TECHNOLOGY AND PRESERVICE TEACHER EDUCATION: A MIXED-METHODS STUDY OF TECHNOLOGY INTEGRATION BY ARTS AND SCIENCES FACULTY INTO SECONDARY EDUCATION CONTENT COURSES

by

N. SUSAN HUFFMAN

ANGELA D. BENSON, COMMITTEE CHAIR
ROBERT E. HAYES
MARGARET L. RICE
ALAN L. WEBB
VIVIAN H. WRIGHT

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ABSTRACT

In spite of initiatives design to address the integration of technology into teaching and the billions of dollars spent to fund these initiatives, there is still a gap in the research on the extent to which teacher education programs prepare preservice teachers to integrate technology into teaching (Kleiner et al, 2007; Abbitt & Klett, 2007). While Schools, Colleges, and Departments of Education are required to address technology integration for accreditation, how and when technology is address is left to the discretion of each institution. Because pre-service secondary education students typically take the majority of their courses outside of the College of Education, teacher preparation programs have a stake in technology use among Arts and Sciences faculty.

This mixed-methods study used the Higher Education-Technological, Pedagogical, and Content Knowledge (HE-TPACK) survey to examine perceptions of Arts and Sciences faculty who teach content courses for pre-service secondary education majors at a southeastern research university. The HE-TPACK addressed eight domains of technology training (TT), pedagogy knowledge (PK), technology knowledge (TK), content knowledge (CK), pedagogy content knowledge (PCK), technological pedagogical knowledge (TPK), technological content Knowledge (TCK), and technological, pedagogical, and content knowledge (TPACK). Interviews were conducted to create a more in depth picture of technology use in the teaching practices of Arts and Sciences faculty. Looking through a theoretical lens of transformative learning, interview participants were asked about their experiences with technology, opportunities they provide for their students to integrate technology through assignments, and any transformative experiences that caused them to view technology in a different way.

Based on the findings of this study, many faculty overestimate their HE-TPACK abilities. While many faculty still view technology as a production or communication skill, there were specific examples of transformative experiences that changed the way certain individuals address technology for student learning. This agrees with previous research that modeling technology integration helps teachers feel more comfortable and better prepared to teach with technology (Whipp, Schewiezer, & Dooley, 2001; Kayne-Chaplock, Whipp, & Schwiezer 2004). Because of their own transformative experiences, these faculty members were able to facilitate a transformative learning experience for their students (Jang & Chen, 2010).

DEDICATION

For my dad who taught me to never give up and my mom who is always there for me.

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CONTENTS

ABSTRACT ii

DEDICATION iv

ACKNOWLEDGEMENTS v

LIST OF TABLES vii

LIST OF FIGURES xiii

CHAPTER I: INTRODUCTION 1

Technology in Arts and Sciences 4

Theoretical Framework 6

Statement of the Problem 9

Statement of Purpose 9

Significance of the Study 10

Research Questions 11

Methods 11

Assumptions 12

Limitations 12

Definitions 13

Summary 14

CHAPTER II: REVIEW OF RELATED LITERATURE 16

Introduction 16

21st Century Learning, the Generation Gap, and Preservice Teachers 16

Technology Standards....................20
Technology for Preservice Teachers....................22
Technological Pedagogical Content Knowledge (TPACK)....................24
Research on Technology in Higher Education....................28
Research on Technology in Preservice Education....................31
Technology in the Content Areas....................34
Transformative Learning....................35
Critical Reflection in Transformative Learning....................38
Fostering Transformative Learning....................40
Transformative Learning in Distance Learning or Technology Integration....................42
Essential Components of Transformational Learning....................42
Criticisms of Transformative Learning....................44
Summary....................45
CHAPTER III: METHODLOGY....................48
Introduction....................48
Research Questions....................48
Mixed Methods Research Design....................49
Setting of the Study....................50
Undergraduate Secondary Education Degree Requirements....................51
Participants....................52
Instrumentation....................53
Validity and Reliability....................55
Data Collection....................57

Quantitative Data Collection....57

Qualitative Data Collection....57

Data Analysis....60

Quantitative Analysis....60

Qualitative Analysis....61

Summary....62

CHAPTER IV: RESULTS....64

Introduction....64

Sample....65

Quantitative Participants....65

Qualitative Participants....69

Quantitative Results....70

Research Question 1....70

Technology training domain....70

Pedagogy knowledge (PK) domain....71

Technology knowledge (TK) domain....72

Content knowledge (CK) domain....73

Pedagogy content knowledge (PCK) domain....74

Technology pedagogy knowledge (TPK) domain....75

Technology content knowledge (TCK) domain....76

Technology pedagogy content knowledge (TPACK) domain....77

Summary....79

Qualitative Results....80

Research Question 2 80
Research Question 3 84
Research Question 4 87
Research Question 5 89
Research Question 6 91
Summary 95
CHAPTER V: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS 96
Introduction 96
Summary of the Study 96
Discussion 97
Research Question 1 97
Research Question 2 98
Research Question 3 99
Research Question 4 100
Research Question 5 101
Research Question 6 101
Limitations 102
Conclusions 103
Recommendations for Policy and Practice 105
Recommendations for Future Research 107
Summary 108
REFERENCES 110
APPENDIX A: ISTE STANDARDS FOR TEACHERS 123

APPENDIX B: SECONDARY PROGRAM SHEETS 125

APPENDIX C: HE-TPACK SURVEY 129

APPENDIX D: INTERVIEW QUESTIONS 133

APPENDIX E: CODING MAP 135

APPENDIX F: PERMISSION TO USE HE-TPACK SURVEY 137

APPENDIX F: IRB APPROVAL LETTER 138

LIST OF TABLES

1. Cronbach’s Alpha Summary for HE-TPACK Domains..56

2. Quantitative Data Management Plan 60

3. Qualitative Data Management Plan 62

4. Demographic Descriptive Statistics..68

5. General Description of Interview Participants..69

6. Technology Training Frequency Percentages (n=59)...71

7. Pedagogy Knowledge (PK) Frequency Percentages (n=59)....................................72

8. Technology Knowledge (TK) Frequency Percentages (n=59) 73

9. Content Knowledge (CK) Frequency Percentages (n=59) 74

10. Pedagogy Content Knowledge (PCK) Frequency Percentages (n=59) 75

11. Technology Pedagogy Knowledge (TPK) Frequency Percentages (n=59) 76

12. Technology Content Knowledge (TCK) Frequency Percentages (n=59)..................77

13. Technology Pedagogy Content Knowledge (TPACK) Frequency Percentages (n=59).......78

14. TPACK Domain Descriptive Statistics...79

LIST OF FIGURES

1. Mezirow’s four types of learning..8

2. Technological pedagogical content knowledge (Koehler & Mishra, 2008).........................25

3. Meziro’s (1998b) taxonomy of critical reflection of and on assumptions............................37

4. Content area responses...66

CHAPTER I:

INTRODUCTION

Billions of dollars have been spent on technology for public school systems (Cuban, Kirkpatrick & Peck, 2001; Pellegrino, 2007; Technology Counts, 2007; U.S. Department of Education, 2015) and many programs, both private and public, have been developed to train in-service and pre-service teachers to use technology in the classroom (Apple Classrooms of Tomorrow-Today, 2008; Enhancing Education Through Technology Act of 2001; Preparing Tomorrow's Teachers Today, 2003; Partnership for 21st Century Learning, 2015). With $200 million dollars requested for the 2016 U.S. Department of Education's re-funding of the Enhancing Education Through Technology (EETT or E2T2) initiative (Office of Educational Technology, 2015), and technology standards for accreditation that are "woven throughout the teaching standards because of their importance for learners" (Interstate Teacher Assessment and Support Consortium, 2013, p.4), it is clear that educational technology is still an important topic in education.

But what is instructional or educational technology? The Association for Educational Communications and Technology (AECT), the oldest professional organization for educational technology, defines instructional technology as the 'theory and practice of design, development, utilization, management, and evaluation of processes and resources for learning" and the purpose of instructional technology is to "affect and effect learning" (Seels & Richey, 1994, p. 1). This definition was revised in 2007 to combine the term instructional technology and educational technology into one definition. "Educational technology is the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources" (Januszewski & Molenda, 2013).

This awareness of the potential for technology in education is important to consider with the projected increased in students and the aging of current public school teachers. Enrollment for public elementary and secondary students is projected to increase by 5 percent, from 49.8 million students to 52.1 million students between 2013 and 2023. During the same period, the number of current public elementary and secondary teachers who are age 50 and older is expected to increase 30.7 percent. (Snyder & Dillow, 2013). As these teachers look towards retirement, the need for teachers who can effectively use technology to reach students who grew up with technology is going to be greater than ever.

Because schools, colleges and departments of education (SCDE) are charged with preparing tomorrow's teachers, the logical place to address technology integration is in the pre-service education program. However, many of these programs have not been successful in adequately preparing teachers to use technology appropriately and effectively in the classroom (Kay, 2006; Kleiner, Thomas, & Lewis, 2007; Moursund & Bielefeldt, 1999; Yildirim, 2000). One reason for this is the lack of training of faculty and lack of practice for students (Kleiner et al., 2007). While SCDE's have made efforts to integrate technology in meaningful and effective ways, there is little research on the extent to which teacher education programs prepare preservice teachers to integrate technology into their teaching (Kleiner et al., 2007; Abbitt & Klett, 2007) or the extent technology is used and required in undergraduate teacher education programs (Teclehaimanot, 2003; Vu & Fadde, 2014).

Since the re-affirmation of the International Society for Technology in Education's (ISTE) Standards for Teachers (formally NETS) in 2000 and, again in 2007, the National

Council for Accreditation of Teacher Education (NCATE) standards in 2008, and the adoption of the Council for the Accreditation of Educator Preparation's (CAEP) standards in 2013, schools, colleges, and departments of education (SCDE) are required to address technology and the integration of technology into their teacher preparation programs in order to remain accredited to award degrees in education. Currently, ISTE is working on updating the approved ISTE Standards for Students that will be released in June, 2016. Shortly thereafter, ISTE will begin a refresh of the ISTE Standards for Teachers that, if it follows the same process as the Standards for Students refresh, will be released in mid-2017 (Sykora, 2015). Even with the emphasis on technology in teacher education accrediting agencies, the same is not true for general postsecondary education. The Southern Association of Colleges and Schools Commission on Colleges (SACS) only mentions technology in terms of students in their accrediting standards requiring that "the institution's use of technology enhances student learning and is appropriate for meeting the objectives of its programs. Students have access to and training in the use of technology" (SACS, 2012, p. 29). SACS recognizes the growing importance of having faculty who can use emerging technologies to develop, maintain, and use appropriate technology to deliver both synchronous and asynchronous courses (SACS, 2010).

With the flexibility allowed to SCDE as to how technology is addressed in the program, there is no 'right' way or 'wrong' way to incorporate technology into the preservice education program. How and when technology is addressed within the program of study is left up to the individual institutions. Many SCDEs use the common approach of designating one or two classes to meet the technology requirement while others address technology throughout the undergraduate program (Vu & Fedder, 2014; Ottenbreit-Leftwich & Bruch, 2011).

Harris and Hofer (2011) offer ideas on how to integrate technology when they suggest the "possibilities for technology use should be considered according to the types of learning activities that have been selected, which in turn, have been chosen to match students' learning needs and preferences" (p. 575). In other words, instructional planning should include technology integration based on content goals and learning activities. Harris and Hofer also offer a 'when' by suggesting that technology integration be "introduced during or immediately following the completion of curriculum-based methods courses" (Harris & Hofer, 2010, p. 604).

Currently, there is no consensus of the best way in which to address technology in preservice education (Kay, 2006), however research has shown the modeling of technology by faculty throughout the program of study helps preservice teachers feel better prepared to teach with technology (Whipp, Schewiezer, & Dooley, 2001; Kayne-Chaplock, Whipp, & Schwiezer 2004). As secondary preservice teachers spend over half of their academic career in the College of Arts and Sciences taking content courses, teacher preparation programs should evaluate technology use among Arts and Sciences faculty as well as Education faculty.

Technology in Arts and Sciences

The previously mentioned research is grounded in colleges of education and not general education or Colleges of Arts and Sciences, where secondary education students receive their content instruction. Most of the instructors in Arts and Sciences have a background in their discipline rather than in teaching. This has an impact on preservice secondary education teachers because a typical secondary education program in the United States requires a major in the content area taught by content area instructors (Roth & Swail, 2000). For example, a student majoring in secondary education – mathematics normally takes 50 hours of general education courses, 38 hours of professional studies courses taught by the College of Education faculty, and 45 hours in mathematics taught by Arts and Sciences faculty (see Appendix B).

One survey of doctorial students who are interested in a obtaining a faculty position found only 14.1 percent of the students felt they were prepared by their program to incorporate technology in to the classroom (Golde & Dore, 2001). Austin (2013) recommends future faculty members spend time in their doctorial programs developing an understanding of the learning process, teaching strategies, and how to use technology in their teaching. Typically doctorial students do not develop these skills. With research showing many faculty members are uncomfortable with technology and tend to teach in the way which they were taught (Golde & Dore, 2001; Stein & Short, 2001), technology use among higher education Arts and Sciences faculty members needs to be addressed.

One way to increase faculty comfort level with and their use of technology would be to increase their technological pedagogical content knowledge (TPACK). "Technological Pedagogical Content Knowledge (TPACK) is a framework that identifies the knowledge teachers need to teach effectively with technology" (Koehler, 2015). TPACK has been used extensively to evaluate TPACK knowledge, but primarily with pre-service and in-service teachers and "although these findings amongst pre-service teachers are important steps towards validating and refining the TPACK model, limited research is available in a higher education context" (Rienties, Brouwer, & Lygo-Baker, 2013, p. 124).

As higher education faculty and teacher preparation programs try to prepare teachers for 21st century classrooms, they must also adjust their own classrooms to reflect the needs of the 21st century preservice teacher. "Given the realities of globalization, knowledge work, and accelerating societal change, it's obvious that what students learn – as well as how and when they learn – is changing” (Lemke, Coughlin, Thadani, & Martin, 2003, p. 7). Colleges, schools, and departments of education have a responsibility to prepare teacher candidates who have the TPACK knowledge to help them succeed when they are in their own classrooms. Those who prepare our teachers also have the responsibility to ensure teacher candidates are exposed to different ways to integrate technology in ways that will transform their knowledge into new ways to think about technology and education.

Theoretical Framework

According to Webster's online dictionary, a theory is a “scientifically acceptable general principle or body of principles offered to explain a phenomenon; an idea or set of ideas that is intended to explain facts or events” and a framework is “a set of ideas or facts that provide support for something” (Merriam-Webster, 2015). In research, the theoretical framework sets the tone for the research, providing a frame and “shaping what the researcher looks at, how the researcher thinks about the study and its conduct, and, in the end, how the researcher conducts the study” (Anfara & Mertz, 2015, p. 227).

