sq
Time*group	TK	.348	.707	.002
	CK	1.21	.301	.008
	PK	2.65	.071	.018
	PCK	3.23	.041	.022
	TCK	3.58	.029	.024
	TPK	3.43	.034	.023
	TPACK	2.471	.086	.017

Note. TK = Technological Knowledge, CK = Content Knowledge, PK = Pedagogical Knowledge, PCK = Pedagogical Content Knowledge, TCK = Technological Content Knowledge, TPK = Technological Pedagogical Knowledge, and TPACK = Technological Pedagogical Content Knowledge.

Further analysis of the plotted means revealed that for each of the significant subscales, Group 1 showed higher means on each of the significant subscales when compared to Groups 1 and 2. The plots for the subscales are provided in Figures 4 - 6.

Figure 4. Plotted means for each group for Time 1 and 2 on the PCK subscale.
Group 1 = Technology-enhanced learning group, Group 2 = fully online, Group 3
= face-to-face without technology-enhanced learning. TPK = Technological
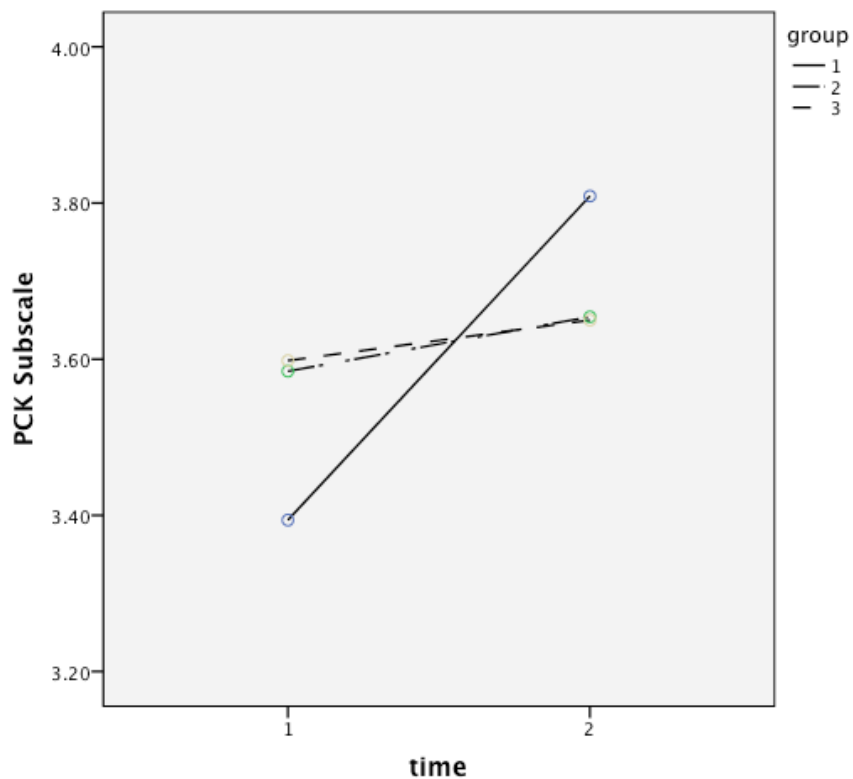Pedagogical Content Knowledge.

Figure 5. Plotted means for each group on Time 1 and 2 on the TCK subscale. Group 1 = Technology-enhanced learning group, Group 2 = fully online, Group 3 = face-to-face without technology-enhanced learning. TCK = Technological Content Knowledge.
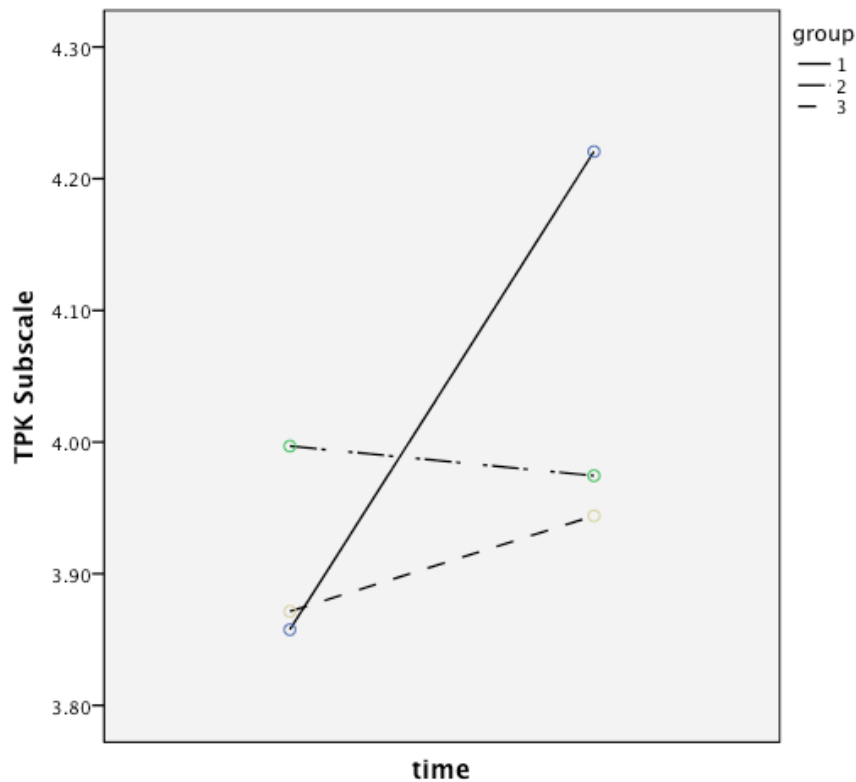
Figure 6. Plotted means for each group on Time 1 and 2 on the TPK subscale. Group 1 = Technology-enhanced learning group, Group 2 = fully online, Group 3 = face-to-face without technology-enhanced learning. TPK = Technological Pedagogical Content Knowledge
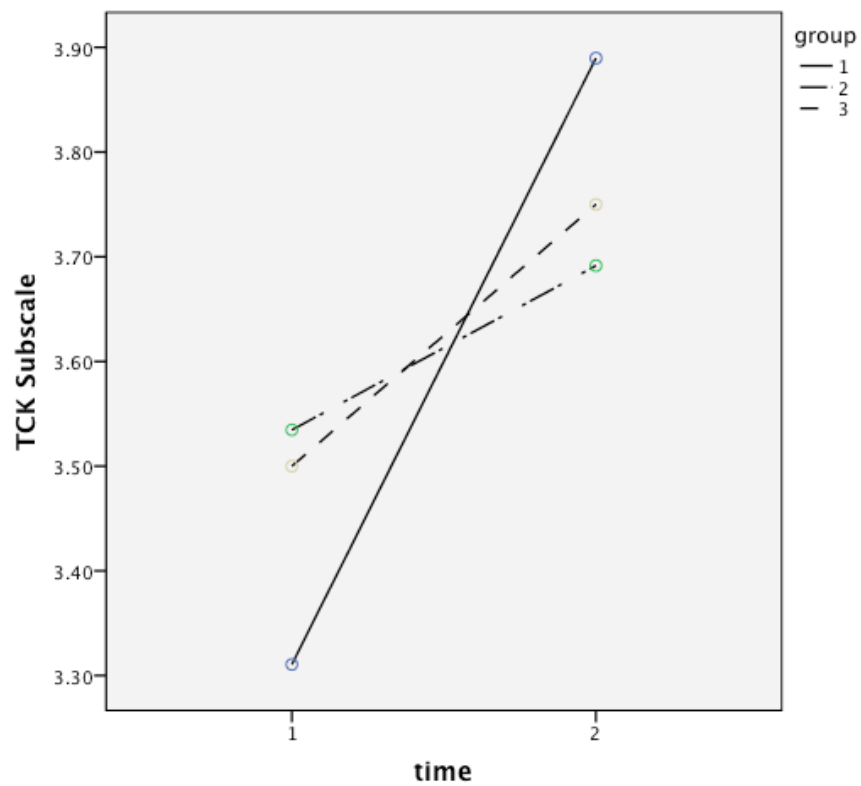
H4: There will be no difference in pre- and post- TPACK scores for students enrolled in the comparison group (Group 3).