This study is grounded in a theoretical framework of transformative learning and is informed by the philosophical assumptions of constructivism/interpretivism and pragmatism. Transformative learning is an adult education learning theory first developed by Jack Mezirow in the late 1970s and is defined as changing the assumptions or the frame of reference through which experiences are viewed. A frame of reference encompasses

> cognitive, conative, and emotional components and is composed of two dimensions: habits of mind and a point of view. Habits of the mind are broad, abstract, orienting, habitual ways of thinking, feeling, and acting influenced by assumptions that constitute a set of codes. These codes may be cultural, social, educational, economic, political, or psychological. Habits of mind become articulated in a specific point of view—the constellation of belief, value judgment, attitude, and feeling that shapes a particular interpretation. (Mezirow, 1997, p. 5)

> Points of view are subject to continuing change as we reflect on either the content or process by which we solve problems and identify the need to modify assumptions. (Mezirow, 1997, p.6)

Interpretivism assumes the researcher is an integral part of the research; therefore the research is influenced by the researcher's perspectives and values (Ritchie & Lewis, 2003). Constructivists believe that "how one constructs knowledge is a function of the prior experiences, mental structures, and beliefs that one uses to interpret objects and events" (Jonassen, 1991). This understanding is gained through interviews with open-ended questions, focusing on how each participant's background shapes their world. It is the researcher's goal to interpret the meaning others have assigned to the subject. The pragmatic view is focused on outcomes and the best way to address the research problem (Carnaghan, 2013).

With its roots in constructivism and social cognitive theory, transformative learning seeks to effect a change in the frame of reference that defines the world based on the learner's experiences, expectations, perceptions, and feelings. Through critical reflection, the learner transforms their frame of reference, becoming more aware of different viewpoints, assumptions, and possibilities. It is in this awareness that growth and learning take place (Mezirow, 1997). Kitchenham (2003) suggests using transformative learning to study adult learners' experiences with technology.

One way to provide a transformative learning experience for pre-service teachers would be through the demonstration or modeling of technology integration. The "ability to learn in one situation and then to use that learning possibly in modified or generalized form in other situations where it is appropriate, is known as transfer of learning" (Hunter, 1971. P. 2). One way to promote transfer of learning or knowledge is practice or simulation. By practicing the skill in the manner in which it is used, transfer of knowledge from one situation to another is easier for the learner (Hunter, 1971). By modeling different ways to integrate technology, content professors can affect the preservice teacher's point of view of how to integrate technology rather than doing what has always been done out of habit or automatic response (Kitchenham, 2008). Transformative learning seeks to expand both the habits of the mind and the point of view.

According to Mezirow (2000), learning occurs in four ways. They are expanding one's viewpoint, learning a new viewpoint, changing the way one normally sees the world, and changing one's belief system or the way one feels about the world around us. A change or expansion of one area or any combination of areas is when learning occurs. As shown in Figure 1, "in addition to elaborating existing frames of reference or meaning, learning new frames of reference, and transforming habits of the mind, learning can occur by transforming points of view" (Kitchenham, 2008, p. 118). This process of learning can be a cumulative process over time or experiences or can occur with one event prompting change.

(Baumgartner, 2001).

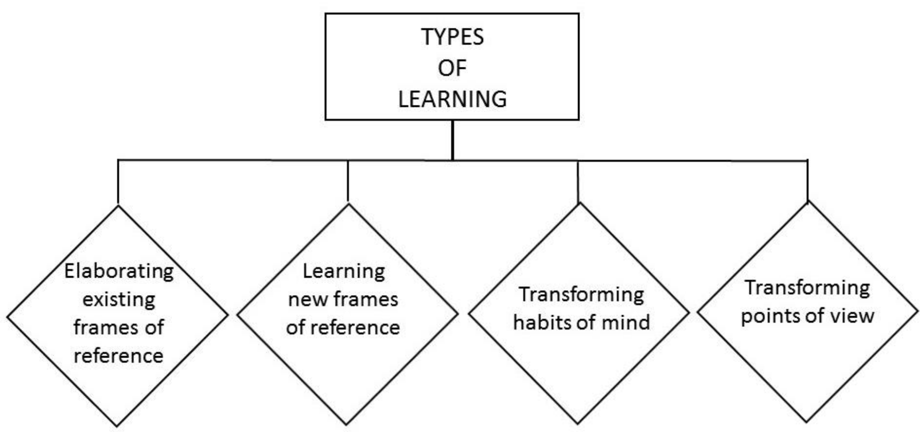

Figure 1. Mezirow's (2000) four types of learning

Because transformative learning theory requires a shift in the point of view and expanding the habits of the mind for learning to occur, this theory guided this study on how teacher educators integrate technology into required content courses for undergraduate secondary preservice teachers. The focus of this project will be the transformative opportunities created by teacher educators for preservice teachers within secondary content courses.

Statement of the Problem

> Integrating technology is not about technology—it is primarily about content and effective instructional practices. Technology involves the tools with which we deliver content and implement practices in better ways. Its focus must be on curriculum and learning. Integration is defined not by the type of technology used, but by how and why it is used. (Earle, 2002, p. 8)

Many have overlooked the root of true educational reform: the training of preservice teachers and the modeling of technology integration as part of the educational program (Pellegrino, Goldman, Bertenthal, & Lawless, 2007). This study examined the technology integration practices of teacher educators, specifically in the secondary content areas language arts (English and theatre), general sciences (biology, chemistry, and physics), math, social sciences (economics, history, and political science), and foreign languages (French, German, Latin, and Spanish) of a certified teacher preparation program. At the research site, journalism is a required content course for secondary language arts, but was omitted from this study because journalism is taught in the College of Communications and this study is focused on Arts and Sciences courses. Economics was also omitted because it is taught in the College of Business.

Statement of Purpose

The purpose of this study was to determine if content area professors integrate technology in their content courses and to what extent students majoring in secondary education are required to demonstrate technology integration within those content courses. It was the goal of this research to provide an understanding of how and when secondary education students were exposed to technology integration outside of the College of Education during the period of the research.

Significance of the Study

> Although educational technology courses have developed over time to include more technology integration and less focus on technology skills, there is still a balance between equipping preservice teachers with technology skills and educating them on how technology can be integrated into the classroom. (Ottenbreit-Leftwich & Brush, 2011, p. 1612)

There is little research on how preservice teachers learn to integrate technology in a way that will benefit student achievement rather than using technology to improve production (Schmid, Bernard, Borokhovski, Tamim, Abrami, Wade, Surkes, & Lowerison, 2009; Ottenbreit-Leftwich & Bruch, 2011; Jones, Buntting, deVries, 2013). This is particularly true with technology in the content courses. While there is extensive research on faculty use of technology, that research focused primarily on demographics or barriers to technology and not how or when technology is used in different content areas (Xu & Meyer, 2007). Much of this research is older, having been conducted between the years of 2000 and 2010 (Schmid, Bernard, Borokhovski, Tamim, Abrami, Wade, Surkes, & Lowerison, 2009).

Research on the potential gaps in Pedagogical Content Knowledge (PCK) and TPACK in preservice and in the K-12 setting is well documented but little is known about those same gaps with teacher educators and even less with higher education faculty in content areas (Garrett, 2014; Jones et al., 2013). Results from this study can be used to identify current gaps in technology exposure for preservice teachers. In addition, this could lead to collaborations between the College of Education and the College of Arts and Sciences to improve technology use among faculty campus wide. With the advances in instructional technology over the past few years, it is time to revisit how faculty model technology integration for their students, particularly in the content areas.

Research Questions

The following research questions guided this study:

1. What are faculty self-assessments of TPACK in the secondary education content areas of English/language arts, mathematics, science, foreign languages, and social sciences;
2. How do content area professors address the possibilities of technology integration in content courses;
3. How do content area professors make connections between technology used in everyday life and technology used in the classroom;
4. What opportunities do content professors provide for students to use technology for learning;
5. How do content area professors reflect on their experiences in the classroom; and
6. What makes content professors change the way they teach?

Methods

This study used an explanatory mixed methods design utilizing a previously validated Higher Education Technological Pedagogical Content Knowledge (HE-TPACK) survey based on the research of Lux, Bangert, & Whittier (2011) and modified for higher education by Garrett (2014) to assess faculty self-reported TPACK. The HE-TPACK consists of seven demographic items and 49 five-point Likert scale items. An electronic version of the HE-TPACK was sent to all Arts and Sciences faculty in the five core areas of secondary education; English/language arts, mathematics, science, foreign languages, and social sciences using Qualtrics online survey software. Data were analyzed using SPSS Statistics, version 23.

The results of the survey were used to “guide purposeful sampling for a qualitative phase” of data collection (Creswell & Plano Clark, 2011, p. 82). Interviews were used to gather more in-depth information from two faculty members in each of the five core areas of secondary education as defined by the research site; English/language arts, mathematics, science, foreign languages, and social sciences. Two faculty members selected represented the high and low end of the self-reported TPACK. Qualitative data analysis was analyzed using InVivo, holistic, and versus coding to determine the four most important themes from the interview.

Assumptions

Several assumptions have been made about this study. It was assumed that participants understood the survey and interview questions and were honest with their responses. It was also assumed that participants answered these questions without bias. The assumption was made that each participant would only take the survey one time. It was assumed that faculty are experts in their content areas. Because of this, it was assumed that faculty would rate themselves higher in the domain area of content knowledge versus technology knowledge.

Limitations

While this study was a mixed methods study, it focused on developing a better understanding of the faculty and why or how they integrate technology as part of their teaching. Since this focus is qualitative in nature and thus offers a descriptive account of the technology integration of selected faculty members, it is not intended to describe the other faculty not interviewed nor should readers draw inferences to other programs based on the results of this study.

Definitions

CAEP – Council for the Accreditation of Educator Preparation. The accreditation agency for teacher preparation programs, CAEP seeks to offer quality assurance by offering program reviews and conducting evidence-based analysis of those programs. In 2013, NCATE and TEAC combined to form CAEP.

Content area professor – a professor who teaches content area courses (social sciences, mathematics, English/language arts, science, foreign languages), usually housed in the College of Arts and Sciences.

CK –One of the three primary forms of knowledge, Content Knowledge refers to the teacher's knowledge about the subject matter to be taught.

HE-TPACK – Higher Education Technological Pedagogical Content Knowledge. Adapting the concept of combining pedagogy, content, and technology knowledge into effective teaching (TPACK) for higher education.

In-service teacher – a teacher who is currently employed in a k-12 classroom

InTASC – Interstate Teacher Assessment and Support Consortium. A consensus of encompassing standards for the skills which new teachers should be able to demonstrate.

IT – Instructional Technology or Informational Technology – The effective use of technology in learning.

ISTE – International Society for Technology in Education – A nonprofit organization dedicated to promoting and establishing policy for educational technology, including the development of technology standards for students, teachers, and administrators.

Technology Integration – the use of technology by students and teachers to enhance teaching and learning and to support existing curricular goals and objectives.

Multimedia – the use of computers to produce any combination of text, full color images and graphics, video, animation, and sound.

NCATE – National Council for Accreditation of Teacher Education. The former accrediting agency for teacher education programs focused on accountability and improvement in teacher preparation. NCATE merged with TEAC to form CAEP.

Preservice Teacher – student admitted to a college, school, or department of education's teacher preparation program.

SCDE – Schools, colleges, and departments of education offering bachelor, masters, or doctorate degrees in education potentially leading to teacher certification.

TEAC – Teacher Education Accreditation Council. Nonprofit accrediting agency seeking to improve academic degree programs for professional educators.

Teacher Educator – professor, associate professor, assistant professor, instructor, or faculty member teaching in a college, department, or school of education.

TPACK – Technological Pedagogical Content Knowledge – The basis of effective teaching with technology, requiring an understanding of the content, pedagogy, and technology and how to combine the three to improve student learning.

Summary

Even with the substantial monetary investments in technology for instructional use and the profound affect technology has had on other aspects of everyday life, there has been little change in the past 25 years in the way teachers teach (Norris, Soloway, & Sullivan, 2002). The technology training preservice teachers receive as part of their teacher preparation program is key to long-term change in the way technology is used in education. The importance of technology integration is evident based on the technology requirements for accreditation. With improvements in technology integration and teacher preparation, there is no consensus on how to best incorporate technology into teacher preparation programs (Kay, 2006) and we “still do not know what influences technology integration across a teacher education program” (Smith & Robinson, 2001, p. 154).

Research suggests many faculty members are not comfortable enough with technology to use it in their classrooms. These faculty members also tend to teach in the manner in which they were taught (Golde & Dore, 2001; Stein & Short, 2001). One way to increase faculty comfort level with technology would be to increase their technological pedagogical content knowledge (TPACK).

By evaluating Arts and Sciences faculty’s TPACK with the Higher Education Technological Pedagogical Content Knowledge survey and interviews with Arts and Sciences faculty, potential gaps in technology use by those faculty can be identified and addressed. Narrowing the technology gaps, if any, between what students sees modeled in the College of Education and the College of Arts and Sciences can potentially help preservice teachers by creating a transformative learning experience by expanding the habits of the mind and the points of view of what is possible with technology in the classroom.

CHAPTER II:

REVIEW OF RELATED LITERATURE

Introduction

"The success of technology in the K-12 world is strongly influenced by the experiences and preparation students have with technology in their higher education programs and activities" (Guba & Percy, 2005, p. 133). Even though technology is used in nearly every aspect of a student's life, that technology use does not necessarily enhance or support learning. Both students and faculty need specific guidance on technology integration in the classroom (Dahlstrom & Bichel, 2014). With the emphasis placed on K-12 teachers to integrate technology into the curriculum, it stands to reason that higher education faculty from all disciplines should be expected to possess the same skills as the students they are teaching (Rogers, 2000). The technology experiences provided for preservice teachers; 21st Century Learning, the generation gap and preservice teachers; technology standards; technological pedagogical content knowledge; technology in higher education and preservice education; and transformative learning all impact how preservice teachers learn to use technology in the classroom.

21st Century Learning, the Generation Gap, and Preservice Teachers

Students in K-12 classrooms today have grown up in the digital age. As Rushkoff (1996) writes in *Playing for the Future*, "students are native to cyberspace, where the rest of us are immigrants" (p. 3). In the almost 20 years since, many of those in teacher education programs have become 'residences' of cyberspace, if not natives. However, many teacher educators still use technology solely to improve personal productivity, which does not result in effective integration of technology for student improvement (Polly, Mims, Shephard, & Inan, 2009). "Until we get to the era when digital natives teach digital natives, the future success of a technology driven educational system in the 21st Century rests upon the nucleus of preservice teachers being trained at teacher education programs across America to use 21st Century systems to use these new technologies in their classrooms" (Bull, 2010, p. 2167).

In addition to the core subjects of English, reading, world languages, arts, mathematics, economics, science, geography, history, and government, The Partnership for 21st Century Skills defines key areas needed for successful students as (Partnership for 21st Century Skills, 2014):

1. *21st century themes:* global awareness; financial, economic, business, and entrepreneurial literacy;
2. *life and career skills:* flexibility and adaptability; initiative and self-direction; social and cross-cultural skills; productivity and accountability; leadership and responsibility;
3. *learning and innovation skills:* creativity and innovation; critical thinking and problem solving; communication and collaboration; and
4. *information, media, and technology skills:* information literacy; media literacy; information, communications and technology (ict) literacy.

As technology is becoming more and more available in classrooms in the United States, newly graduated teachers are expected to know how to use this technology to benefit student learning (Stobaugh & Tassell, 2011). Computers are available within the K-12 classroom for ninety-seven percent of teachers, yet these computers are only used forty percent of the time during instructional time (Gray, Thomas, & Lewis, 2010). Even with increased access to computers in the classroom, the impact on the learning process has changed very little (Becker & Ravitz, 2001; Cuban, Kirkpatrick, & Peck, 2001). Preservice teachers will need to be prepared to face ever changing technology in the classroom (Rackley & Viruru, 2014) especially if they are to develop students' 21st century skills.

One successful example using technology to increase 21st century skills is a case study of a middle school language arts class using Web 2.0 tools to meet 21st century skills. Students used blogs, word processing programs, and presentation software to create a class magazine covering a topic of research. Students collaborated to create the magazine and worked independently to write a research paper. Once the research paper was written, students created a presentation for the class using Prezi software. This strategy resulted in a 30% increase in the student's understanding of the topic after the paper was written and a 50% increase in growth after creating the Prezi presentation. This class will be used as a model of technology integration to improve 21st Century skills (Peters & Hopkins, 1994)

Baby boomers (born 1946-1964), Generation X'ers (born 1965-1980), and Millennials (born 1981-2000) have different views towards and expectations of technology and learning. Babyboomers have acquire technology skills viewing technology nice to have, but not necessary. This group focuses on learning 'what' and 'how' before the 'why' and are process oriented (Mangold, 2007). Gen X'ers have adapted to using technology. They want to know why they need to learn something so time is not wasted doing something that is not necessary (Johnson & Romanello, 2005). Millennials, who make up the majority of students at most universities, (Snyder & Dillow, 2015), see technology as an integral part of life and necessary in virtually every aspect of life. Mangold (2007) stated,

> This generation prefers, expects, and appreciates technology in learning and excitedly anticipates what will come next. In fact, the pace at which this savvy generation can assimilate technology exceeds the ability of faculty to maintain and integrate technologically enhanced education. (p. 22)

According to the Digest of Educational Statistics, in 2011 60.4% of education faculty, 40.6% of humanities faculty, and 49.1% of natural science faculty are over the age of 50, making a majority of faculty that preservice students come in contact with either of the Babyboomer or

Generation X age group. The majority of students majoring in education would be considered traditional college students with 65.4% of the students being under the age of 25. An additional 19.2% were between the ages of 25 and 35 (Snyder & Dillow, 2015), making most students of the Millennial generation.

This generation gap between faculty and students can compound any gaps in technology use among Arts and Sciences faculty. In a survey of over 2500 Arts and Sciences graduate students who hope to become faculty members, over half (53.6%) were required to act as teaching assistants. However only 14.1% felt prepared by their academic program to incorporate information technology into the classroom and only 26.6% felt they could develop and articulate a teaching philosophy (Golde & Dore, 2001). Another study of higher education faculty found those faculty members with 10-19 years teaching experience had the least amount of technology integration into their teaching practices (Adams, 2003). This implies the goal of digital natives teaching digital natives appears to be a ways away.

Millennial students bring a certain skill set, including comfort with technology to the classroom. However this does not mean they have the skills to translate using technology to teaching with technology (Bull, 2003). One study of first year preservice teaching fellows found the students in the study had positive attitudes towards technology and the impact of technology on education. Even though the students began the semester with positive attitudes towards technology, there was no influence by the program to improve those attitudes. Bull (2010) found the following as reasons first-year students lacked improvement in their attitude towards technology: 1) limited use of technologies by faculty (Blackboard course management software, computers, projectors, email) 2); limited use of emerging technologies in the program; 3) students who knew more about technology than their instructors; and 4) limited knowledge or refusal to integrate technology by older professors. Faculty, regardless of generation, need to consider student’s ages, learning styles, and ways they communicate in order to reach students in different ways (Oblinger, 2003).

Students’ immersion in technology in their everyday life does not necessarily translate to being able to use technology academically. This makes the modeling of education with technology important in encouraging learning supported by technology (Bennett, Maton, & Kervin, 2008). In spite of students’ familiarity with technology, concerns about critical thinking, privacy, source credibility, security, and ethics are all areas of concern that should be addressed in post-secondary education (Lorenzo & Dziuban, 2006).

Technology Standards

Currently, the International Society for Technology in Education (ISTE) Standards for Teachers (see Appendix A) are used by the Council for the Accreditation of Educator Preparation (CAEP), formally known as the National Council for Accreditation of Teacher Education (NCATE, 2014). Technology is also “woven throughout the standards” for the National Association for the Education of Young Children (NAEYC, 2012), the specialized professional association for Early Childhood Education. These standards must be addressed by teacher preparation programs seeking CAEP accreditation (NCATE, 2014).

The National Council of Teacher of Mathematics lists technology as one of its six principles stating “technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning” (National Council of Techers of Mathematics, 2015). The National Council of Teachers of English lists a position statement entitled Beliefs about Technology and the Preparation of English Teachers to guide English educators in both post-secondary and in-service areas on the focus areas and implications of technology (National Council of Teachers of English, 2015). The National Science Teachers Association recognizes the connection between science, engineering, and technology and their influence on society as well as the interdependence of science, engineering, and technology (National Science Teachers Association, 2015).

ISTE Standards for Teachers state “effective teachers model and apply the ISTE Standards for Students as they design, implement, and assess learning experiences to engage students and improve learning; enrich professional practice; and provide positive models for students, colleagues, and the community” (ISTE, 2015). The standards and performance indicators that all teachers should meet are listed in the table in Appendix A (SITE, 2008). The ISTE/NCATE standards (2003) support the use of modeling as an effective approach to teaching technology in preservice education. The clear advantage to using modeling is that it transfers directly to the ‘real world’ classroom, unlike the single course and integrated strategies (Howland & Wedman, 2004; Marra, 2004; Kay, 2006). Disadvantages to modeling include the inability of faculty to provide meaningful and effective technology examples (Eifler et al., 2001; Vannatta & Beyerback, 2000) and preservice students not being given the opportunity to construct their own technology-based lessons.

Many universities meet or address these technology requirements by offering one technology integration course for most students majoring in education. This course is taken with core classes before the student is admitted to a field placement program. Students learn Web page creation, word processing, presentation software, and other basic productivity applications. By the time students enter the field placement, they have often forgotten much of what was learned in the introduction class taken up to two years previously (Arhar, Koontz, & Hill, 2002). At the same time, a professional development course taken three or four semesters after an introductory course while under the demands of student teaching also does not prepare preservice teachers for the 21st century classroom (Arhar et al., 2002; Hare, Howard, & Pope, 2002). While preservice teachers are given instruction in “computer literacy and are shown examples of computer software, they rarely are required to apply technology in their courses and are denied role models of faculty employing technology in their own work” (Wise, 1997, p. 13). One way to meet technology standards, as well as accreditation requirements, is to increase preservice teachers’ technological pedagogical content knowledge (TPACK), beginning in the content areas.

Technology for Preservice Teachers

To have a meaningful experience that has the power to transform teaching practice, students should be provided situational learning experiences before or in conjunction with student teaching or field experiences (Putnam & Borko, 2000). However, many universities rely on a few teacher education faculty members with technology experience or a single technology course to expose students to technology integration and to meet accreditation standards (Teclehaimanot, Mentzer, & Hickman 2011). This leaves many teachers unsure of how to integrate technology into learning and uncertain about their technology skills (Office of Technology Assessment, 1995; Willis, Thompson, & Sadrea, 1999).

> Responsibility for preservice teacher education is not limited to a college or department of education within a university. In general, teachers take more courses in general education and in their academic majors and minors than they do in professional studies. Any effort to remake teacher education must consider all of the undergraduate and graduate experience of teachers. (Wise, 1997, p. 12)

In a typical secondary curriculum program, preservice teachers take 60 credit hours of general studies or core classes, 31-34 credit hours of professional studies courses including teaching methods courses, and 36-80 content courses. Professional studies courses are generally taken in the College of Education with COE faculty. These courses are often offered as co-requisites or block courses and are taken during the student’s junior and senior years. Content courses are taken in the College of Arts and Sciences with A and S faculty members and are taken throughout the student’s academic career except the student teaching or internship semester (The University of Alabama Undergraduate Academic Catalog, 2015).

Common approaches for meeting technology integration standards within the teacher education program include a single technology course, workshops, modeling, teacher education coursework assignments, field-based assignments, and collaborations (Vu & Fedder, 2014). Currently, there is not a consensus of best practices for technology integration into a teacher preparation program (Kay, 2006), although integration throughout the teacher education coursework and a single technology course are the most common ways of addressing technology in teacher education (Vu & Fedder, 2014).

When the method of technology integration across the curriculum is used, content areas should model technology integration so the preservice teachers learn not only the content knowledge, but also how to use technologies to teach those concepts or technological content knowledge. Research has shown modeling appropriate technology use by teacher education faculty is an effective way to help preservice teachers develop an understanding of the power of technology (Hsu & Hargrave, 2000; Howland & Wedman, 2004), however, many faculty do not feel comfortable enough with technology to use it in their teaching practices (Vu & Fedder, 2014).

Content area professors can begin to lay the foundation for developing technological, pedagogical, and content knowledge by modeling technology use themselves. This exposure to using technology in the content areas can help students begin to connect the areas of content, pedagogy, and technology (Chai, Koh, & Tsai, 2010).

For teachers to adequately prepare students to succeed in the 21st century, the modeling of technology must permeate throughout the program of study, including content courses (Whipp, Schewiezer, & Dooley, 2001; Kayne-Chaplock, Whipp, & Schwiezer 2004). “It is this teaching and modeling of best practices that cements a preservice teacher’s commitment to the application and adaptation of technology with the expectation that it will carry over to the classroom of the new teacher” (Teclehaimanot, 2003, p. 3872).

Technological Pedagogical Content Knowledge (TPACK)

Technological Pedagogical Content Knowledge is a conceptual framework that builds on Shulman’s pedagogical content knowledge to include technology (Koehler & Mishra, 2008). Because Shulman thought that what was taught and how it was taught were inextricably linked, his original work combined the knowledge domains of content and pedagogy, into another domain of pedagogical content knowledge (PCK). Pedagogical content knowledge “represents the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction” (Shulman, 1987, p. 8).

Teachers need an understanding of the role technology plays in both the content they teach and how they teach. Koehler and Mishra’s (2009) domains of technological content knowledge (TCK) and technological pedagogical knowledge (TPK) help fill in the gaps of Shulman’s work now that technology is so pervasive in society. TCK helps explain how technology and content are linked. By understanding not only the content, but also the available technology, teachers can determine if technology is appropriate and what technologies will help students understand the content. TPK can be described as knowing when to use what technologies to help students during the learning process while developing an understanding of how using those technologies can affect the learning environment. Harris and Hofer (2009) explain the three specific overlaps as follows: 1) Pedagogical Content Knowledge (PCK) – How to teach particular content-based material; 2) Technical Content Knowledge (TCK) – How to select and use technologies to communicate particular content knowledge; and 3) Technical Pedagogical Knowledge (TPK) – How to use particular technologies when teaching. By adding a technological component, new domains and a new intersection of domains was created. This intersection is called Technological Pedagogical Content Knowledge or TPACK (see Figure 2).

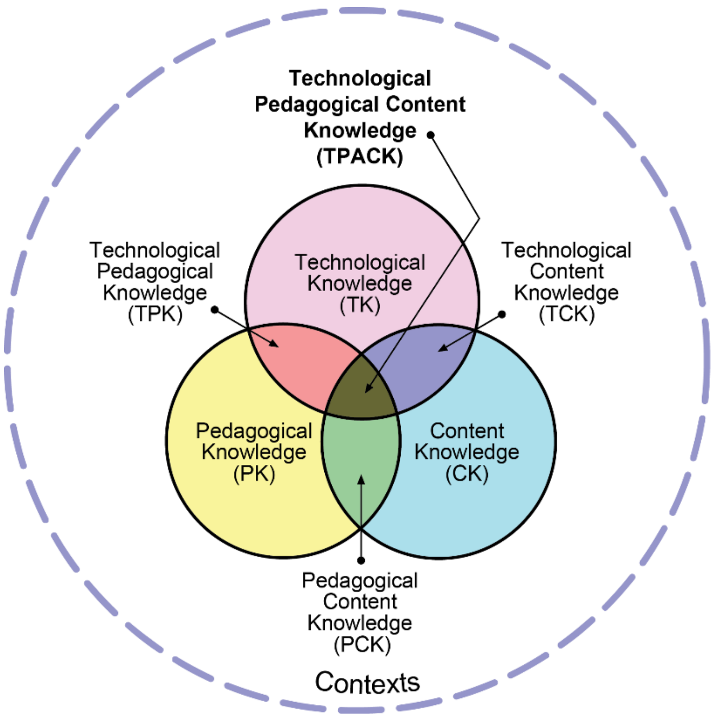

Figure 2. Technological Pedagogical Content Knowledge (Koehler & Mishra, 2008)

TPACK is described by Koehler and Mishra (2009) as

> the basis of effective teaching with technology, requiring an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or strengthen old ones (tpack.org)

This idea of using prior knowledge to build new ways of thinking about and with technology is directly related to the transformative learning's expanding existing frames of reference and developing new habits of the mind.

Because of the knowledge of technology and content that is required for TCK, it is the most difficult knowledge base to build (Koehler & Mishra, 2008). One reason for this is that it is difficult to develop a knowledge base for technology when technology is constantly changing (Abbitt, 2011). College professors who teach content courses should be proficient in PCK. For this reason, TCK and TPK are the areas of interests in this study. In particular, this study will focus on the TCK of content area teachers and how they model TCK and TPK for their students.

Using transformative learning to increase TCK will be the focus of this study. One way to build TCK in preservice teachers is to have content courses that "focus on modeling instructional strategies that incorporated technology" and "using the experiences to discuss the particular models" providing "the student teachers with many more opportunities to consider instructional strategies that incorporated technology" (Niess, 2005, p. 521).

A change in thinking about how and why technology can be used in the classroom requires preservice teachers be provided different experiences that model technology integration throughout their teacher preparation program (Yildirim, 2000), while at the same time providing opportunities for "investigating, thinking, planning, practicing, and reflecting" on instructional practices (Niess, 2005, p. 511). By including technology integration into content courses, with technologies and examples specific to content, preservice teachers can build their TCK (Schmidt et al., 2009). This opportunity for reflection leads to a change in the habit of the mind is another key element transformational learning.

To facilitate a change in teaching with technology, content area professors must explore their own use of various technologies within their teaching and work with those in the teacher preparation program to provide learning experiences involving technology as a part of the whole teacher preparation program and not in isolation from it (Hechter, Phyfe, & Vermette, 2012). Those educators must then offer transformative experiences, examples by modeling, and reflecting on technology use to facilitate a transformative learning process for their students (Jang & Chen, 2010). It is because of the content-specific nature of TPACK that professors in the content areas need to be included in the conversation of technology standards required for teachers (Thomas, Herring, Redmond, & Smaldino, 2013). This is the reason transformative learning is the theoretical lens through which this research will be viewed.