A MANOVA showed non-significant results when pre and post test scores for Group 3 were compared. Table 10 presents the MANOVA comparison for Group 3.

Table 10

MANOVA Results for Pre and Post Scores for Group 3.

Source	Subscale	F	Significant	Partial Eta Squared
Time	TK	.32	.58	.006
	CK	1.00	.32	.019
	PK	.18	.68	.003
	PCK	.08	.78	.002
	TCK	2.48	.12	.046
	TPACK	1.20	.28	.023

Note. TK = Technological Knowledge, CK = Content Knowledge, PK = Pedagogical Knowledge, PCK = Pedagogical Content Knowledge, TCK = Technological Content Knowledge, TPK = Technological Pedagogical Knowledge, and TPACK = Technological Pedagogical Content Knowledge.

Summary

This chapter presented the results of analysis of data on Groups 1, 2, and 3 on pre and post test survey administration. The information included descriptive information on the participants and the organization of the data analysis that included a factorial MANVOA and follow-up plot analysis and MANOVAs to discern differences from pre and post administration for each of Groups 1 and 3. In the overall model, three of the seven subscales were significant and the plotted means showed the highest mean for each subscale in Group 1 giving more insight into the differences between groups identified by the

analysis. The comparison of Group 1's pre and post-test scores yielded

significant results for five of the six subscales under consideration while the pre

and post-test difference for Group 3 did not reach significance.

CHAPTER V

FINDINGS, CONCLUSIONS, AND IMPLICATIONS

Research on technology integration supports the supposition that technology is not successfully integrated at any level of the P-16 educational system. The literature called for efforts to identify and then implement effective course experiences at a preservice level to better equip teachers to use technology to capacity and realize the potential that the tools have for enhancing teaching and learning by increasing levels of TPACK. This study examined the relationship between instructional strategies in different course experiences and preservice educators' level of TPACK. This chapter first gives a summary of the study and presents the findings from the statistical analysis of the data. A discussion of the conclusions and implications provide connections between the research and the larger context of previous and current work in the area of technology integration, innovative learning spaces, and new literacy skills. Suggestions for future work are provided and shaped by the conclusions, implications, and the current work across disciplines. Finally, a summary is provided.

Summary of the Study

This research used a quasi-experimental design to gauge the impact of group membership in one of three course formats on preservice educator candidates' level of Technological Pedagogical Content Knowledge – the complex skill set believed to be necessary for successful and student-centered technology integration (Mishra & Koehler, 2006). There were 159 respondents in the pre and 140 of those participants also completed the post test administration.

The three groups, all participating in different sections of the same course, included a group that completed a Technology-Enhanced Learning (TEL) experience, a group that took the course in a fully online format, and a group that completed a face-to-face format without explicit technology instruction and modeling.

Summary of Findings

A factorial MANOVA and two one way MANOVAs were used to analyze the data according to the research questions. Research questions included: (a) does instructional methodology and the use of technology tools for collaborative learning increase preservice teacher candidates' level of the complex knowledge (TPACK) required to successfully integrate technology in the K-12 classroom? and (b) are there differences between groups of preservice teacher candidates' level of TPACK as a result of group membership in a technology-infused course experience, a fully online course experience, or students that participate in the comparison group?

The MANOVA results that compared pre and post test scores for Group 1 revealed a significant change between survey administrations. Further analysis of the means and the plotted data showed that the differences were attributable to an increase in TPACK scores that reached significance for five of the six subscales of interest.   The subscales with the significant change from pre to post included pedagogical knowledge, pedagogical content knowledge, technological content knowledge, and technological pedagogical knowledge, and technological pedagogical content knowledge.

The same type of analysis was performed with the data from Group 3 (face-to-face comparison group) to determine if this group showed significant increases in scores from pre to post test measures. This group did not show a significant increase on any of the six TPACK subscales.

A factorial MANVOA was employed to compare Group 1 results with the scores of the groups enrolled in the fully online sections and the face-to-face section that did not incorporate TEL. The plotted means revealed higher scores for Group 1 on all subscales, but those differences only reached significance in three of the six subscales under consideration. The significant subscales included technological content knowledge, pedagogical content knowledge, and technological pedagogical knowledge.

Conclusions

The imperative for this work is multifaceted and conclusions should be couched in these priorities. First, acquisition of TPACK skills for teacher candidates is essential for seamless and effective technology integration in the K-12 setting. This integration is a prerequisite to adequately preparing K-12 students to participate in a global economy that situates the workforce in environments that are collaborative and reliant on constantly evolving tools. Second, facilitating and modeling TPACK skills supports and encourages instructional practices that transform the classroom space into a student-centered, participatory environment. This type of learning space both models the practices and effectiveness of innovative approaches and encourages participants to gain a deep understanding of the course content. Third,

effectively shaping future educators' ability to design and implement powerful lessons that capitalize on digital tools prepares a cadre of teachers that are prepared to assume the role of change agent and, especially for those students in high poverty schools, inspire students to be active, participatory citizens through access and understanding.

There are several conclusions that can be drawn from the results of this study. After analysis of the data, both of the research questions were answered in the affirmative. The TEL strategies were effective in increasing participants' level of TPACK on five of the six subscales as measured by the survey, and group membership did have implications for the scores. When compared with participants enrolled in the other two groups, those in the TEL group displayed greater gains in TPACK skills and those gains reached significance for three of the subscales in the survey when all three groups are included in the analysis. Further examination allows for a more nuanced discussion. This discussion begins with the differences between pre and post test scores for Group 1 which are presented with conclusions germane to the findings. The role of each of the TEL components is discussed including communities of practice and blogging for critical reflection, design activities, UDL content, and other modeled technologies. Next, the results of the factorial MANOVA comparing the pre and post test scores of all three groups are scrutinized with remarks on noted differences in course design that may have contributed to the different outcomes. The final conclusion that is presented is drawn from the non-significant change in pre and post test

scores for Group 3 to examine possible explanations for lack of significant gains in skill level of participants.

TEL (Group 1) Pre and Post Scores

The TEL group did not show a significant increase in technological knowledge from pre to post test administration. It was the one subscale under consideration in this study that did not display a significant increase in scores when the TEL group data was examined. This finding lends itself to two conclusions. First, the participants in this study brought a level of technology knowledge that was consistent and, according to the means on a 5 point scale (pre = 3.5, post = 3.6), fairly robust. The second conclusion that can be drawn from this data is that the domain of technology knowledge was not increased by the TEL course experiences or in the face-to-face comparison group.

There have been several authors that have argued that technology knowledge alone does not guarantee successful use of technology for teaching and learning (Mishra & Koehler, 2005; Sandholtz & Reilly, 2004). The data for the TEL group seems to support the idea that technology knowledge does not equate with the more complex overlap of this knowledge domain with the domains of content and pedagogy because the subscales that measured the overlaps of these forms of knowledge did show a significant increase from pre to post test administations even though the technology knowledge domain did not. The participants did not experience a huge growth in their technology knowledge as a result of participation in the course, but this did not prevent the skills measured by the other subscales from realizing a significant increase. This

could be attributable to the course design in that the course is not an ICT or educational technology course. The technologies that were employed were integrated into the content and either modeled or used by participants to accomplish an objective such as sharing a blog post.

Each of the other subscales showed a statistically significant increase when the TEL pre and post test scores were compared. The course design was highly effective in increasing participants' levels of self-reported skills and provided a replicable model for teacher educators and preservice administrations to consider as programs answer the numerous calls for reform or, as Futrell (2010) urged, to transform current practice. It is difficult to discern the effect of any one component of the TEL on participants' TPACK, so the entire model is believed to have contributed to the significant increase in TPACK scores for the TEL group on each of the subscales except technology knowledge.