While there is ample research on the TPACK survey instrument for preservice teachers and in-service teachers, there is limited research on TPACK used in a higher education setting (Rienties et al., 2013). The original TPACK instrument is now being modified to measure specific technologies or content areas including, ICT-TPACK, TPACK with assistive technology, Technological Pedagogical Science Knowledge (TPSK) (Yurdakul, Odabasi, Kilicer, Coklar, Birinci, & Kurt, 2012). Adding to this expanding knowledge of TPACK is the Higher Education-TPACK or HE-TPACK. This version of the TPACK instrument was adapted to the TPACK of faculty members in higher education (Garrett, 2014). The HE-TPACK was reviewed by experts in TPACK or technology training and has been validated and proven reliable through review and testing. Because this research is focused on higher education, the HE-TPACK instrument was used.

Research on Technology in Higher Education

Higher education has been changed significantly by technology. Changing technologies "affect the very nature of the fundamental activities of the university: creating, preserving, integrating, transmitting, and applying knowledge" (Duderstadt, Atkins, & Van Houweling, 2002). Technology can "provide the means for creating, storing, analyzing, transferring, reproducing, and transforming information" (Bates & Sangra, 2011, p. 11).

In 2002, education, including K-12, higher education, and professional development in the workplace was a $740 billion dollar industry in the United States alone (Duderstadt, et.al, 2002). Faculty members have seen the effects of lower prices, greater capacity, and increased availability of technology use for both personal production and instruction. Innovative uses of technology have affected the way courses are taught and the way information is delivered. According to a survey conducted for the Pew Research Center (Parker, Lenhart, & Moore, 2011), 89% of public, four-year institutions and 60% of private, four-year institutions offer online classes; 58% of colleges and universities offer degrees that can be earned entirely online; and 63 % of college presidents think that in ten years, half of the textbooks used by students will be entirely digital. However, many faculty technology training programs focus on the 'how' to use this technology and not 'why' use it to affect changes in learning and to create an environment for the transfer of knowledge from one situation to another (Johnson, Wisniewski, Kuhlemeyer, Isaacs, & Krzykowski, 2012).

In their book *Managing Technology in Higher Education: Strategies for Transforming Teaching and Learning*, Bates and Sangra (2011) conducted a comprehensive review of the literature on the management and governance of technologies in universities and colleges, a web-based search and analysis of strategic planning documents of sixteen universities, and a twelve-year case study of eleven institutions of higher education. The researchers studied these institutions to gain an understanding of best practices on how to transform teaching and learning with technology. Through this research, Bates and Sangra found that even though most universities and colleges have a technology center to support faculty technology use, course design, and the development of digital course materials, often those centers are not utilized by faculty because faculty were not aware of the services of the center, faculty chose not to use those resources, or faculty thought they could manage on their own (Bates & Sangra, 2011).

A three-year case study of chemistry instructors at a science and technology institution found the lack of knowledge on how to incorporate technology for educational purposes and ambivalent attitudes towards technology were the most common barriers for faculty. With exposure to the potential benefits of technology in teaching and collaboration among other faculty members, the chemistry instructors slowly became more open to the possibilities of technology in teaching, (Barak, 2007).

One program funded by the U.S. Department of Education to help faculty and teacher preparation programs understand the role technology should play in education, was the Preparing Tomorrow's Teachers to use Technology (PT3) grant program. From 1999 to 2003, this program awarded $337.5 million dollars to fund faculty development, course restructuring, changes to certification policies, and online teacher preparation (U.S. Department of Education – archived, 2015). Applicants for PT3 grants were encouraged to search for solutions and connections between teacher education programs, faculty development, and learning and teaching with technology. One area of focus for PT3 was the modeling of meaningful technology integration into the teacher preparation program (Washington, 2002).

While faculty members recognize the value of modeling effective technology use in the classroom, this type of modeling is not prevalent throughout teacher preparation programs (Chuang, 2004). “Higher education faculty can promote the use of technology best by integrating it into their own instruction” (Gunter, 2001, p. 19). Research showed when faculty model technology use throughout the preservice education program, preservice teachers are able to create meaningful experiences with technology (Brush, Glazewski, Rutowski, Berg, Stromfors, Van-Nest, Stock, & Sutton, 2003; Moursund & Bielefedlt, 1999; Persichitte, Tharp, & Caffarella, 1997; OTA, 1995).

A closer look at these studies shows overwhelming support for the modeling of technology integration throughout the preservice student’s educational program. In a study conducted jointly for the American Association of Colleges for Teacher Education (AACTE) and the National Council for Accreditation of Teacher Education (NCATE), Persichitte, et al (1997) surveyed 466 Schools, Colleges, and Departments of Education. This study found that while 78% of faculty use the computer occasionally for professional purposes, 22% of faculty used computers primarily for word processing. One recommendation from this study was “faculty should model both professional and personal uses of computer technologies” (Persichitte, et al, 1997, p. 11).

In a mixed-methods study of 100 preservice elementary students, Brush et al (2003) found modeling activities throughout the educational program not only provided preservice teachers with authentic ways to integrate technology into teaching, but also gave preservice teachers an additional strategy for demonstrating technology while in the classroom for their student teaching activities. A study commissioned by the Milken Exchange on Education Technology and conducted by the International Society for Technology in Education (Moursund & Bielefeldt, 1999) of 446 faculty members in schools, colleges, and departments of education found the mean and median estimated proportion of faculty using IT in teaching was 26-50% suggesting most faculty do not model technology skills in their teaching. This study recommended faculty should model and integrate technology into their own teaching.

Research on Technology in Preservice Education

The way technology is addressed in preservice education has changed as technology has become more prevalent in society. In the early 1980s, many preservice education programs did not offer technology training even though secondary students were required to take a high-school computer course as a graduation requirement. In the late 1990s, an introductory computer course focused on applications such as word processing were fairly common in teacher preparation programs (Moursund & Bielefedlt, 1999).

As technology became more prevalent in everyday life an emphasis was placed on technology in education. In a survey of 88 universities that offer teacher preparation programs, Hsu and Hargrave (2000) found while most of the schools responding addressed technology with a specific instructional technology course, the focus of that course was shifting from computer technology for personal or professional productivity to curriculum integration and instructional design.

Barriers to technology integration in colleges of education include the lack of technology resources, time, professional development, and support. But if faculty do not model the integration of technology, then teachers will be less inclined to include technology in their own classrooms (Strudler & Wetzel, 1999; Zehr, 1997). There is little research showing that changes in attitudes or training programs resulted in teachers who are confident in their abilities to evaluate, select, and use technology effectively (Collier, Weinburgh, & Rivera, 2004). Building this confidence is important because teachers who are limited in their knowledge about technology and how to use it in the classroom often focus on technology for production and not higher order thinking skills (Jones et al., 2013).

In a case study of four colleges of education with the reputation of being exemplary in technology and preservice education, Strudler and Wetzel (1999) found there were several commonalities among the preservice programs; university wide planning for technology integration; the use of national standards; pedagogical fit; and support for faculty and students. Another two-year study of how a restructured introduction to technology course impacted student learning found that technology modeling by faculty, a continued emphasis on basic skills, helped students positively change student's attitudes towards educational technology (Gunter, 2001).

In an effort to "identify, describe, and evaluate strategies used to incorporate technology into preservice education" (Kay, 2006, p. 385), Kay reviewed 68 articles published in referred journals evaluating strategies used to incorporated technology into preservice education. Of those articles, only 14 studies included reliable data collection methods and formal statistics. Of those 14 studies, only four included a complete sample description. Kay (2006) found at least ten methods for teaching technology to preservice teachers: including integrating technology in all courses (44%); using multimedia (37%); focusing on education faculty (31%); delivering a single technology course (29%); modeling how to use technology(27%); collaboration among preservice teachers, mentor teachers, and faculty (25%); practicing technology in the field (19%); offering mini-workshops (18%); improving access to software, hardware, and/or support

(14%); and focusing on mentor teachers (13%). It is recommended that a combination of two or more of these strategies be used throughout the program (Kay, 2006; Collier et al., 2004; Smith & Robinson, 2003) as well as a stand-alone technology courses and technology modeling in the subject areas (Strudler & Wetzel, 1999). Faculty should incorporate modeling technology integration with the goal of "effective teaching with technology in varied and diverse settings" (Thomas, Herring, Redmond, & Smaldino, 2013, p. 56).

In a study of what technology skills university faculty believe preservice teachers need before beginning student teaching, Collier, Weinburgh, and Rivera (2004) found that faculty believe students should have basic computer skills and teacher educators were able to provide hands-on experiences, improving preservice teachers' ability to select and use technology effectively. This study recommends the design of teacher education programs that give preservice teachers the opportunity to learn and practice with technologies through modeling technology throughout the teacher preparation program (Collier, Weinburgh, & Rivera, 2004). Since "how a person learns a particular set of knowledge and skills, and the situation in which a person learns, become a fundamental part of what is learned" (Putnam & Borko, 2000, p. 4) preservice teachers need to experience technology throughout their program, including content courses.

In a series of case studies involving six university education departments that emphasize the effective use of technology, Fulton, Glenn, and Valdez (2004) identified eight key categories to evaluate technology training within a teacher education program: vision; leadership; faculty use of technology; teacher candidates' use of technology; funding for technology resources, training, and support; collaboration with Arts and Sciences; PK-12 partnerships; and meeting external mandates. These same categories should be used to evaluate content courses taken by secondary preservice teachers.

Technology in the Content Areas

This researcher found little research conducted on the technology use for faculty in the content areas, especially Arts and Sciences faculty. Much of the research on technology in the content area focuses on elementary education and methods classes. As such, the literature reviewed in this section refers mainly to methods classes, preservice elementary education programs, or K-12 subject areas.

A seven year longitudinal study of eighty-eight social studies teacher educators examined the beliefs, practices, and efficacy of technology integration within a social studies methods course. In this study, 69.9% of faculty believed their preservice students were adequately prepared to teach with technology. One faculty member commented her students were “required to produce several power point presentations in their education class” (Bolick, Berson, Friedman, & Porfeli, 2007, p. 182). A common theme in this study was that faculty believed technology was a complicated issue and the faculty felt they “were not doing an adequate job providing models of integration. Faculty members believe their students have technology skills, but not the appropriate pedagogy to teach with technology” (Bolick et al., 2007, p. 182). This is consistent with previously reported literature that technology knowledge and production skills do not necessarily translate into teaching with technology (Bull, 2003; Kay, 2006; Kleiner et al., 2007; Moursund & Bielefeldt, 1999; Ottenbreit-Leftwich & Bruch, 2011; Yildirim, 2000). The Bolick et al study also found that 24.4% of faculty created instructional webpages, 91.8% of faculty used email to communicate with students, and 82.4% of faculty used the Internet to access information for class. Instructional practices from helping students select appropriate technology to teaching instructional strategies using technology were also found to have increased throughout the study.

With little empirical research on computer assisted language learning or technology used in second language programs to draw from, Adair-Hauck, Willingham-McLain, and Youngs (2013) conducted a longitudinal program evaluation hoping to inform other foreign language departments about the potential for technology in foreign language education. In their study, technology was found to significantly improve writing scores and collaboration among students without a decrease in cultural understanding (Adair-Hauck et al., 2013). This was one of the few empirical studies this research found on technology and foreign languages.

A qualitative study of the potential of technology in mathematics suggests the Internet has the potential to influence mathematics education as it has business and other areas of daily life. While students can use YouTube or applets to help with the understanding of a particular topic, at this time, little has changed in the actual teaching of mathematics (Borba, Clarkson, & Gadanidis, 2013). Without the opportunity to experience mathematics taught with technology, preservice teachers will not be challenged to expand their point of view of technology and mathematics nor will they change the habits of the mind.

Transformative Learning

Transformative learning is an adult learning theory that helps explain the "process of constructing and appropriating new and revised interpretations of the meaning of an experience in the world" (Taylor, 2008, p. 5). The development of transformative learning as a theoretical framework began in the 1970's with Jack Mezirow work which expanded Paulo Freire's idea of "consciousness-raising" (Dirkx, 1998). "In transformational learning, one's values, beliefs, and assumptions compose the lens through which personal experiences is mediated and made sense of. When this meaning system is found inadequate in accommodating some life experience, through transformational learning it can be replaced with a new perspective” (Merriam, 2004, p.61).

Mezirow suggests that the transformative process occurs across the following phases: 1) a disorienting dilemma; 2) self- examination with feelings of fear, anger, guilt, or shame; 3) a critical assessment of assumptions; 4) recognition that one’s discontent and the process of transformation are shared; 5) exploration of options for new roles, relationships, and actions; 6) planning a course of action; 7) acquiring knowledge and skills for implementing one’s plans; 8) provisional trying of new roles; 9) building competence and self-confidence in new roles and relationships; and 10) a reintegration into one’s life on the basis of conditions dictated by one’s new perspective. (Mezirow, 2000, p. 4). As one progresses through these ten phases, the current frame of reference is expanded and new points of view are created.

An example given by Kitchenham (2008) and shown in Figure 2 describes the transformative process using the example of a faculty member who believes he or she is too old to learn about technology use in the classroom. By reflecting on his or her values and belief system, the faculty member reflects on worldviews or assumptions. This graphic representation shows how the process of critical reflection can challenge current beliefs, expanding the current frame of reference to include new possibilities. It is in this process of expansion and reflection that growth occurs, leading to news ways of knowing.

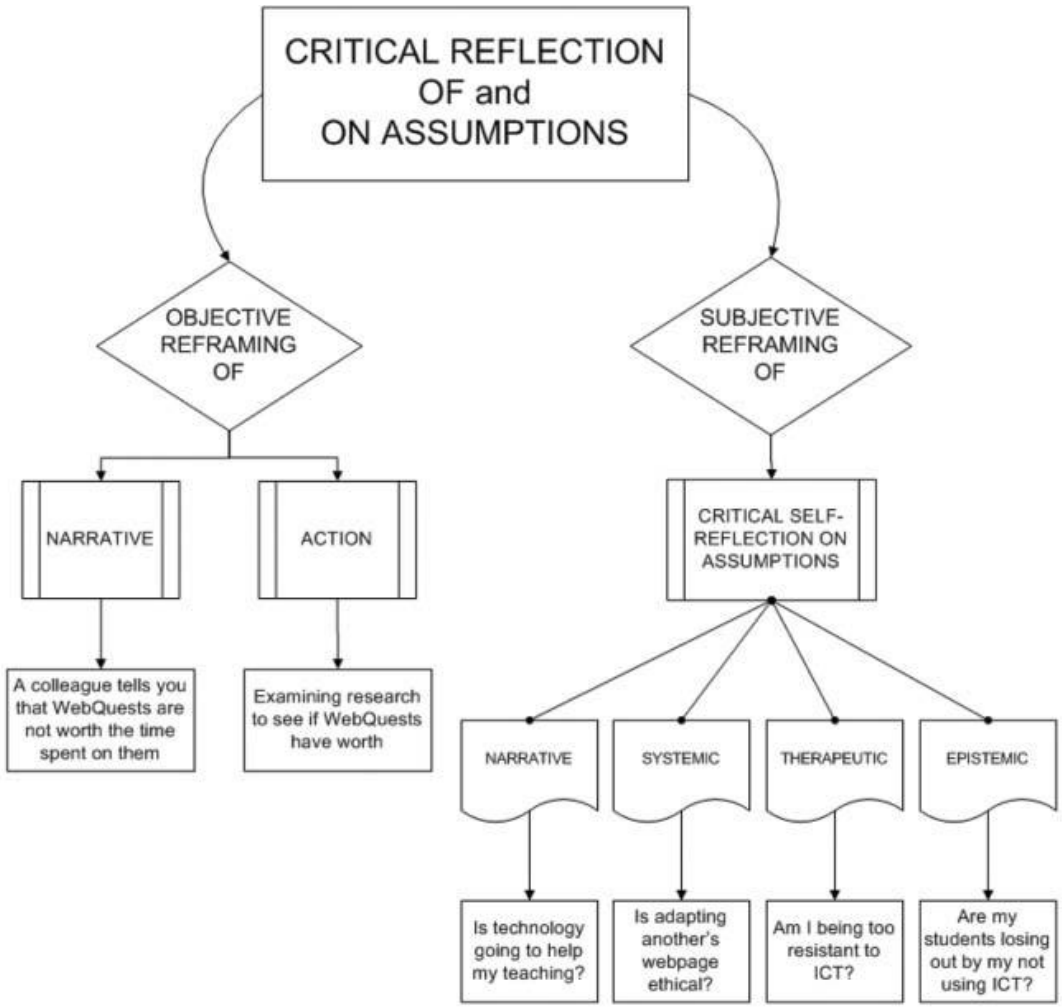

Figure 3. Mezirow's (1998b) Taxonomy of Critical Reflection of and on Assumptions

Through offering opportunities to integrate technology in assignments and professors' modeling of technology integration, preservice teachers have the opportunity to use "prior interpretation to construe a new or revised interpretation of the meaning of one's experience in order to guide future action" (Mezirow, 1996, p. 162). This transformative process might be referred to in layman's terms as a light bulb moment where previously disconnected ideas are joined together to form new meaning

Critical Reflection in Transformative Learning

A crucial part of the transformative learning process is the opportunity to critically reflect on events and experiences. This self-reflection takes place throughout the transformative process. It is this reflection that confirms prior beliefs or allows for new thoughts and actions (Mezirow, 1990). The ability to critically reflect for the purpose of developing new meanings is a skill that preservice teachers will need when faced with the challenges of the classroom, including the use of technology (Yost, Sentner, & Forlenza-Bailey, 2000). Taylor (2011) described three types of reflection required for the transformation of meaning perspectives: 1) Content Reflection – reflecting on the way one thinks, feels, and acts; 2) Process Reflection – reflecting on how one assign meaning; and 3) Premise Reflection – reflecting on why one sees things the way one does.

In a study of reflection in higher education, Kreber (2004) interviewed 36 faculty members to explore their reflective practices within the domains of instructional, pedagogical, and curricular knowledge. Using a repertory grid, faculty were asked to think about their beliefs in relation to reflection on teaching. All participants were able to provide concrete examples of content reflection. This was an indicator that all participants could express what they know about instruction, pedagogy, and curriculum or content reflection. While 66% of participants could give specific examples of process reflection in instructional and pedagogical knowledge, only 20% could give examples of premise reflection in the area of curricular knowledge (Kreber, 2004). This led to speculation that while faculty say they reflect on certain domains of knowledge, they could not demonstrate this reflection with concrete examples. “Both process and premise reflection were identified the least often for the domain of curricular knowledge (knowledge about the purposes and goals of teaching) and premise reflection the least often across all three knowledge domains” (Kreber, 2004, p. 41). Without reflection in all three areas of reflection, faculty will not change how and why they teach. Without this transformative experience themselves, faculty will not be able to model or provide preservice teachers with a transformative learning experience.

Adults bring their experiences, ideals, and beliefs into the post-secondary classroom. These experiences work together to shape a student's frame of reference (Merzirow, 1997). While it can be argued that post-secondary students are not adults in the truest sense of the word, they do have a wealth of experiences, both good and bad, garnered over twelve to fifteen years of schooling. Students need the opportunity for authentic practice to develop a trusting, safe environment necessary for critical reflection. It is this critical reflection that allows transformative learning to take place (Mezirow & Taylor, 2011). Without the opportunity to critically reflect on past and present classroom experiences, preservice teachers cannot develop the expanded frame of reference required for transformative learning. Learning experiences and reflecting on those experiences can help students develop new ways of seeing and understanding which can lead to the questioning of existing assumptions and beliefs (Dirkx, 1998, pp. 9-10). Transformative learning takes these assumptions or points of view and expands them to form new habits of the mind and new ways of knowing.

According to Mezirow and Taylor (2011), this transformational process can occur in several ways; existing beliefs can be elaborated upon, new beliefs or meaning schemes can be learned, meaning can be transformed, or the meaning perspective can be transformed. When faculty challenge traditional academic roles and become mentors to their students, they can better facilitate transformative experiences in the classroom (Mandell & Herman, 2009).

An analysis of 41 studies conducted between 1999 and 2005 that used transformative learning as the primary theoretical framework with methodological and findings sections that contributed to the body of knowledge of transformative learning, suggests that transformative learning can be adapted and combined with other research strategies to create a flexible approach well suited to many disciplines and context (Taylor, 2007). In this critical review of empirical studies, Taylor (2007) grouped this research in the following areas according to how each informed a particular aspect of transformational learning: the understanding of fostering transformative learning (20 studies); transformative learning in relation to distance learning or technology integration in a higher education setting (4 studies); essential components such as critical reflection (3 studies), relationships (3 studies), and purpose (3 studies); and transformational learning in specific context such as personal crises or alternative education programs (8 studies). Taylor found a shift from research about the “possibility and process of transformative learning occurring in a particular context or result of a particular life event, and more research about the nature of a learning experience and how it informs our understanding of transformative learning” (Taylor, 2007, p. 176). An updated review in 2010 found an additional 49 studies conducted between 2006 and 2010 that used transformational learning as the theoretical framework. The majority of this new research was found to inform transformational learning in three primary areas: cross-cultural research (14 studies), the growing significance of relationships (9 studies), and ways to foster transformative learning (18 studies) (Taylor and Snyder, 2012).

Fostering Transformative Learning

The studies reviewed by Taylor (2007) that focused on ways to foster transformational learning took place in almost exclusively in higher education settings and included graduate level classes and faculty professional development. These studies covered a variety of disciplines such as medical education, environmental education, and cooperative extension programs. In an update of this research, an additional 18 studies were conducted during 2006-2010 that were found to be centered on fostering transformational learning (Taylor & Snyder, 2012).

One mixed methods study (King, 2004) that contributed to the body of knowledge of ways to foster transformational learning in higher education, surveyed 58 adult educators who were also graduate students enrolled in an education foundations course. The professor of the course was interviewed for insights into the needs of the students, obstacles to transformative learning, and recommendations for providing a transformative experience for students. King (2004), found that learning activities had more of an impact (86.1%) on transformative learning than other people (72%) or life changes (29%). The results of this study demonstrate that learning experiences in the classroom which lead to questioning and highlighting critical reflection help to expand both the habits of the mind and frames of reference for students.

In another mixed-method study, King (2002) surveyed 175 in-service and preservice teachers to identify those who had a transformative experience within a Master’s level educational technology course. Forty-five participants who self-reported a transformative experience were then selected for in-depth interviews. Participants reported that some particular learning activities which facilitated their transformative experience included class discussion (40.6%), “hands-on” experience (37.7%), and reflective activities (32.0%). King found a “radical alteration of teaching perspectives and practice are possible. Rather than solely aiming for modified curriculum, professional development initiatives can be used to cultivate new views of teaching and learning” (King, 2002, p. 295).

Gravett (2004) interviewed 60 higher education faculty participants who took part in a series of four workshops designed to foster transformative learning in higher education. According to this study, participants responded positively to reflection on their existing teaching practices and were open to other alternatives. However, when asked to implement a dialogic teaching approach, which challenged both habits of the mind and frames of reference, faculty participants reported feelings of insecurity and a desire for more detailed guidance (Gravett, 2004). Participants wanted a model for the new teaching method and continual support before feeling comfortable enough to use the dialogic model of teaching in their classrooms (Gravett, 2004).

Transformative Learning in Distance Learning or Technology Integration

One of the studies cited by Taylor (2007) was a study of 41 in-service teachers and 6 preservice teachers enrolled in a technology integration course as part of a graduate teacher preparation program. This phenomenological study looked at the changes in teaching adult educators experienced while enrolled in this technology integration course (King, 1999). King, (1999) found that 91.5% of participants reported a change in perspective of using technology to support learning. Factors influencing this change were hands-on activities (40.4%), discussions (38.3%), reflections (34%), and challenges from the teacher (31.9%). Taylor (2007) suggests the lack of research studies looking at online learning and technology through a transformative learning lens shows this is a relatively area needing additional research.

Essential Components of Transformative Learning

A grounded theory study by Cranton and Carusetta (2004), looked at 23 faculty members over a 3-year period to explore authenticity in teaching. Critical reflection was found to be a key component of authentic teaching. This critical reflection encompassed the areas of self, other, relationships, and context. Cranton and Carusetta (2004) hypothesize that teachers who reflect critically in these areas are more likely to be authentic by not unconsciously accepting all the components of teaching and learning. This speaks to the importance of critical reflection to the process of changing the habits of the mind.

In a study of 9 career women, Carter (2002) found that when women communicated with other women in a supportive role within the workplace, a transformative environment was created. This environment led to women who felt comfortable enough to voice their thoughts while at the same time listening to the voices of others. This communication helps support these women both professionally and personally while minimizing the competitive nature of the workforce. This transformative experience was facilitated by the relationships developed with other participants in the study which led to an environment of acceptance, mutual respect, and lack of judgement (Carter, 2002).

A study of personal crisis through a transformative lens was conducted by Courtenay, Merriam, Reeves, and Baumgartner (2000) as a follow up to their previous research that looked at 18 participants who were HIV positive and had participated in a study of the centrality of meaning- making in transformative learning. The researchers looked at whether these participants maintained their transformative views two years after their initial HIV diagnosis or if they reverted back to their old ways of thinking. The researchers found the participants were more focused on the future, had a greater awareness of the need to take care of themselves, and had integrated living with an HIV-positive diagnosis into their lives. The researchers found a significant shift from content reflection to process reflection and meaning perspective from self to other (Courtenay et al, 2000).

Criticisms of Transformative Learning

Critics of transformative learning theory say that all learning is transformative, the transformation is only reported by the learners themselves, and learning is a finite process (Newman, 2012). Cranton and Kasl (2012) remind us while there were limits to Mezirow's initial concept of transformation learning in the 1970s, scholars such as Dirkx, Taylor, and Cranton have taken the original concept of transformational learning and elaborated on it, calling for a unified theory of an educational process that has an ebb and flow much like the learning process itself. To address any gaps in the original idea of transformational learning theory, many researchers are using additional theoretical frameworks to better and more distinctly define the assumptions upon which the study is based, thereby creating an integrated model of transformative learning. These gaps include the non-linear process of learning; the impact of relationships, thoughts and feelings; and the cumulative effects of experiences (Baumgartner, 2001). An update of review of transformational studies conducted between 2006 and 2010 found a shift in research to the areas of cross-cultural research (14 studies) and the growing significance of relationships (9 studies), (Taylor & Snyder, 2012). These additional studies show transformational learning theory has adapted to address these gaps in the original framework proposed by Mezirow in the early 1970's.

Examples of additional theoretical frameworks found in Taylor's (2012) updated review of research include Africentrism, critical theory, critical social theory, new grief theory, and the Contextualized Model of Adult Learning (Taylor & Snyder, 2012). The studies that included an additional theoretical framework did so because Mezirow's framework did not adequately account for the assumptions of the research problem being studied. For example, one study included a critical lens framework to account for power relations that Mezirow's framework did not address in its early version (Taylor & Snyder, 2012).

To address concerns about gaps in the theoretical framework and to reflect additional research, Mezirow refined the theory of transformational learning several times. The updated theory contained components that addressed relationships (1991), emphasized critical reflection (1995), further defined critical reflection to include assumptions and critical reflection on those assumptions (1997), and emphasized transforming points of view and habits of the mind (2000). This research is based on Mezirow's updated transformational learning theory that "like all strong theories, has been critiqued, tested, revised, and retested throughout the past three decades (Kitchenham, 2008, p. 119).

Summary

While many organizations have focused on the skills needed by 21st century teachers and technology standards required by teacher preparation programs, much of the research has been focused on K-12 classrooms or methods courses. There is an increasing call for professional development to address the needs of technology integration as a part of redesigned teacher preparation programs (Strehle, 2002). "To date, the response of universities and colleges has been ultraconservative, focusing on protecting and enhancing the traditional model of teaching and learning, even though the context of postsecondary education has changed dramatically" (Bates & Sangra, 2011, p. 51).

As technology integration becomes more important in the accreditation process, teacher education programs will continue to address technology in new and different ways. To prepare students for success in the digital age, we must prepare teachers to teach in the digital age. Because this researcher believes we construct our own realities based on our individual or shared experiences, teacher educators in the content areas can help construct the reality of technology integration for preservice teachers by modeling technology integration in their own classrooms. This modeling will help transform the preservice teacher's frame of reference and construct a new reality of what it means to integrate technology into the classroom. By exposure to more possibilities of technology use in the classroom, preservice teachers become more informed and aware of different possibilities. "One important mechanism for transfer of knowledge from one setting to another is the provision of vicarious experience, often supplied by case study reports" (Guba & Lincoln, 1994, p. 114).

The problem with this philosophical assumption and technology is if learners create their reality based on their experiences and we teach in ways that do not offer opportunities to interpret or reflect on ways to expand his or her current point of view, then preservice teachers are merely re-constructing the teacher educator's reality and not constructing their own (Jonassen, 1991). There is no transformative experience that allows for new meaning and constructs. The technology skills students develop for personal and social use does not automatically transfer to academic or pedagogical use (Bates & Sangra, 2011). Technology never becomes more than the classroom aid or production tool it has always been. By providing tools, examples, and modeling technology integration into their teaching, content teacher educators can help develop multiple perspectives that will help preservice teachers transform their current knowledge of technology into new constructs and realities. Technology training that is focused on production skills will not lead to a change to in technology integration as part of teaching (Zhao & Bryant, 2006; Vu & Fadde, 2014).