Communities of practice. This research used the Ning social networking platform to extend the face-to-face interactions to a digital space that allowed each participant to blog on topics related to the course materials, share videos, create a homepage with photos, and interact with peers through discussions and comments on blogs posts. The success of this space reiterated Wenger's (1998) ideas about the benefits of creating communities of practice and other work showing the benefits of blogging for reflection and community. For example, Yang (2009) investigated the use of blogs to facilitate critical reflection and to build a community of practice and concluded, like Stiler and Philleo (2003), that blogs were useful for reflective practice. The Ning space proved beneficial

because it provided individual student blogs housed on one platform that could be easily accessed by other participants. Additionally, the participants were able to share their thoughts on a number of topics and many related personal experiences that connected to the material. This allowed the classroom community to be extended through personal student writing enhanced by photos that the participants opted to share with the group. The space allowed other opportunities to build community as well. Participants shared music selections, links of interest, comments on peers' blogs posts, and the results of a multiple intelligences survey. Each of these activities strengthened the community of practice as participants were encouraged to actively share their own knowledge, experiences, preferences, and personality through this digital space. In addition to these benefits, the Ning platform housed the links to the collaborative Wiki activity.

Design activities. Previous work had demonstrated the positive impact of design activities in preservice and graduate education on participants' level of TPACK (Chai, Koh, & Tsai, 2010; Koehler & Mishra, 2005). Two components of the TEL were conceptualized as design: the UDL educator checklist that was completed on a collaborative wiki and the planning matrix assignment. Each of these activities challenged participants to think about how technology might be used to facilitate learning. The UDL checklist was especially unique and a potent learning tool because it used a Web 2.0 tool to model a collaborative activity and prompted participants to brainstorm ways to provide multiple means of representation, engagement, and assessment. Many of the activities and

materials that the candidates added to the checklist were ideas and activities that capitalized on digital tools.

Universal design for learning. The module on UDL set the stage for much of the dialogue within the community about the affordances of various technologies and how those tools can be harnessed to provide access for all learners. This component of the TEL was especially effective because it introduced participants to the three principles of UDL, included a reflective blog post on the topic, and encouraged participants to think about lesson planning in an entirely new and different way. UDL encourages flexible and creative planning. Technology is inherent to the principles because it provides a malleable and flexible presentation of content, heightens engagement and interest, and provides options for assessing student knowledge. This content led to numerous class discussions and examples surrounding UDL and technology use as a support for diverse learners and as a tool to alter the classroom milieu in a manner that is more conducive to learning for all students. During class, UDL Book Builder was also featured as one tool that provides support for various learning styles and needs and this demonstration led to numerous conversations about barriers in print based curriculum and other instructional materials. Once the module was completed, the dialogue continued to return to UDL as students completed the planning matrix assignment, watched videos and discussed strategies modeled in inclusive classrooms, and reflected on their own experiences in the course where UDL planning was evident.

Other technologies. Modeling of other technologies during the course also proved effective and contributed to the increase in TPACK scores for the TEL group. One particularly successful activity included use of student cell phones and www.pollanywhere.com to review for an upcoming exam. Participant engagement was high during this activity and many of the TEL group were able to articulate ways that the tool could be used in a K-12 classroom and the benefits of mobile technology as a teaching and learning tool. The approach that was quite effective for the live polling, interactive video, and web based modules such as IRIS was modeling the tools to teach content and discussing ways that the tool could be integrated into learning activities in the K-12 environment during the modeling rather than going through the technical aspects of the technology itself. This approach translated into a good deal happening within each learning activity, high energy in the classroom, and active engagement from participants.

Comparison of the Three Groups

When the TEL group was analyzed and compared to the face-to-face without TEL and the fully online sections, significant differences emerged between the groups' scores on three of the subscales: technological content knowledge, pedagogical content knowledge, and technological pedagogical knowledge. The plotted means clearly support the conclusion that the TEL group means explain most of this variance between groups with consistently higher scores on the post-test and a greater change between administrations. The TEL model was the most effective model in significantly increasing TPACK scores on

three of the six subscales when compared to the fully online and face-to-face without TEL models.

The TEL course design was better able to positively impact TPACK skills than the fully online course format. This finding is especially interesting in light of the increasing number of university courses that are moving to a fully online format. The online format in this examination did not adequately prepare preservice teachers to successfully integrate technology for teaching and learning when the TPACK survey was used to gauge skill level. This research did not employ a hypothesis specific to the online group because there is limited literature connecting online learning experiences with TPACK skills. This lack of literature on facilitating TPACK using fully online course formats makes the results of this study particularly germane to current work since the majority of emerging work measured the impact of face-to-face course models using different strategies.

The two fully online sections in this study used many of the tools that are available in the course management system. These included threaded discussions and blog posts – both with potential for creating a community of practice. The online sections embedded a variety of materials into the modules and one of the section made use of video and linked outside the course shell to web-based IRIS modules. Despite the use of technology to complete all aspects of the course, the format did not increase participants' skill level. This finding may be attributed to the lack of UDL content and the absence of active dialogue about technology including ways to wield it in teaching and learning situations.

Moreover, there was no evidence that either of the online sections incorporated design activities or used the digital tools available in the course management system or on the web to craft collaborative activities for knowledge construction.

The effectiveness of the TEL group was also examined by comparing the pre and post test scores of participants enrolled in Group 3 (the face-to-face comparison group). This analysis did not show any significant changes in TPACK skills on any of the subscales for this group. The course design did not increase participants' level of TPACK and this finding urges revaluation and reflection on the part of teacher educators about how to best incorporate technology in course experiences in meaningful ways that may deviate from more traditional learning activities. There was little evidence in this face-to-face comparison group of technology use other than for projection. Design activities were not incorporated, a module on UDL was not included in the course, and technology was not seamlessly integrated or modeled as a plethora of tools to build collaborative work spaces. According to other work, this finding is the norm rather than the exception. Preservice education courses and programs have been indicted by researchers for poor technology integration and inadequate preparation of teachers to integrate technology (Belland, 2009; Futrell, 2010; Gotkas, Yildirim, & Yildirim,

2009).

<div align="center">Implications</div>

These conclusions have implications that inform both immediate practice in the preservice classroom, and also have potential to shape changes in

learning spaces from more teacher-directed experiences to learning activities that allow active participation, collaboration, and knowledge construction. This potential shift is furthered when digital tools are used to facilitate student-centered practice. Student-centered experiences that capitalize on the affordances of available technologies not only broaden access of the curriculum to students with diverse abilities, but also allow acquisition of skills necessary to successfully participate in the 21st century as active, engaged, and informed citizens (Futrell, 2010; NETP, 2010). Implications are organized according to the conclusions presented in the previous section and include the potential impact of the TEL course model and the fully online sections. These results are also discussed within the potentially broader impact of transforming classroom spaces and addressing issues of digital equity.

TEL Course Model

Existing literature has bemoaned the ineffectiveness of a stand-alone technology course in adequately preparing preservice candidates for technology integration (Choy, Wong, & Gao, 2009). Authors have suggested that providing models of effective technology use for pedagogically sound instruction (Bai & Ertmer, 2008) and including technology in content area courses constitute an approach that should prove much more effective (Judge & O'Bannon, 2008). The current study provided support for an integrated approach to technology modeling in a course that was not an instructional technology course. The model that was implemented, referred to as "TEL," was effective according to the analysis and is replicable. The impact of this model on the participants' level of

TPACK provided preservice educators and administrators with information on digital tools and teaching strategies that can be employed to improve upon preservice experiences. These experiences better prepare candidates for technology integration and may be more effective than other course formats. Tools can be matched with course objectives and used to create innovative learning activities and assignments. Incorporation of digital tools also extended the community of practice and demonstrated learning activities that used technology for collaboration and knowledge construction. These types of activities can be integrated into any course in the education sequence to boost the skills of participants and also to provide richer, more engaging course experiences.

In the current study, scores were significantly impacted after only 8 weeks of course experience in one course – except scores on the technology knowledge subscale. The implication of this finding for program evaluation and design is that other course formats and instructional activities should be considered to specifically target technology skills. The caveat to this implication is that the participants may have a solid technology background and lack of change may be attributable to a robust preexisting skill set. In this scenario, supported by examination of the means on this subscale, the implication for practice includes a tailoring of course technology experiences to the skill level of participants and providing more technical instruction to those students that do not have adequate technology knowledge.

Fully Online Course Design

According to the analysis of survey data, the fully online course was not effective in increasing TPACK scores even though all course experiences rely on technology. This finding is concerning and should prompt a reevaluation of online course experiences as a format for effectively preparing preservice candidates to integrate technology while keeping in mind that the data here only represent two sections of a fully online course. Minimally, activities that are integrated into these digital spaces should be planned according to the TPACK framework to evaluate how the online course technology is used and consider ways to improve upon the experiences. One way to accomplish that may be to incorporate some of the components included in the TEL model that allowed participants to build a community of practice through social networking platforms, collaborative assignments that use Web 2.0 tools, and more exposure to UDL principles. The only overlap in the online course designs that could be discerned through an interview with one of the instructors, through the researchers own design and implementation of one of the sections, and review of course documents was that one of the online sections did include blogs housed in the course management system.

Transforming Learning Spaces

The findings and conclusions also have implications for effective transformation of learning spaces. The potential is there because the type of situated knowledge described and assessed by the TPACK model lends itself to teachers' ability to design learning and spaces that are vibrant and innovative. There is much discussion in the literature and in public discourse about how to

best reform education, but Futrell (2010) posed the provocative question, "Do we want to *reform* or *transform* our system of education?" (p. 432). The author contrasted the two terms to illuminate the focus on transformation as change that enables the system to accomplish new things whereas reform tweaks an existing system to improve performance of existing operations. The current study was able to accomplish new things by exploiting digital tools and creating a more participatory course experience – and in turn increased participants' skills that are believed to be necessary for them to perpetuate the same models in K-12 classrooms.

The isolated success described in this work added to the momentum to examine practices at all levels of the K-16 educational system. Many classrooms are adhering to traditional modes of instruction and technology refusal or low level use that is rendering the current model obsolete. The results of this study are confirmation that efforts at a preservice level can effectively increase participants' level of TPACK. Further work is required to determine if these gains translate into educational transformation that makes classroom spaces relevant and authentic. At this point, it can be concluded and considered that concerted efforts to build a community of practice in a digital space, blogging for connections and reflection, content on UDL, and wiki collaboration contributed to increased TPACK for preservice educators. Each of these components was tailored to the learning objectives and content of the course, however many of the tools would be appropriate for many university-level courses. All of the tools were selected and used in a way that encouraged and extended the community

of practice that was created in the course and this approach could be effective across the curriculum.

Digital Equity

While the research questions in this study were not explicitly focused on low-income or disenfranchised students, the implications for these students and students with special needs were viewed as intrinsic to the work and the findings are assumed to have the potential to improve outcomes for these students. This was true for two reasons. First, while all students benefit from a shift from an "obsolete" educational model to a more student-centered and collaborative model, the potential empowerment of students from these populations is especially potent – especially when available evidence suggests that the learning activities and technology that some of these students experience are quite different from their peers. When the research on pedagogy is examined, there is a disparity between the way that technologies are used with students from different backgrounds (Solomon & Allen, 2003). In classrooms where the population is predominantly students of color, technology is most often used for skill and drill exercises whereas classrooms where the majority of students are white are much more likely to use the tools for critical thinking, construction of new knowledge, and inquiry-based learning. Second, these students are often marginalized and may not possess the requisite skills for engaged and active citizenry in the 21st century. Arming future educators with the skills necessary to fully integrate technology in a way that recreates classroom spaces is a precursor to K-12 students acquiring abilities that Gee (2010) and other scholars

have dubbed new literacy skills. New literacies are essential to participate fully in a global community and are constantly changing as new technologies emerge. Inherent to the theory of new lIteracies is the theme of active participation in society and culture – and of power. Individuals who are fluent in new literacy skills are better equipped to participate in the shifting landscape of the digital age with its focus on user-created content and self-publishing. It is no longer enough to simply teach students how to read and write – especially when we were not even doing that task very well. As Futrell (2010) concludes, "Failing to transform the system will result in more division within our schools based on race, ethnicity, and socioeconomic status" (p. 439).

Learning activities and spaces that represent this transformation become the norm rather than the exception only when educators have an exceptional command of knowledge in the three areas of technology, content, and pedagogy. Gorski (2008) said that scholars and researchers should discontinue advocacy "for a growing role of technology in education until all teachers, regardless of the composition of the students they serve, are trained to integrate these technologies in progressive and pedagogically sound ways" (p. 360). Teachers must first be fluent in wielding these tools to enhance teaching and learning if they are to usher innovation into any classroom – especially those educational spaces where technologies have not been utilized beyond rote learning. The current work provided evidence that these skills can be fostered in a preservice environment that integrates the TPACK framework through explicit modeling of use of digital tools, content on UDL, opportunities to construct their own

knowledge by using the tools, and beginning design activities that challenge

them to integrate technologies into learning activities. Therefore, the results

indicate that supporting TPACK skills and equipping teachers to assume the role

of change agent can be accomplished in a preservice setting when the TPACK

framework is used for course design.

Summary of Conclusions and Implications

Given the data collected and analyzed in this research, several

conclusions and implications were discussed. First, it was concluded that the

TEL model was effective in increasing TPACK scores for preservice candidates.

This conclusion has implications for evaluation and design of preservice courses

and provides teacher educators with quantitative data to support the

implementation of specific digital tools and experiences to support TPACK skills.

Second, technology knowledge was not significantly impacted by the TEL course

experience. This finding should translate into thoughtful course sequences that

include explicit technology instruction and tailored instruction and exposure

according to technology skill level. Third, the TEL was more effective in

increasing TPACK scores than the online course format or the face-to-face

without the TEL experiences. This indicated that both of these course formats

may require a redesign according to a TPACK model and incorporation of tools

and experiences identified by this and other research as effective if these

courses are to better prepare preservice educators to integrate technology.

Finally, the evaluation, redesign, and transformation of learning spaces has the

potential to positively impact the outcomes of all students and begin to address disparities in experiences for students from historically marginalized groups.

Suggestions for Future Research

Future work should continue to examine and attempt to discern the instructional practices that are most effective in transforming course experiences to ensure solid acquisition of the content and to capitalize on the benefits of modeling effective, engaging instruction for those individuals that will be teachers. Additionally, research should extend into the classroom to ascertain if high levels of TPACK do in fact result in effective technology integration. This work should examine lesson plans and include observation of classroom activities. As many authors have pointed out, there are distinct limitations to reliance on self-report measures (Belland, 2008). Despite this, most research in the area of technology integration has only used self-report survey instruments. The few studies that have conducted observations of classroom behaviors have found inconsistencies between professed pedagogical beliefs and instructional practices at a university level (Andrew, 2007). Research in the K-12 setting has replicated this finding (Brown & Warschauer, 2006; Frederick, Schweizer, & Lowe, 2006).

Previous work has examined the school context as a factor that inhibits technological integration, so future work should look at those teachers that are effective in spite of the system in order to identify characteristics that inspire these educators to be change agents as research indicates that novice teachers are vulnerable to the drive to conform (Roehrig, Kruse, & Kern, 2007) and most

of these contexts have not espoused an innovative approach to creating classroom spaces that use technology for facilitating student learning. This is especially germane to the current dialogue highlighted by Cochran-Smith and Power (2010) surrounding the push to reform teacher education by aligning teacher preparation more closely with state and district priorities and focusing on experiences embedded in the schools. Critics of this approach express concern that this could result in new teachers being less likely to "question the status quo and challenge current practice" (p. 12).

Lastly, research and scholarly work should accept the challenge issued by Gotski (2008) and engage in critical analysis of how digital tools are employed along gender, race, and disability category lines. These examinations require thoughtful research and dialogue around equity, access, and power distribution.

Summary

This chapter presented an overview of the study and provided a summary of the findings. These findings were discussed and conclusions provided within the context of the broader implications of the work. The TEL course experience was effective in increasing participants' level of TPACK on five of the six subscales. The design was significantly more effective in positively impacting TPACK scores on three of six subscales when the analysis compared to participants' in a fully online course and a face-to-face course that did not incorporate technology modeling and other TEL components. Additionally, the face-to-face comparison group did not show significant gains as a result of their participation in a course format that did not include TEL. These results are

important for evaluation and transformation of preservice course experiences to better equip teachers for successfully and transformative technology integration. The findings also have potential implications for improving the learning experiences of students that historically have not had sufficient opportunity to build 21st century and new literacy skills that are necessary for full and active participation in knowledge construction and later engaged citizenship. Based on the findings, conclusions, and implications the chapter also included suggestions for future work.