Teacher educators must include content courses when planning technology integration throughout teacher preparation programs. Preservice teachers must have the opportunity to observe best practices modeled for them prior to methods classes and their student teaching experiences. They should be given opportunities to practice with technology while in content classes, reflecting and improving on those practices. “When preparing TPACK ready teacher candidates, faculty must incorporate and model TPACK, within the teacher education curriculum, which often requires an ongoing change process” (Thomas, Herring, Redmond, & Smaldino, 2013, p. 55). As educators we must first attend to our own learning “to make meaning of our experience. . . .Then having attended to our own meaning making process, we’ll be in a position to facilitate that process in others” (Clark, 1992, p. 17).

CHAPTER III:

METHODOLOGY

Introduction

Since this researcher believes there is no singular truth about human behavior, this research was based in the interpretive/constructivist paradigm. The realities found in this research are “local, transitory, and contextually based” (Willis, Thompson, & Sadera, 1999).

The purpose of this study was to examine the current practices of teacher educators within a College of Arts and Sciences and how they integrate technology within the content courses for preservice secondary education students. An explanatory-sequential, mixed method approach using an HE-TPACK survey followed with theoretical case study was conducted to determine technology use and teacher educator’s feelings towards their preparedness to integrate technology into their classroom and the experiences they provide their preservice students.

Research Questions

The questions central to this explanatory-sequential, mixed method research study included the following:

1. What are faculty self-assessments of TPACK in the secondary education content areas of English/language arts, mathematics, science, foreign languages, and social sciences;
2. How do content area professors address the possibilities of technology integration in content courses;

3. How do content area professors make connections between technology used in everyday life and technology used in the classroom;
4. What opportunities do content professors provide for students to use technology for learning;
5. How do content area professors reflect on their experiences in the classroom; and
6. What makes content professors change the way they teach?

Mixed Methods Research Design

Mixed methods research is defined as a type of research that combines both "quantitative and qualitative research techniques, methods, approaches, concepts, and or language into a single study" (Johnson & Onwuegbuzie, 2004). A mixed methods design is recommended when the researcher wants to generalize findings to a specific population while developing a deeper understanding of the research problem (Creswell, 2003). Advantages of a mixed methods research design include: broader research questions; insights into the research problem that using one method might miss; qualitative and quantitative together can offer a more complete picture that can be used to inform practice (Johnson & Onwuegbuzie, 2004). An explanatory, sequential mixed methods design was chosen because of the need to use qualitative data to explain quantitative results and the need to use the results of the quantitative data to inform the selection of the qualitative participants (Creswell & Plano Clark, 2011).

The quantitative component of this study used the HE-TPACK survey. The HE-TPACK survey was sent to content professors in the five secondary education content areas of language arts (english and theatre), general sciences (biology, chemistry, and physics), mathematics, social sciences (history, political science), and foreign languages (French, German, Latin, and Spanish). This survey collected data on the faculty's knowledge about technology, the level of use of technology, and faculty perceptions of technology in the classroom. The results of the HE-TPACK survey determined how comfortable teacher educators in the secondary content areas were in integrate technology into their teaching.

After the data collected in during the quantitative phase was analyzed, a series of interviews were conducted with faculty members to gain a deeper understanding of technology practices and HE-TPACK results. Teacher educators were asked about their technology experiences within the content courses required or recommended for the secondary program of study, the extent to which these teacher educators integrated technology, what modeling of technology these teacher educators did, and what opportunities students had to use technology in assignments for content courses.

Setting of the Study

This convenience study took place at a research university in the Southeast United States. In the fall of 2014, the total enrollment was reported as 36,155 with 30,754 (85.1%) undergraduate students and 4,870 (13.5%) graduate students. Enrollment was almost doubled in the past 20 years; from 19,366 in 2004 to the current enrollment of 36,155.

According to reported numbers, in 2014, the College of Education enrolled 1,978 undergraduate students and 1,043 graduate students for a total enrollment of 3,021 students (OIRA, 2015). Of those undergraduate education students, 273 undergraduate students majored in secondary education with 31% in language arts (n=87); 7% in general science (n=20); 17% in mathematics (n=49); 40% in social sciences (n=110); and 2% in foreign languages (n=7). Graduate students in secondary education totaled 128 students enrolled in Masters of Education, Educational Specialists, Doctor or Education, and Doctor of Philosophy programs (OIRA, 2015).

Because this study was focused on technology in undergraduate courses, details of graduate students and courses were not a consideration.

Undergraduate Secondary Education Degree Requirements

Currently, undergraduate students majoring in the secondary education areas of language arts (english and theatre), general sciences (biology, chemistry, and physics), mathematics, social sciences (history, political science), and foreign languages (French, German, Latin, and Spanish) are required to earn a minimum of 120 semester credit hours which lead to a bachelor of science in education degree (see Appendix B for program requirements). Most secondary education programs require more than 120 semester credit hours. Of those 120 hours, 60 hours are general studies courses, 31-34 hours are considered professional studies, and the remaining credit hours (30+ hours) are taken within the content area. This means a preservice secondary education student will take at least 90 hours of their required courses outside of the College of Education.

Each content area except foreign languages includes a required methods course taught by College of Education faculty that carries a computer designation assigned and approved by the university. The secondary education clinical experience course also carries a computer designation. To carry this designation, courses must "substantially integrate the application of appropriate software or require writing computer programs. Students must make extensive use of the computer as a condition for passing the course" (University Core Curriculum and General Education Requirements, 2015). Students are required by the university to take either a six-hour sequence of computer designated courses or a six-hour sequence of foreign language courses carrying a foreign language designation as part of core education requirements. Secondary education students in content areas except foreign languages satisfy the computer requirement through their methods and clinical courses, which are taken towards the end of the program.

However, only one course within the content areas of language arts (english and theatre), general sciences (biology, chemistry, and physics), mathematics, social sciences (economics, history, and political science), and modern language classics (French, German, Latin, and Spanish) carries a computer designation; a biology course which is not required for secondary education majors. The only other courses in Arts and Sciences with a computer attribute are geography courses.

Participants

Participants were tenured faculty, non-tenured faculty, and graduate teaching assistants in the five content areas of language arts (english and theatre), general sciences (biology, chemistry, and physics), mathematics, social sciences (history, and political science), and foreign languages (French, German, Latin, and Spanish) within the College of Arts and Sciences who taught content courses required by the College of Education teacher education programs during the spring 2016 semester. The HE-TPACK survey was sent electronically to all 416 faculty and graduate teaching assistants within the content areas. Fifty-nine people completed the HE-TPACK survey for a response rate of 13%.

Originally, six faculty members volunteered to be interviewed for this study. After a second invitation sent by an administrator in the college, three additional faculty members agreed to be interviewed. These nine faculty members were interviewed to gain a deeper understanding about their technology use in their teaching, any technology required by their students during the course and their thoughts as to what instigated a change in their teaching.

Instrumentation

The HE-TPACK survey used in this study was developed by Garrett (2014) using a combination of a PT-TPACK survey designed to measure the technology and teaching knowledge of preservice teachers (Lux, Bangert, & Whittier, 2011) and a survey designed to measure faculty perception of technology training (Georgina & Hosford, 2009). The original PT-TPACK instrument developed by Lux et al (2011) consisted of a 45-item survey with a four-point Likert scale to measure each of the seven TPACK domains. Georgina and Hosford (2009) used a 24-item survey with a five-point Likert scale survey to measure teaching strategies, technology proficiency, technology training and demographics in higher education. The combination of these surveys allowed for more appropriate use of the TPACK survey in a higher education setting (Garrett, 2014).

The HE-TPACK survey (see Appendix C) used a five-point Likert scale to measure domain specific items within the TPACK framework. The Likert scale choices were strongly agree, agree, not sure, disagree, and strongly disagree. These choices were equal to the following values: strongly agree = 1, agree = 2, not sure = 3, disagree = 4, and strongly disagree = 5, thus a lower score is interpreted as a higher level of confidence. The HE-TPACK survey collected demographic data and data about teaching experience within the discipline. Each of the seven domains of TPACK were addressed with items specific to that domain. Example questions used by Garrett (2014) included

1. Technology knowledge (TK) domain contained six items. A sample TK item stated: I am familiar with a variety of hardware, software and technology tools that I can use for teaching;

2. Pedagogy knowledge (PK) domain contained four items. A sample PK item stated: I know how to assess student learning;
3. Content knowledge (CK) domain contained six items. A sample CK item stated: I have a comprehensive understanding of the curriculum I teach;
4. Pedagogical content knowledge (PCK) domain contained six items. The PCK item stated: I understand that there is a relationship between content and the teaching methods used to teach that content;
5. Technological content knowledge (TCK) domain contained six items. The TCK item stated: I understand how the choice of technologies allows and limits the types of content ideas that can be taught;
6. Technological pedagogical knowledge (TPK) domain contained six items. A sample item stated: I understand how teaching and learning change when certain technologies are used;
7. Technological pedagogical content knowledge (TPACK) domain contained eleven items. A sample item stated: I understand how digital technologies can be used to represent content in a variety of formats; and
8. Technology training section contained four items. A sample item stated: Technology training would enhance my teaching.

Changes were made to three of the HE-TPACK demographic questions to better meet the needs of this study. Question 5 was changed from “Select the primary college of which you are a member” to “Select the primary content area of which you are a member.” Question 6 was changed from “Select the primary discipline program which you are a member” to “It is important for students to see their instructors use technology in different courses.” Question 7 was changed from “How many technology training sessions have you attended in the last year” to “It is important for students to use technology for assignments or projects” to determine faculty’s views of technology. Question 8, “Are you aware of any technology standards required for teacher certification” was added to determine if faculty members were aware of technology standards required for teacher certification. If faculty in the content areas were aware of the certification requirements for other disciplines, in this case, teacher education, they might have more of a desire or incentive to include technology into their teaching.

Validity and Reliability

Establishing validity and reliability was crucial for the integrity of the research, because it verifies the quality of the research, the findings, and the results (Creswell & Plano Clark, 2011). The validity of the HE-TPACK instrument was previously established by Garrett (2014) using five expert reviewers trained in TPACK and/or instructional technology to evaluate content validity. Construct validity was supported by the negative wording of 22% of the survey questions. Reliability as established by Garrett (2014), was proven for the HE-TPACK instrument using Cronbach alpha for each domain and is shown in Table 1.

Table 1

Cronbach's Alpha Summary for HE-TPACK Domains

Domain	Cronbach's Alpha	Number of Items
Technology Training (TT)	.566	4
Pedagogical Knowledge (PK)	.863	4
Technology Knowledge (TK)	.739	6
Content Knowledge (CK)	.822	6
Pedagogical Content Knowledge (PCK)	.822	6
Technological Pedagogical Knowledge (TPK)	.805	6
Technological Content Knowledge (TCK)	.776	6
Technological Pedagogical Content Knowledge (TPACK)	.922	11

Validity in qualitative research is focused on the credibility and trustworthiness of the researcher (Lincoln & Guba, 1985). Internal validity and credibility were addressed using the strategies of triangulation, member checking, and a statement of the researcher's biases (Merriam, 1988).

The researcher reviewed the syllabi of content professors who were interviewed (triangulation), participants were asked to review the findings for accuracy (member checking), and the researcher included a position statement clarifying any biases. This also established dependability of results assuring that the results make sense and match the data collected (Lincoln & Guba, 1985). Because reliability is secondary in qualitative research (Creswell & Clark, 2007), it will not be addressed with a specific strategy, but established through quantitative measures and qualitative validity.

Data Collection

Data collection included both quantitative and qualitative strategies, collecting both numeric and text information (Creswell & Clark, 2007). This included the key components of "sampling, gaining permissions, collecting data, recording the data, and administering the data collection" (Creswell & Clark, 2007. P. 171). Data collection began after the researcher received approval from the university's Institutional Review Board (IRB). A copy of this approval is in Appendix F. Permission was granted to the researcher to use the HE-TPACK survey for this project (see Appendix E). Quantitative data were gathered first, followed by qualitative data.

Only faculty who were teaching a required or recommended course for secondary education students during the academic term in which the study was conducted were invited to participate. Each interview participant was asked for permission to record the interview and could opt out of the study at any time.

Quantitative Data Collection

Quantitative data were collected through an online survey that was distributed to 416 (113 in language arts, 128 in general sciences, 30 in mathematics, 99 in social sciences, and 46 in foreign languages) tenured, non-tenured, and graduate assistants in each of the secondary education content areas. An email with a link to an online survey created using Qualtrics was sent to the targeted faculty using the email address available through the campus directory.

The instrument was designed to allow multiple survey completions from an Internet Protocol (IP) address. This was done because of the large number of graduate students who share office space, including a desktop computer, however, it is assumed that participants only completed one survey. This was confirmed by the date stamp on the survey. The initial invitation to participate was sent to participants in February of 2016 with two additional reminders sent one week apart. Quantitative data were analyzed to determine descriptive statistics.

Qualitative Data Collection

The researcher identified participants who volunteered to be interviewed during the quantitative phase of this project. In keeping with the constructivist/interpretivist foundation of transformational learning, guiding questions were broad and open-ended to better understand the participants' views and not restrict participants' responses (Creswell & Clark, 2007). Interviews consisted of 13 basic questions and lasted approximately one hour. Follow-up and clarifying questions were asked if needed. Each interview was recorded with the participants' permission and transcribed verbatim. The results of these interviews were used to develop a picture of technology integration among content faculty members in the College of Arts and Sciences.

Interview questions focused on what each faculty member did to integrate, model, and offer opportunities for transformational learning experiences for their students. The interview questions consisted of three categories: background information to establish a foundation for the interview; technology questions used to establish the participants' view of technology in the classroom; and questions about change used to determine the participants' viewpoints and habits of technology. The guiding questions on technology were influenced by research that showed technology used in everyday life does not necessarily translate into the skills to teach with technology (Bull, 2003) and faculty members tend to teach in the same manner in which they were taught (Golde & Dore, 2001; Stein & Short, 2001). Guiding questions about change were based on Mezirow (2008) and Taylor (2011) and their work in the area of transformative learning.

Guiding interview questions (on background, technology, and change) included the following:

1. What courses do you teach for Arts and Sciences;
2. Do you have any teaching experience other than at the college level;
3. Tell me about how you learned to teach adults;
4. How do you define technology;
5. What technologies do you use in your teaching;
6. How do you use these technologies in your classroom;
7. Why did you choose these particular technologies;
8. What technologies do you require your students to use in your classroom;
9. Thinking back to when you were in school (undergraduate or graduate), what do you remember about the technology used in the classroom by your professor;
10. What role do you think technology plays in your classroom;
11. What technologies does the College of Arts and Sciences provide/support;
12. Why do you think modeling technology use in an Arts and Sciences classroom is important;
13. How comfortable are you with technology in your teaching;
14. In general how have your teaching methods changed in the past five years? In regards to technology? How? Why? What caused you to make these changes?
15. Have you ever experienced a moment in teaching (good or bad) that caused you to reconsider your use of technology? Tell me about that experience;
16. Describe how you evaluate your teaching;
17. What do you think makes people change the way they teach;

18. Are you aware that you teach preservice secondary education students; and

19. Do you know what technology proficiencies are required for preservice secondary education students?

Data Analysis

Data analysis for this study employed both quantitative and qualitative methods to address the research questions. This meant both sets of information were analyzed by preparing the data for analysis, exploring the data, analyzing the data, representing the data through statistical significance and themes, and interpreting the results (Creswell & Clark, 2007).

Quantitative Analysis

Survey results were analyzed for descriptive statistics, including frequencies mean, mode, and standard deviations using SPSS software version 23. Percentages were calculated for each of the demographic questions contained in the first part of the survey. This gave the researcher basic information about the sample population. Descriptive statistics, including mean, mode, and standard deviation were obtained for each subscale of the HE-TPACK in each domain. Because of the values associated with the Likert-scale options, lower values were associated with a higher the level of confidence in that area. Quantitative research questions and the corresponding data management plan are shown in Table 2.

Table 2

Quantitative Data Management Plan

Research Question	Measure	Dependent Variable	Analysis
1	HE-TPACK survey	Average of TPACK responses per domain	Descriptive Statistics

Qualitative Analysis

Following statistical analysis of the HE-TPACK, the researcher interviewed faculty members who volunteered to speak with the researcher further about their views on technology and change. Qualitative coding is a recurring process that is viewed and influenced by the ontological and epistemological lens through which the researcher sees his or her research. Because of this, all coding is subjective (Saldaña, 2012).

Qualitative data analysis was analyzed using a three cycle coding protocol of holistic, InVivo, and values coding to determine the most important themes from the interviews. A code is defined as a "word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data" (Saldaña, 2012, p. 3). Codes were grouped into categories, then evaluated for emerging themes. A map of the code to theme analysis is included in Appendix E.

The first cycle coding method was holistic coding. Holistic coding was used because it is helpful when the research has a preliminary idea of what information to explore (Saldaña, 2012). By looking at the data as a whole, the researcher hoped to gain a big picture view. This first coding cycle revealed nine categories with three emerging themes: 1) technology used for student engagement and learning; 2) technology used as a production tool; and 3) lack of exposure to technology integration in the classroom.

InVivo coding is recommended for all types of qualitative research, but is particularly useful in case study to preserve meaning in the participant's words. This is why InVivo coding was selected as the second method of coding. The goal of this coding was to examine the participant's interpretation of the interview questions (Saldaña, 2012). Analysis using InVivo supported the emerging themes identified through the holistic coding.

The third cycle of coding used in this study was values coding. Values coding helped determine the participants' values, beliefs, and attitudes towards a particular construct. Values coding is particularly valuable for studies looking at "intrapersonal and interpersonal participant experiences and actions in case studies" (Saldaña, 2012, p. 111). This cycle of coding looked specifically at interview questions addressing the process of change and reflection in relation to teaching. These lived experiences were important to gain an understanding of any transformative learning experiences that influenced the participants' views on technology and teaching. Table 3 contains the data plan for the qualitative research questions.

Table 3

Qualitative Data Management Plan

Research Question	Measure(s)
2.	Interview: Question 1, 2, 5, 6,7; Review of syllabi
3.	Interview: Questions 1, 2, 4,7
4.	Interview: Questions 2, 4, 13
5.	Interview: Question 9, 10, 11, 12
6.	Interview: Questions 12, 13, 14, 15, 16, 17,

Summary

Data were collected using an explanatory, sequential mixed methods design of the HE-TPACK survey and interviews. This design was appropriate because the quantitative and qualitative portions of this study were conducted separately with the qualitative results offering an explanation of the quantitative findings. This study used a previously designed survey to measure HE-TPACK of content faculty in a College of Arts and Sciences. The self-assessed

TPACK was analyzed for potential gaps between exposure, modeling, and opportunities for transformational experiences for preservice teachers before they begin taking computer designated methods and clinical experience classes later in their programs of study. Interviews were conducted with nine faculty members, giving further insight as to the technology use by faculty in the content areas. These interviews were analyzed using holistic, InVivo, and values coding to identify emerging central themes. Because the results of the quantitative data were used to inform the selection of qualitative participants, an explanatory sequential mixed methods approach was used for this research.

CHAPTER IV:

RESULTS

Introduction

The purpose of this explanatory-sequential mixed-methods study was to determine when and to what extent preservice secondary education students are exposed to technology integration while taking core and content classes in the College of Arts and Sciences. This study hoped to identify any gaps in technology integration by comparing and contrasting the results of the HE-TPACK with the themes discovered in semi-structured interviews. The research design included an online survey administered using Qualtrics and SPSS version 23 to analyze quantitative data for descriptive statistics and frequencies. Interviews were conducted to determine the extent of technology used in specific classrooms, feelings towards technology, and change agents as identified by those instructors.

The following research questions guided this study:

1. What are faculty self-assessments of TPACK in the secondary education content areas of English/language arts, mathematics, science, foreign languages, and social sciences;
2. How do content area professors address technology integration in content courses;
3. How do content area professors make connections between technology used in everyday life and technology integration used for learning;
4. How do content area professors provide opportunities for students to practice integrating technology through required assignments;

5. How do content area professors reflect on their experiences in the classroom, expanding their frame of reference for the possibilities of technology in education; and
6. What do you think makes people change the way they teach?

Sample

The nonrandom sample consisted of 416 faculty members within the College of Arts & Sciences. These particular faculty members were purposefully selected because they were teaching a course within the College of Arts & Sciences that was required or recommended for secondary education students during the term in which the research was conducted. Because the participants were purposefully selected, results of the survey are not meant to present a statistical representation that might be generalized to other populations, but rather a snapshot of this particular faculty at this particular moment in time. However, findings can be assumed to be representative of this particular group of faculty, leading to a "greater depth of information from a smaller number of carefully selected cases" (Teddlie & Yu, 2007, p. 84).

Quantitative Participants

An invitation to participate in the survey was sent via email to all 416 faculty members with 56 responding for a response rate of 13%. Though web and email surveys typically do not have as good a response rate as mailed surveys, this is lower than the desired 60% response rate for mailed surveys (McPeake Bateson & O'Neill, 2014). The sample was compromised of 52% male and 48% female. Survey responses indicated that 14% were professors (n=8); 13% were associate professors (n=7); 18% were assistant professors (n=10); 7% were adjunct (n=4); 2% were clinical/lecture track faculty (n=1); 4% were instructors (n=2); 13% were full-time temporary instructors (n=7); 7% were part-time temporary instructors (n=4); and 23% were graduate teaching assistants (n=13). Of those responding, 28% were tenured faculty (n=15); 15% were tenure track faculty (n=8); and 57% were neither (n=31) tenured or tenure track. Two respondents did not indicate their faculty position.

From this sample, 15% indicated less than one year of teaching experience (n=8); 24% specified 1-4 years of teaching experience (n=13); 35% indicated 5-9 years of teaching experience (n=19); 9% indicated 10-14 years of teaching experience (n=5); 13% selected 15-19 years of teaching experience (n=7); and 5% indicated 20 or more years of teaching experience (n=3). The 56 survey participants represented all of the secondary content teaching areas with 20% (n=11) in language arts; 27% (n=15) in general science; 9% (n=5) in mathematics; 27% (n=15) in social sciences; and 18% (n=10) in foreign languages. Figure 4 offers a visual representation of all content area responses. Complete descriptive statistics are represented in Table 4.

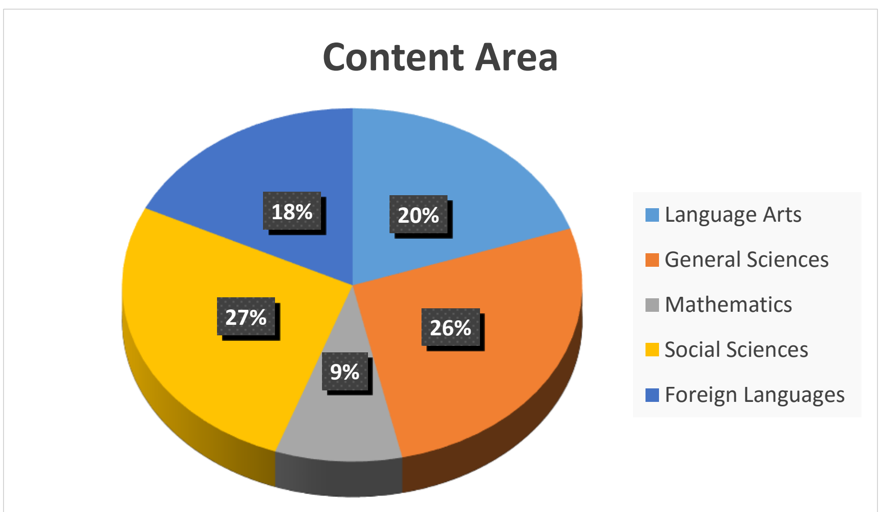

Figure 4. Content area responses

When asked if it was important for students to see their instructors use technology in different courses, 21% (n=12) strongly agreed; 55% (n=31) agreed; 13% (n=7) were not sure; 7% (n=4) disagreed; and 4% (n=2) strongly disagreed. Participants indicated that it was important for students to use technology for assignments or projects with 29% (n=16) strongly agreeing; 48% (n=27) agreeing; 11% (n=6) not sure; 9% (n= 5) disagreeing; and 4% (n=2) strongly disagreeing. A majority of 93% (n=52) of respondents were not aware of any technology standards required for teacher certification.

Table 4

Demographic Descriptive Statistics

	Responses	n	%
Gender	Male	30	54%
	Female	26	46%
Academic Ranking	Professor	8	14%
	Associate Professor	7	13%
	Assistant Professor	10	18%
	Adjunct	4	7%
	Clinical Instructor	1	2%
	Instructor	2	4%
	Full-Time Temporary Instructor	8	14%
	Part-Time Temporary Instructor	4	7%
	Graduate Teaching Assistant	12	21%
Tenure Status	Tenured	15	28%
	Tenure-Track	8	15%
	Neither	31	57%
Teaching Experience	Less than 1	8	15%
	1-4 years	13	24%
	5-9 years	19	35%
	10-14 years	5	9%
	15-19 years	7	13%
	20+ years	3	5%
Content Area	Language Arts (English, Theatre)	11	20%
	General Science (Biology, Chemistry, Physics)	15	27%
	Mathematics	5	9%
	Social Sciences (History, Psychology, Political Science)	15	27%
	Foreign Languages (French, German, Latin, Spanish)	10	18%

Qualitative Participants

All of the 416 faculty participants were invited to be interviewed to give further insights as to their thoughts on the use of technology in the classroom, the role technology plays in learning, and their thoughts on change and change agents. Of the 416 participants, only six faculty members volunteered to be interviewed. After a second invitation sent by an administrator in the college, three additional faculty members agreed to be interviewed for a total of nine faculty members who were interviewed. A general description of each interview participant can be found in Table 5.

Table 5

General Description of Interview Participants

	General Description	Avg. TPACK Score
A	Female, Foreign Language graduate teaching assistant with 7 years' experience	1.67
B	Female, tenure-track, assistant professor in Language Arts with 8 years' experience	1.97
C	Male, tenure-track, assistant professor of General Science with 8 years' experience	2.38
D	Female, tenured, associate professor in General Sciences with 15 years' experience	1.97
E	Female, Social Sciences graduate teaching assistant with 4 years' experience	2.12
F	Male, Social Sciences graduate teaching assistant with 5 years' experience	1.84
G	Female, tenured-track, assistant professor in General Sciences with 18 years' experience	1.82
H	Male, adjunct Social Sciences teacher with 6 years' experience	2.03
I	Male, adjunct Social Sciences teacher with 15 years' experience	2.39

Quantitative Results

Descriptive statistics including mean, mode, standard deviation, and frequencies were calculated using SPSS. The average TPACK score was also calculated for each interview participant and is shown as part of the general description of the participants in Table 5. Participants were asked to evaluate their ability to integrate technology, pedagogy, and content to improve student learning. The Likert scale choices were strongly agree, agree, not sure, disagree, and strongly disagree. These choices were equal to the following values: strongly agree = 1, agree = 2, not sure = 3, disagree = 4, and strongly disagree = 5. Since the purpose of this study was to look at when and how preservice secondary education students are exposed to technology within the content areas taught in Arts and Sciences, only descriptive statistics and frequency percentages were calculated.

Research Question 1

What are faculty self-assessments of TPACK in the secondary education content areas of English/language arts, mathematics, science, foreign languages, and social sciences? Participants were asked to evaluate their ability to use technology, pedagogy, and content knowledge to improve student learning using a five-point Likert scale value. The Likert scale choices corresponded with numerical values as follows: strongly agree = 1, agree = 2, not sure = 3, disagree = 4, and strongly disagree = 5. The mode was included to demonstrate the similar values between Likert options versus including only the average of each domain.

Technology training. Survey questions 9, 10, 11, and 12 asked participants about technology training at the research university. The mean for this section was 2.41 and the mode was 2.00 (See Table 6). This indicates that the majority of participants felt that technology training is important. For example 19.6% (n=10) strongly agreed and 43.1% (n=22) agreed that their teaching would be improved with technology training. In spite of a recognition of the impact of technology training on teaching, 48% of respondents either strongly agreed (19.2%) or agreed (28.8%) that technology training should not be a requirement for faculty. However 71.1% of respondents strongly agreed or agreed that technology training should be offered by each academic department. Table 6 shows the descriptive statistics for the technology training section.

Table 6

Technology Training Frequency Percentages (n=59)

Survey Item	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
9. Technology training would enhance my teaching.	19.6	43.1	15.7	17.6	3.9
10. It is the University's responsibility to train me to use technologies that will enhance my teaching.	11.5	40.4	23.1	21.2	3.8
11. The University should not make technology training a requirement for faculty.	19.2	28.8	25.0	25.0	1.9
12. Technology training should be offered in each academic department at my university.	19.2	51.9	17.3	11.5	0

Pedagogy knowledge (PK) domain. Survey questions 13, 14, 15, and 16 examined participant's self-evaluation of their pedagogy knowledge. The mean for this section was 1.85 and the mode was 2.0 (see Table 6). This showed the participants are aware of pedagogical methods for teaching and assessment. A strong majority of respondents either agree or strongly agree that they have an understanding of pedagogy (88.5%); practices, strategies, and methods (90.4%); assessment (90.4%); and motivation (82.7%). Table 7 depicts the descriptive statistics for all items in this area.

Table 7

Pedagogy Knowledge (PK) Frequency Percentages (n=59)

Survey Item	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
13. I have a clear understanding of pedagogy (e.g. designing instruction, assessing students' learning).	30.8	57.7	5.8	5.8	0
14. I am familiar with a wide range of practices, strategies, and methods that I can use in my teaching.	30.8	59.6	5.8	3.8	0
15. I know how to assess student learning.	30.8	59.6	5.8	3.8	0
16. I know how to motivate students to learn.	30.8	51.9	15.4	1.9	0

Technology knowledge (TK) domain. Technology knowledge (TK) was addressed by survey questions 17, 18, 19, 20, 21, and 22. The mean for the section was 2.68 while the mode was 2.66 (see Table 6). This indicated a level of confidence and understanding of using technology in the classroom as well as how technology can impact teaching. There is still a lack of confidence among respondents as to their level of comfort with technology when something goes wrong with the technology with 36.5 % indicating that they are not confident in their ability to troubleshoot problems. See Table 8 for complete descriptive statistics for the Technology Knowledge component of the survey.