APPENDIX A

INFORMED CONSENT AND IRB APPROVAL

Dear Potential Participant,

I am a graduate student at The University of Southern Mississippi and am conducting research on education candidates' self-reported level of comfort and understanding of different areas of teaching. These areas include what you teach, how you teach the material, and technology. You are being asked to complete this online questionnaire to help aid in this research. If you agree to participate, then you will complete the first survey now and the second survey approximately 12 weeks from this date. There are minimal risks that may include the time it takes to complete the questionnaire. Once this research is complete, instructors may be able to use these findings to improve instructional practices related to preparing students for teaching.

Post-secondary students completing this questionnaire must be 18 or over and should be currently enrolled in SPE 400. Completion of each questionnaire should take no more than 20 minutes. Participants will not be asked to include any identifying information on the questionnaire. All data will be compiled and reports will be developed based on the information obtained from findings. The final summary reports may be published or presented in a professional venue. Any personal information inadvertently obtained during the course of this study will be kept confidential and destroyed once all information has been compiled. All participants will provide consent prior to completing the survey questionnaire.

It is important to note that participation in this research project is completely voluntary. Participation may be declined or discontinued at any point without concern over penalty, prejudice, or any other negative consequence. Refusal to participate will not have implications for your grade. Feel free to contact the principle investigator (PI) if you have any questions and/or concerns regarding this research project. You can

contact the PI through email at Shannon.haley@usm.edu or phone at 601.606.9227.

This research is being conducted under the supervision of David Walker, Ph.D. (david.walker@usm.edu). This project has been reviewed by the Institutional Review board, which ensures that research projects involving human subjects follow federal regulations. Any questions or concerns about rights as a research participant should be directed to the Chair of the Institutional Review Board, The University of Southern Mississippi, 118 College Drive #5147, Hattiesburg, MS 39406-0001, (601) 266-6820. By completing the following questionnaire, you give the above mentioned researchers permission for this anonymous and confidential data to be used for the purposes outlined above.

Thank you for your consideration and help with this project.

1. Do you agree to participate in this research study? *

(participants will indicate their agreement through use of a drop down menu. The survey will be designed sequentially so they must indicate agreement before they can access the next page)

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

Institutional Review Board

118 College Drive #5147
Hattiesburg, MS 39406-0001
Tel: 601.266.6820
Fax: 601.266.5509
www.usm.edu/irb

HUMAN SUBJECTS PROTECTION REVIEW COMMITTEE
NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Human Subjects Protection Review Committee in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months.
  Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: **C10111503**
PROJECT TITLE: **The Effect of Instructional Methodology on Preservice Educators' Level of Technological Pedagogical Content Area Knowledge**
PROPOSED PROJECT DATES: **01/01/2011 to 01/01/2013**
PROJECT TYPE: **Previously Approved Dissertation Project**
PRINCIPAL INVESTIGATORS: **Shannon Haley-Mize**
COLLEGE/DIVISION: **College of Education & Psychology**
DEPARTMENT: **Curriculum, Instruction, & Special Education**
FUNDING AGENCY: **N/A**
HSPRC COMMITTEE ACTION: **Exempt Approval**
PERIOD OF APPROVAL: **02/22/2011 to 02/21/2012**

Lawrence A. Hosman   _2-24-2011_
Lawrence A. Hosman, Ph.D.   Date
HSPRC Chair

APPENDIX B

INSTRUCTIONAL SEQUENCE FOR TEL

(Group 1)

Week 1 – 3
January 18 – March 4
Module1: Special Education and Inclusive Schooling
    Learning Objectives:

- Become familiar with Ning platform and assignment requirements
- Use features of Ning including discussion, video, links and blog posting features
- Embed hyperlinks and video into blog postings
- Identify technology as a support for communication and inclusion

Instructional Methods:

- Demonstrate Ning site and features to large group
- Discuss assignment descriptions and benefits of Ning
- Model navigation and use of various tools
- Guided practice in the computer lab
- View *Including Samuel* (features technology use by a student with special needs to communicate and participate in an inclusive setting)

Learning Activities

- User created Ning pages
- Multiple Intelligences blog post
- Inclusion blog post

Week 4
February 7 - 11
Module 2: UDL
    Learning Objectives:

- Define the three principles of UDL
- Identify the benefits of UDL planning
- Connect UDL with inclusive services
- Explore the role of technology to support UDL
- Examine interactive, web-based learning material (UDL modules and IRIS module)
- Build a digital interactive text

Instructional Methods

- Class discussion and viewing of the UDL modules, Book Builder, and Educator Checklist
- Introduce wiki assignment and model navigation and steps to editing
- Guided practice with UDL Book Builder in computer lab

Learning Activities

- Create a digital text using Cast Book Builder
- Collaborative Educator Checklist using PrimaryPad Wiki
- UDL blog post

Week 5
February 14 - 18
Module 3: Collaborating with Families and Other Professionals
Learning Objectives:

- Use a web-based resource to acquire knowledge
- Recognize design components in IRIS module that supports learning

Instructional Methods

- Modeling use of web-based technology tools to facilitate teaching and learning
- IRIS module and class discussion

Week 6
February 21 - 25
Module 4: Culturally and Linguistically Diverse Students/Differentiating Instruction
Learning Objectives

- Identify web-based resources to support teaching and learning
- Examine ways to differentiate instruction and the role of technology
- Explore technological affordances and pedagogical practices

Instructional Methods

- Model use of web-based streaming video resources to facilitate content
- Edutopia video featuring technology integration and project-based learning at an elementary schools

Week 7
February 28 – March 4
Module 5: Promoting Social Acceptance and Managing Student Behavior
Learning Objectives

- Identify ways to support learning with web based resources

- Link presentation of content to UDL principles

Instructional Methods

- PBIS graphic organizer
- PBIS video
- Class discussion

Week 8
March 7 – 11

Learning Objectives

- Identify web-based resources to support professionals in inclusive settings
- Use blog tools to share information

Learning Activities

- Resources blog posts with hyperlinks and embedded video

APPENDIX C

TEL (GROUP 1) CALENDAR

Date	Topic and Objectives
Week of Jan. 18 - 21	Getting Started: Introduction to the Course **Learning Objectives:** *Become familiar with course description, content and requirements* *Relate course content to professional field of study and role as a teacher and/or therapist* *Identify student learning strengths* *Recognize attitudes related to disability and challenges that students might encounter* *Readings and Materials* Course syllabus Blackboard supplement SPE 400 Ning Assignment Descriptions *Activities* 1. Multiple Intelligence Survey Blog Post 2. Ning photo and page

Week of Jan 24 – 28 and Week of Feb. 31 – March 4	Module 1 Chapter 1 – 2: Special Education and Inclusive Schooling **Learning Objectives:** *Identify seminal special education legislation and relate the evolution of policy to philosophy and practice* *Define inclusion and identify benefits and challenges* *Understand the concept of least restrictive environment* *Articulate components of The Individualized Education Plan (IEP)* *Articulate the response to intervention process* *Issues that RTI attempts to address and role of teacher and progress monitoring* *Readings and Materials* Chapters 1 - 2 Mississippi RTI info Inclusion Glossary IEP forms Chapter 1 – 2 powerpoints
Week of Feb. 7 - 11	Module 2 Universal Design for Learning *Define the three principles of UDL* *Identify the benefits of UDL planning* *Connect UDL with inclusive services* *Explore the role of technology to support UDL* *Readings and Materials* UDL modules: http://udlonline.cast.org/home UDL Book Builder: http://bookbuilder.cast.org/ Educator's Checklist: http://www.udlcenter.org/implementation *Activities* Create a UDL book using Book Builder UDL Educator Checklist via Primary Pad Wiki (link on Ning discussion board)

| Week of Feb. 14 | Module 3
Collaborating and Coordinating with Other Professionals and Families

Learning Objectives
Define the differing roles that professionals will play in collaboration and teaming
Articulate the differences between consultation and collaboration
Understand the role of the team in providing educational services and the role of the teacher within the team
Facilitate collaboration between the teaching team and the family
Employ strategies, such as co-teaching, to strengthen collaboration
Identify resources required for successful collaboration
Address potential barriers to collaboration
Define transdisciplinary teaming and its importance
Relate the emotional needs of families

Readings and Materials

Chapter 3 powerpoint

IRIS Module – Families
http://iris.peabody.vanderbilt.edu/fam/chalcycle.htm

Activities
IRIS module |
| Week of Feb. 21 – Feb. 25 | Module 4

Chapter 4: Teaching Culturally and Linguistically Diverse Students

Learning Objectives
Discuss issues related to diversity in classrooms and schools
Further understanding of diverse cultures and methods of providing education to children from diverse backgrounds
Identify dimensions of multicultural education
Relate the different approaches to multicultural curricula |

Week of Feb. 21 – Feb. 25	Module 4
	Chapter 4: Teaching Culturally and Linguistically Diverse Students
	Learning Objectives
	Discuss issues related to diversity in classrooms and schools
	Further understanding of diverse cultures and methods of providing education to children from diverse backgrounds
	Identify dimensions of multicultural education
	Relate the different approaches to multicultural curricula
	Employ strategies to create a community of learners
	Reading and Materials
	NY Times Interactive Map and Video Story
	http://www.nytimes.com/interactive/2009/03/13/us/ELL-students.html
	http://www.nytimes.com/2009/03/15/us/15immig.html
	Edutopia video: Differentiating Instruction
	http://www.edutopia.org/stw-differentiated-instruction-technology-elementary-video
Week of Feb. 28 – March 4	Module 5
	Chapter 5: Promoting Social Acceptance and Managing Student Behavior
	Learning Objectives
	Establishing a classroom climate that promotes acceptable behaviors and acceptance
	Identify the primary components of the PBIS model
	Relate methods of implementing the PBIS model in the classroom setting
	Relate PBIS to RTI
	Develop skills to conduct and implement a Functional

APPENDIX D

NING ASSIGNMENT DESCRIPTION

Ning Participation Assignment Guidelines
What is Ning?
Ning is the social platform for the world's interests and passions online. Based in Palo Alto, Calif., Ning offers an easy-to-use service that allows people to join and create Ning Networks. With more than 1.9 million Ning Networks created and 40 million registered users, millions of people every day are coming together across Ning to explore and express their interests, discover new passions, and meet new people around shared pursuits. Ning was founded in October 2004 by Gina Bianchini and Marc Andreessen. The company is privately held. For more information, visit www.ning.com

(quoted from the Ning website)

Why does SPE 400 incorporate Ning participation?
Digital media provides an engaging and malleable forum for collaborative learning and sharing. Each of you comes to this course and the content with your own experiences, thoughts, expectations, and fears. As an instructor, I believe that the most powerful learning occurs when everyone is involved in building the learning environment and each individual is acknowledged for what they have to contribute to the endeavor. Ning provides a variety of opportunities for you to share what you bring to the table, rather than passively sitting in lecture. You can customize your page, share music and photos, and blog about your reactions to the material. The medium also supports threaded discussions so you can create dialogue with other participants to actively construct understanding.

In addition to all of these benefits, I believe that digital media is a powerful tool when incorporated into the K -12 classroom. It can create opportunities for active learning and problem solving as well as provide support to students who have a variety of learning needs. I hope that your exposure to Ning and the capabilities that it offers will help prepare you to think about technology integration in your own professional life – whether it be as a classroom teacher or a consultant to others.

What do I have to do?

The minimum requirements are outlined below, but part of the beauty of social networking sites is that they are entirely created by the users. So, feel free to go far beyond the minimal requirements to reflect your vision of online learning spaces.
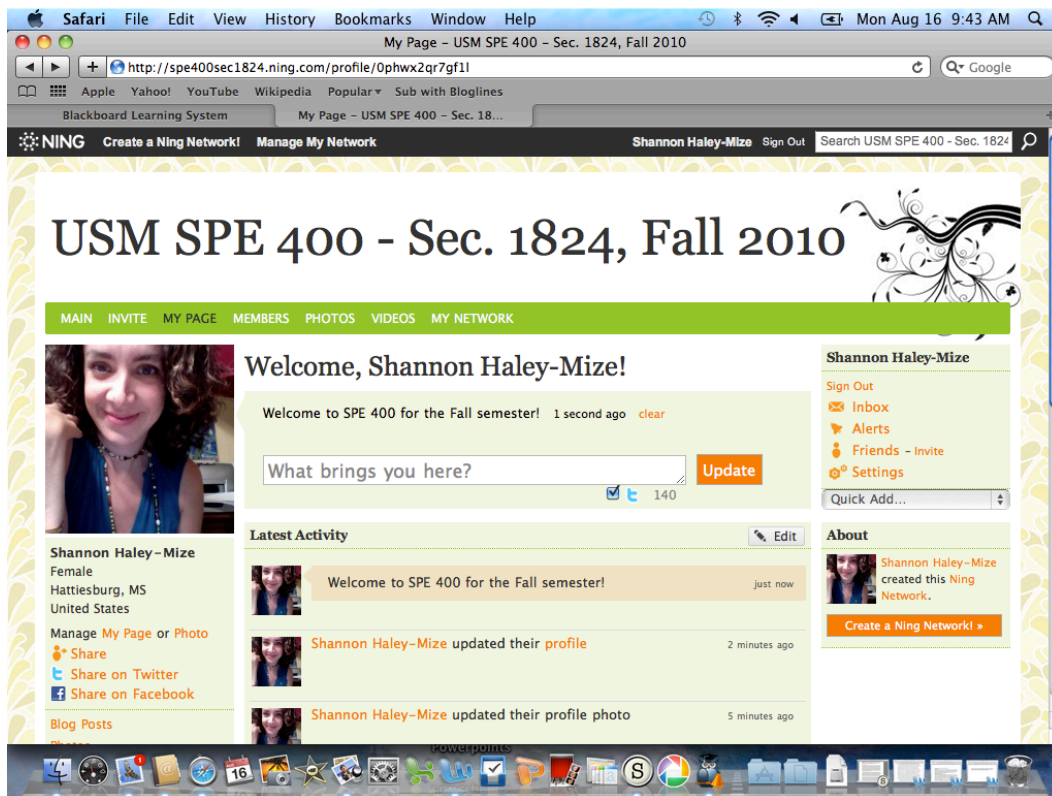
Steps to Active Ning Participation
1. Include your email address on the initial class sign in sheet and you will receive an invitation to join a Ning that I have already set up for SPE 400 (www.spe400sum2010.ning.com). Personalize your page and explore the site's capabilities. (As you can see, those of you that use facebook or myspace will find the interface very familiar.)
2. Upload a photo to your profile; please make this photo one of your face and not your internet boyfriend, child, or pet iguana. These other photos can be added to your page, but to build classroom community, I'd like to be able to associate your contributions with your (current) face.
3. Complete the required blog postings and peruse classmates' postings.
4. Go above and beyond! Add music, pictures of your family and hobbies, chat with classmates on the discussion board. You can also join other Nings of interest and link your Ning account to Twitter.

Due Date 11:59 pm	Assignment	Point Value
1/25	**Profile Photo.** Accept the invitation to join the Ning network (SPE 400 Fall 2010) and upload a current, clear photo of yourself to your profile.	2
1/29	**Blog Post. Topic: You and Your Learning Style** Use the Multiple Intelligences survey to write your first blog post. In your post, describe your learning strengths and weaknesses based on the survey and your own self-awareness. What makes a great learning environment for you (if I was going to learn the maximum amount in this class, the instructor would ...)? Also include some personal information to help us learn more about you, what career path you are currently on, and what you hope to gain from this course. (500 - 700 words)	7
2/5	**Blog Post. Topic: Inclusion** How do you feel about serving children with various abilities either in the classroom or in a therapeutic setting? What fears do you have related to serving students with diverse abilities? What is your experience level with students with disabilities? Should all students be included? Why or why not? (500 – 700 words)	7
2/7	**Read and respond.** Read some of the member blog posts on inclusion and leave your thoughts in the comments. (min: 2 comments)	4

Due Date 11:59 pm	Assignment	Point Value
2/12	**Blog Post. Topic: Universal Design for Learning** How does UDL fit with your role with students? What are some ideas that you have about providing alternative ways for students to demonstrate knowledge (assessment)? How could you use technology to support the three areas: representation, expression and engagement? Does the Ning provide a way to do that? Other technologies? (500 – 700 words)	7
2/19	**Music Upload.** Upload your theme song or provide a link to a YouTube version. Write a short blog post about how you might incorporate music into the classroom.	2
2/26	**Blog Post. Topic: Current Events (TBA)**	7
3/5	**Effective Classroom Behavior Plan** Design your classroom behavior plan and post to blog	7
3/5	**Resources Blogging. Topic: Web-Based Resources** Create a blog post that includes at least 6 high-quality links for ***professionals*** in your field (not parents) that provide information on serving children with exceptionalities. Include a short synopsis of the link provided and a statement about why you thought it worth sharing. YouTube, TeacherTube, and other videos can also be great resources! Also, look for scholarly articles that provide timely guidance and/or interactive news stories.	7

Due Date 11:59 pm	Assignment	Point Value
4/29	**Reflective Blogging. Topic: Connections** What connections have you made this semester between your coursework and the kind of professional you hope to be? What content or experience (any course) has most helped you gain perspective on teaching and learning? (800–1000 words)	7

APPENDIX E

PLANNING MATRIX ASSIGNMENT

A planning matrix is a tool that allows for active support, teaching, and integration of goals for students that are working on alternate content standards, instructional goals, and/or instructional objectives. By using activity-based learning, teachers can accommodate multiple levels of learning within one lesson. This assignment is intended to build and assess the teacher candidate's ability to meet the needs of exceptional individuals within activity-based instruction. Of particular interest is the ability to develop comprehensive learning experiences for students with exceptionalities within the general education setting and activities.

The following NCATE and CEC standards are addressed in this assignment:

CC2K2: Educational implications of characteristics of various exceptionalities.

CC4S1: Use strategies to facilitate integration into various settings

CC5S3: Identify supports needed for integration into various program placements

CC7S1: Identify and prioritize areas of the general curriculum and accommodations for individuals with exceptional learning needs

INTASC:

Principle 1: The teacher understands the central concepts, tools of inquiry, and structures of the discipline(s) he or she teaches and can create learning experiences that make these aspects of subject matter meaningful for students.

Principle 2: The teacher understands how children learn and develop, and can provide learning opportunities that support their intellectual, social and personal development.

Principle 4:   The teacher understands and uses a variety of instructional strategies to encourage students' development of critical thinking, problem solving, and performance skills. Principle 5: The teacher uses an understanding of individual and group motivation and behavior to create a learning environment that encourages positive social interaction, active engagement in learning, and self-motivation.

Principle 7: The teacher plans instruction based upon knowledge of subject matter, students, the community, and curriculum goals.

NETS-T:

I-A: Teachers demonstrate introductory knowledge, skills, and understanding of concepts related to technology. I-B: Teachers demonstrate continual growth in technology knowledge and skills to stay abreast of current and emerging technologies.

Steps for successful completion

1. Select a lesson plan that represents an area or age group that you would like to work with in an educational setting.

   If you are an SLP or major that will be providing professional services to students, then select a lesson plan that represents the age group with which you are likely to work. If you expect that you will work with adults, then choose a K-12 age group that you are interested in learning a little more about. If there is a situation that I have not mentioned, JUST PICK A LESSON PLAN. You may think lesson planning does not further the skill set that you will require, but the ability to analyze routine activities and infuse therapeutic and educational goals applies to all populations. Working on a skill in an authentic learning task is much more effective than isolated, repetitious practice. The purpose of this assignment is NOT writing a lesson plan.

   Please note that you should pick a good lesson plan (see rubric) and if there are things you need to add to make it better, then please do so in the teaching steps and indicate the changes and why you decided to make those adjustments.

   Some examples of lesson plans can be found at the following sites:

   http://www.discoveryeducation.com/teachers/free-lesson-plans/index.cfm

   http://www.readwritethink.org/classroom-resources/lesson-plans/

   http://www.nationalgeographic.com/xpeditions/lessons/matrix.html

2. Use the Planning Matrix form to break the lesson plan into discrete (small) teaching steps, identify and indicate which IEP goals will be infused within each step, and provide information on HOW that will occur.

   Ask yourself the following:

   - What are the steps of the lesson plan that are most appropriate to target these particular goals without compromising the integrity of the lesson, the full participation of the all students, and/or the dignity of the student with exceptionalities?
   - How can ensure active participation and build classroom community?
   - What teaching steps might pose a barrier for the student and how might that be handled?
   - What supports might you integrate into the classroom community and routines to facilitate participation in any learning activity?

- How are you going to teach the skill? (Remember: the kid doesn't know how to do these things. You have to teach and support. While you aren't sure exactly where she is with learning the steps, articulate how and what support you might provide if needed.)

3. Identify a teaching step or part of the learning goals that could be enhanced by technology, digital media, or Web 2.0 tools. Add the required teaching steps to integrate the tool into the sequence. Use the UDL principles to enhance the representation, engagement, or expression of the teaching step/activity and articulate which of the principles the tool could be classified as and how it will be used for a student-centered task or step.

   Resources for this step:
   http://www.collegeathome.com/blog/2008/06/10/100-helpful-web-tools-for-every-kind-of-learner/
   http://school.discoveryeducation.com/schrockguide/edtools.html
   http://www.diigo.com/list/kathyschrock/web20tools

4. **Review the scoring rubric** and make sure you have addressed all areas.

It is important to note that the instructional intent of the suggested activity may be quite different than the instructional objectives given here. The purpose of this assignment is to test your creativity in infusing alternate goals/content in the most naturally occurring manner possible. You should attempt to infuse these skills in the most efficient manner while maintaining the integrity of the student's opportunities to learn his/her individualized skills within your class's activity. You should also attempt to infuse the skills in a manner that is age-appropriate for the student and maintains his/her dignity. You should assume that the student is the same chronological age as the other students in your class.
Use the table provided to develop your planning matrix. Please give enough detail about what you will actually DO in class so that determinations about appropriateness can be made.
Target Student Description:
LaTonya is a student with moderate mental retardation and some physical disabilities. Developmental testing has indicated that she is functioning on a pre-kindergarten level in most academic areas. LaTonya has adequate gross motor skills but very limited ability to perform fine motor tasks. Despite her low level of academic success, LaTonya has a strong desire to be around her peers and teachers have discovered that her learning is the greatest when engaged in activities with her typical, same- aged peers. LaTonya has always been included with her typical peers for the majority of the school day. She exhibits no behavior problems in the regular education setting, but does exhibit challenging behaviors in a segregated setting. LaTonya likes to be the center of attention and

sometimes gets upset if she isn't the leader in all activities. Her peers interact well with LaTonya, but often help her too much.

The following alternate goals/instructional objectives should be infused to the greatest extent possible in your lesson:

1. The student will identify eight basic colors (red, orange, yellow, blue, purple, green, black, brown) with 80% accuracy in 4 out of 5 opportunities.
2. The student will identify the printed numerals 1 – 10 with 80% accuracy in 4 out of 5 opportunities.
3. The student will print her first and last name on a line in 4 out of 5 opportunities.
4. The student will respond to others in conversational settings within 5 seconds of the original statement in 4 out of 5 opportunities.
5. The student will stay in the instructional area with 2 or fewer reminders for at least the first 15 minutes of the lesson or activity for 3 of 5 class periods.
6. The student will wash and dry her hands with no assistance in 4 out of 5 opportunities.

Dimension	Sophisticated	Competent	Needs Work
Lesson Plan Selection and Teaching Steps	The lesson plan selected represents a solid learning activity with identifiable teaching steps and a solid learning objective supported by the steps. Teaching steps are appropriately identified and fully articulated in the planning matrix form. 4-5 pts	Lesson plan is adequate, but not a stellar example of a teaching sequence and the learning objective is unclear. Teaching steps are understandable, but could be more clearly defined and articulated. 2-3 pts	Lesson plan is too brief to be considered a comprehensive learning plan and/or teaching steps are not well outlined or each step contains too many tasks to fully consider how the student might be integrated into the discrete activities. 0-1 pts
Infusion of IEP goals into the existing plan	Each identified skill is infused and represented in several steps in the teaching procedures. Not only are the skills to be targeted identified, but how the skills will be facilitated, taught and supported is well-articulated. There is evidence of creativity in modifying the lesson plan to accommodate alternative learning objectives. Terminology from the text and course content is used (i.e. peer support, graphic organizer, etc). 16 – 20 pts	Most of the IEP skills are represented and targeted during the teaching steps, but information on how the skills be taught and supported is not consistently and clearly articulated for each skills and/or the procedures are not appropriate for the teaching step. Creativity and flexibility in integrating the skills are not clearly evident throughout. Support is provided for some of the skills, but not all. 9 – 15 pts	The manner of support is not identified and it is unclear how the student will learn to execute the skill or what support is provided to ensure that the opportunity for practice is realized. There may also be areas in the lesson plan that should include either support or a modification, but those are not well defined for all potential barriers. 0 – 9 pts

Technology	Technology, digital media, and or a Web 2. 0 application has been added to the existing lesson plan. The addition clearly supports and facilitates the learning objective and provides an alternative in one of the three areas of UDL: representation, expression, or engagement. It is clear from the planning matrix form what the technology is and how it will be used to facilitate a collaborative or student-led teaching step. 7 - 10 pts	Technology, digital media, and/or Web 2.0 application is used, but it is either not well aligned with the learning objective or does not obviously create a portion of the lesson that is student-led and/or created. The link between the technology, digital media, and/or Web 2.0 application and the teaching steps is not explicit. The IEP skills are not facilitated by the addition. 4 – 7 pts	Technology, digital media, or a Web 2.0 application is not integrated or the identified tool(s) does not support the learning objectives or integrate well into the teaching steps. The addition only allows for teacher-directed activities and/or does not facilitate the IEP skills of the student. 0 – 4 pts

APPENDIX F

DIRECTIONS FOR WIKI ASSIGNMENT AND EDUCATOR CHECKLIST

Directions for Participation:

A wiki is a website that is used to create documents collaboratively. Users

can add, revise, and edit using a web browser and accessing the

document online. Changes and additions are then saved and the revised

version is visible to other users. Typically, changes can be tracked in

various ways including different font colors and dates associated with

editorial changes. We are going to use PrimaryPad, which isn't exactly a

wiki, but it has many of the same functionalities. The advantage is that we

can all work on the same document and everyone has a responsibility to

contribute. We also can reap the benefit of the collective, rather than

trying to be utterly brilliant all on our own - even though it comes so easy

to some of us :)

So, to accomplish this mission, you should follow these steps:

1. SIgn up for either the elementary or secondary group based on your

interests.

2. Listen and participate when we discuss UDL in class on August 30th.

3. Review the information found at www.cast.org. From this site, you can

review the principles of UDL, view model lesson plans, and access many

other resources.

4. Use the links provided below to access the lesson plan and the

PrimaryPad document. I have already started the document, so the

outlines for the educator checklist are already there. Under each principle

(engagement, representation, and action/expression, write your thoughts

on things that could be added to the lesson plan to meet the criteria listed.

For example, under Multiple Means of Representation, 1.1 Customize the

Display of Information - you might add a variety of presentation media like

handouts, access to digitized texts, powerpoint, etc.

5. After you make your suggestions, be sure TO SAVE.

6. Revisit the document as other group members make suggestions and

add other thoughts you might have.

APPENDIX G

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) 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:

Schmidt, D. A., Baran, E., Thompson A. D., Koehler, M. J., Mishra, P. & Shin, T. (2009-10). Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers. *Journal of Research on Technology in Education, 42*(2), 123-149.

Schmidt, D. A., Baran, E., Thompson A. D., Koehler, M. J., Mishra, P. & Shin, T. (2009). The Continuing Development, Validation and Implementation of a TPACK Assessment

Instrument for Preservice Teachers. Paper submitted to the 2010 AnnualMeeting of the American Educational Research Association. April 30-May 4, Denver, CO.

Schmidt, D., Baran, E., Thompson, A., Koehler, M.J., Shin, T, & Mishra, P. (2009, April).*Technological Pedagogical Content Knowledge (TPACK): The Development and Validation ofan Assessment Instrument for Preservice Teachers.* Paper presented at the 2009 AnnualMeeting of the American Educational Research Association. April 13-17,San Diego, CA.

Schmidt, D., Baran, E., Thompson, A., Koehler, M.J., Mishra, P., & Shin, T. (2009, March).*Examining preservice teachers' development of technological pedagogical content knowledgein an introductory instructional technology course.* Paper presented at the 2009 InternationalConference of the Society for the Information and Technology & Teacher Education. March 2-6,Charleston, SC.

Shin, T., Koehler, M.J., Mishra, P. Schmidt, D., Baran, E., & Thompson, A.,(2009, March). Changing technological pedagogical content knowledge (TPACK) through course experiences. Paper presented at the 2009 International Conference of the 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

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 <u>confidential</u> 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

4. Area of Specialization

5. Year in College

6. Are you completing an educational computing minor?
a. Yes
b. No

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"

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
TK (Technology Knowledge)					
1. I know how to solve my own technical problems.					

2. I can learn technology easily.					
3. I keep up with important new technologies.					
4. I frequently play around the technology.					
5. I know about a lot of different technologies.					
6. I have the technical skills I need to use technology.					
CK (Content Knowledge)					
Mathematics					
7. I have sufficient knowledge about mathematics.					
8. I can use a mathematical way of thinking.					
9. I have various ways and strategies of developing my understanding of mathematics.					
Social Studies					
10. I have sufficient knowledge about social studies.					
11. I can use a historical way of thinking.					
12. I have various ways and strategies of developing my understanding of social studies.					
Science					
13. I have sufficient knowledge about science.					
14. I can use a scientific way of thinking.					
15. I have various ways and strategies of developing my understanding of science.					
Literacy					
16. I have sufficient knowledge about literacy.					
17. I can use a literary way of thinking.					
18. I have various ways and strategies of developing my understanding of literacy.					
PK (Pedagogical Knowledge)					

19. I know how to assess student performance in a classroom.					
20. I can adapt my teaching based-upon what students currently understand or do not understand.					
21. I can adapt my teaching style to different learners.					
22. I can assess student learning in multiple ways.					
23. I can use a wide range of teaching approaches in a classroom setting.					
24. I am familiar with common student understandings and misconceptions.					
25. I know how to organize and maintain classroom management.					

PCK (Pedagogical Content Knowledge)					
26. I can select effective teaching approaches to guide student thinking and learning in mathematics.					
27. I can select effective teaching approaches to guide student thinking and learning in literacy.					
28. I can select effective teaching approaches to guide student thinking and learning in science.					
29. I can select effective teaching approaches to guide student thinking and learning in social studies.					
TCK (Technological Content Knowledge)					
30. I know about technologies that I can use for understanding and doing mathematics.					
31. I know about technologies that I can use for understanding and doing literacy.					
32. I know about technologies that I can use for understanding and doing science.					
33. I know about technologies that I can use for understanding and doing social studies.					
TPK (Technological Pedagogical Knowledge)					
34. I can choose technologies that enhance the teaching approaches for a lesson.					
35. I can choose technologies that enhance students' learning for a lesson.					

36. My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.					
37. I am thinking critically about how to use technology in my classroom.					
38. I can adapt the use of the technologies that I am learning about to different teaching activities.					
39. I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.					
40. I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.					
41. I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.					
42. I can choose technologies that enhance the content for a lesson.					

TPACK (Technology Pedagogy and Content Knowledge)					
43. I can teach lessons that appropriately combine mathematics, technologies and teaching approaches.					
44. I can teach lessons that appropriately combine literacy, technologies and teaching approaches.					
45. I can teach lessons that appropriately combine science, technologies and teaching approaches.					
46. I can teach lessons that appropriately combine social studies, technologies and teaching approaches.					

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