Table 8

Technology Knowledge (TK) Frequency Percentages (n=59)

Survey Item	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
17. I am familiar with a variety of hardware, software and technology tools that I can use for teaching.	30.8	57.7	5.8	3.8	1.9
18. I know how to troubleshoot technology problems when they arise.	25.	38.5	17.3	17.3	1.9
19. I do not know how to use technology in my everyday life.	1.9	0	3.8	42.3	51.9
20. I recognize that technology use can have positive and negative effects.	51.9	48.1	0	0	0
21. I cannot decide when technology can be beneficial to achieving a learning objective.	0	13.5	9.6	55.8	21.2
22. I can decide when technology may be detrimental to achieving a learning objective.	21.2	59.6	9.6	7.7	1.9

Content knowledge (CK) domain. Questions 23, 24, 25, 26, 27, and 28 looked at respondents' content knowledge. The mean and mode for this domain were 1.41 and 1.00, respectively. This shows a high level of confidence in the respondents' self-evaluation of their knowledge of the content area in all areas. This is confirmed by the 98.1 % of respondents who indicated they either agree or strongly agree that they have a comprehensive understanding of the curriculum they teach. A strong self-evaluation in this area is expected given the content expertise of the faculty. Table 9 represents the descriptive statistics for the survey items in this section.

Table 9

Content Knowledge (CK) Frequency Percentages (n=59)

Survey Item	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
23. I have a comprehensive understanding of the curriculum I teach.	71.2	26.9	0	1.9	0
24. I understand how knowledge in my discipline is organized.	63.5	36.5	0	0	0
25. I am familiar with the common preconceptions and misconceptions in my discipline.	53.8	46.2	0	0	0
26. I can explain to students the value of knowing concepts in my discipline.	59.6	40.4	0	0	0
27. I can make connections between the different topics in my discipline.	69.2	28.8	1.9	0	0
28. I stay abreast of new research related to my discipline in order to keep my own understanding of my discipline updated.	48.1	44.2	5.8	1.9	0

Pedagogy content knowledge (PCK) domain. Responses for survey questions 29, 30, 31, 32, 33, and 34 produced a mean of 1.71 and a mode of 1.83 as indicated in Table 6. This indicated the majority of respondents understand the connection between how to teach and what they teach. For example, 48.1% of participants strongly agree and 46.2% of participants agree that they are able to provide multiple representations of content in the form of analogies, examples, demonstrations, and classroom activities. See Table 10 for the descriptive statistics for this section.

Table 10

Pedagogy Content Knowledge (PCK) Frequency Percentages (n=59)

Survey Item	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
29. I understand that there is a relationship between content and the teaching methods used to teach that content.	36.5	57.7	3.8	1.9	0
30. I can anticipate students' preconceptions and misconceptions.	21.2	73.1	3.8	1.9	0
31. I can address students' preconceptions and misconceptions.	26.9	73.1	0	0	0
32. I understand what topics or concepts are easy or difficult to learn.	30.8	65.4	3.8	0	0
33. I can provide multiple representations of content in the form of analogies, examples, demonstrations, and classroom activities.	48.4	46.2	5.8	0	0
34. I can adapt material to students' abilities, prior knowledge, preconceptions, and misconceptions.	38.5	57.7	3.8	0	0

Technology pedagogy knowledge (TPK) domain. Survey questions 35, 36, 37, 38, 39, and 40 contained items for the self-evaluation of technology pedagogy knowledge (TPK). The mean for this section was 2.89 with a mode of 3.00 (see Table 6). This indicated that participants felt somewhat confident in their ability to integrate technology and pedagogy. For example, 61.5% of participants agree and 19.2% strongly agree that they know how to be flexible when using technology to support teaching and learning. Table 11 shows all descriptive statistics for this section.

Table 11

Technology Pedagogy Knowledge (TPK) Frequency Percentages (n=59)

Survey Item	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
35. I understand how teaching and learning change when certain technologies are used.	26.9	48.1	19.2	3.8	1.9
36. I do not understand how technology can be integrated into teaching and learning to help students achieve specific pedagogical goals and objectives.	0	15.4	9.6	50.0	25.0
37. I do not know how to adapt technologies to support teaching and learning.	0	9.8	7.8	58.8	23.5
38. I know how to be flexible with my use of technology to support teaching and learning.	19.2	61.5	13.5	5.8	0
39. I cannot reconfigure technology and apply it to meet instructional needs.	1.9	11.5	19.2	51.9	15.4
40. I understand that in certain situations technology can be used to improve student learning.	32.7	63.5	0	1.9	1.9

Technology content knowledge (TCK) domain. Questions 41, 32, 43, 44, 45, and 46 evaluated respondent's self-evaluation of technology content knowledge. The mean for this section was 2.97 and the mode was 3.0. This indicates an understanding of the need to integrate technology in a context with content. For example, 62.7% agree and 19.2 % strongly agree that they are aware of how different technologies can be used to provide multiple representations of the same content. Table 12 depicts the descriptive statistics for the technology content knowledge domain.

Table 12

*Technology Content Knowledge (TCK) Frequency Percentages **(**n=59**)***

Survey Item	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
41. I cannot select and integrate technological tools appropriate for use in specific disciplines (or content).	0	7.8	13.7	47.1	31.4
42. I understand how the choice of technologies allows and limits the types of content ideas that can be taught.	27.5	47.1	11.8	11.8	0
43. I do not understand how some content decisions can limit the types of technologies that can be integrated into teaching and learning.	2.0	9.8	17.6	47.1	23.5
44. I am aware of how different technologies can be used to provide multiple and varied representations of the same content.	19.6	62.7	11.8	5.9	0
45. I cannot select specific technologies that are best suited for addressing learning objectives in my discipline.	0	7.8	13.7	52.9	25.5
46. I understand that I need to be flexible when using technology for instructional purposes.	35.3	51.0	5.9	5.9	2.0

Technology pedagogy content knowledge (TPCK) domain. Survey questions 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, and 57 address Technology Pedagogy Content Knowledge (TPACK). The mean for this domain was 2.39 and the mode was 2.36. This indicates an understanding of the need to integrate technology, pedagogy, and content for student learning. However, 11.8% were not sure, 7.8 % disagreed and 2.0% strongly disagreed as to what made certain concepts difficult to learn for students and how technology can be used to leverage that knowledge and improve student learning. This indicates that while respondents recognize the need to use technology, pedagogy, and content to facilitate student learning, they might not know exactly how to do that. Table 13 offers descriptive statistics for the Technology Pedagogy Content Knowledge domain.

Table 13

Technology Pedagogy Content Knowledge (TPACK) Frequency Percentages (n=59)

Survey Item	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
47. I can effectively integrate educational technologies to increase student opportunities for interaction with ideas.	20.0	62.0	8.0	10.0	0
48. I have different opportunities to teach specific curriculum content topics with technology.	15.7	54.9	13.7	15.7	0
49. I can use appropriate instructional strategies to teach specific curriculum content topics with technology.	15.7	66.7	9.8	7.8	0
50. I cannot determine when a technology resource may fit with one learning situation in my discipline, and not with another.	3.9	7.8	9.8	60.8	17.6
51. I can flexibly incorporate new tools and resources into content and my teaching methods to enhance learning.	15.7	72.5	2.0	9.8	0
52. I understand how digital technologies can be used to represent content in a variety of formats.	21.6	68.6	2.0	7.8	0
53. I can use teaching methods that are technology-based to teach content and provide opportunities for learners to interact with ideas.	24.0	60.0	8.0	6.0	2.0
54. I understand what makes certain concepts difficult to learn for students and how technology can be used to leverage that knowledge and improve student learning.	13.7	64.7	11.8	7.8	2.0
55. I do not understand how to integrate technology to build upon students' prior knowledge of curriculum content.	2.0	7.8	11.8	56.9	21.6
56. I know how to operate classroom technologies and can incorporate them into my particular discipline to enhance student learning.	35.3	51.0	2.0	9.8	2.0
57. I know how to integrate the use of educational technologies effectively into curriculum-based learning.	23.5	60.8	5.9	7.8	2.0

Summary

Descriptive statistics, including mean (M), mode (Mo), and standard deviation (SD) are shown for each of the domains for the HE-TPACK and are shown in Table 14. As indicated by TPACK scores, participants understand the need to integrate technology, pedagogy, and content and feel fairly confident in their ability to do so. While participants indicated a lower level of confidence in the domains of Technology Content Knowledge (TCK) and Technology Pedagogy Knowledge (TPK), they reported a higher level of confidence in their abilities in the domains of Pedagogy Knowledge (PK), Content Knowledge (CK), and Pedagogical Content Knowledge (PCK).

Table 14

TPACK Domain Descriptive Statistics

Domain Scales	M	Mo	SD
Technology Training	2.41	2.00	1.02
Pedagogy Knowledge (PK)	1.85	2.00	.73
Technology Knowledge (TK)	2.68	2.66	.83
Content Knowledge (CK)	1.41	1.00	.54
Pedagogy Content Knowledge (PCK)	1.71	1.83	.55
Technology Pedagogy Knowledge (TPK)	2.89	3.00	.85
Technology Content Knowledge (TCK)	2.97	3.00	.89
Technology Pedagogy Content Knowledge (TPACK)	2.39	2.36	.86

Qualitative Results

Data for the qualitative portion of this study were collected through interviews with survey participants. The original intent was to interview one high scoring TPACK faculty member and one low scoring TPACK faculty member in each content area. Due to the low response rate to the request for interviews, all those who agreed to be interviewed were interviewed. Four of the five content areas were represented with mathematics being the only content area not represented.

After conducting the interviews, the researcher transcribed the recorded interview verbatim using Microsoft Word. Field notes taken during the interview were written as soon as possible after each interview while still fresh on the mind of the researcher. The data were analyzed using holistic, InVivo, and values coding to identify emerging themes from the interviews.

After coding the interviews, three holistic themes emerged from the data: technology used for student engagement and learning; technology used as a production tool; and lack of exposure to technology integration in the classroom. These themes were confirmed and reiterated by the participants when the interviews were coded using InVivo analysis. Analyzing the data through values coding confirmed the impact transformative experiences had on the participants' teaching.

Research Question Two

How do content area professors address the possibilities of technology integration in content courses? This question was answered through emerging themes discovered through the coding of interviews and a review of the syllabi of interview participants. When asked a series of questions about the role technology plays in the classroom, two themes were discovered, technology for student learning and technology for production and communication. Themes discovered through interview coding are presented first followed by confirming evidence from reviewing the participants' syllabi for the specific courses in question.

Four of the nine interviewees mentioned using technology in ways that enhance student learning. Three of the participants were fairly new to teaching with one being a graduate teaching assistant in the final semester of a Ph.D. program and the other two within five years of completing their respective Ph.D. programs. The fourth participant has taught for almost twenty years. Participant A mentioned several projects using social media as a means of exploring other cultures in a "fun and relatable way." In addition to using video and imaging enhancing technology, Participant A had the following to say about the integration of technology for learning:

> I use Pinterest and all the social media. But I also use tablets and computers and iPhones. We use the actual devices and then we use the programs that enhance and organize their language learning. My biggest thing is with social media. Trying to get them to explore real world perspectives from within the language learning classroom.

Participant B indicated an extensive integration of technology in her class by both students and teacher. Teaching is this participant's second career with the first being software development. Because of this background and comfort level with technology, participant B incorporates "online survey tools, digital collaborations, Dropbox, Google Docs or Microsoft Docs, spreadsheets, basic video production, and infographics" as part of her teaching.

Participant C, who taught a science course, used a student response system, known as clickers to not only assess students, but also to facilitate student interaction and discussion in the classroom. "I ask questions that are often difficult or based on a misconception. If I see that only 20 to 30 or maybe even 40% of the class has the right answer, I can then see that they might benefit from a discussion with their neighbor."

Participant G used GPS, iPad, and smartphones to have students' access data and resources in real time. She said,

> There are things I can do now that I couldn't have done ten years ago, like using the GPS unit. But now watches and phones to the same thing. I do have to tell them not to use their phones…that they need to learn to use a handheld GPS and understand why it works. Otherwise it is just their phone tracking them and they don't know how or why it works.

The other five participants interviewed mentioned using technology only in terms as a production tool or for communication. Using Microsoft Word to type a paper is an example of using technology for production rather than student engagement. Words used to describe technology by these participants were efficient, organization, communication, and convenience. Microsoft Word, Microsoft PowerPoint, Blackboard Learning Management System, and email were given as specific examples of technologies used in these classrooms. Participant F requires students to use "Blackboard to access course information and be able to type on a word processor." These participants viewed technology as a production tool rather than a way to engage student participation and collaboration.

While the five participants all mentioned using PowerPoint in terms of integration, the participants could not give a specific example of how they use PowerPoint to create learning environments that encouraged collaboration (McCormick, 2004), cooperation, and communication with opportunities for interaction between student and teacher (Vallance & Towndrow, 2007). Because participants referred to PowerPoint in terms of a delivery method to convey a message, and not adding any value to the learning experience (Vallance & Towndrow, 2007), these participant use PowerPoint as a tool for delivery. Participant F gave an example of this saying, "The problem with PowerPoint is that it is linear. It is a linear presentation of material. If you get a tangent, it is a barrier.” This shows a lack of understanding of how a technology tool can be used for student learning and engagement.

All participants mentioned Blackboard, the learning management system provided by the university, as a necessity. However, none of these six participants mentioned using Blackboard for collaborative learning, but rather as a communication tool and a way for students to “see their grades faster.” When asked to explain how she used Blackboard, Participant G commented that she “loved it for communication.” Participant F stated technology was a “tool” in his hands, but a “distraction” in the hands of students and he would ban laptops from the classroom if he could because he thought students were better served taking handwritten notes.

A holistic review of the participants’ syllabi confirmed the themes discovered in the interview analysis that technology is used for to facilitate student learning in specific cases. In other cases, it is used for production and communication.

Three of the nine syllabi specifically mentioned activities involving technology as a part of student engagement, achievement, or assessment. These three content professors integrate technology into the content. Participant B’s syllabus shows the connection to technology used for student learning by stating the learning goals for her class as:

> We will investigate the social web and explore a number of modes of digital composing for Internet audiences. We will make different kinds of digital media including memes, podcasts, videos, and Tweets. We will examine the audience expectations of each genre, as well as the tropes, networks of delivery, and monetization of media texts, and communities. This course will get you started thinking how audiences, identities, and economies are shaped by social and digital medias.

The other six syllabi reviewed did not mention the use of technology other than requiring Internet for access to Blackboard learning management system, or requiring Microsoft Word for typing required papers. Assignments required for six of the nine courses made no mention of projects or any student-centered activities.

Based on these interviews, the four faculty members who integrate technology for student learning, use it in meaningful ways to improve student engagement. They create learning environments that encourage collaboration and interaction. However, the majority of those interviewed do not address technology integration as they still think of technology in terms of production or communication, emphasizing efficiency, not student learning.

Research Question Three

How do content area professors make connections between technology used in everyday life and technology integration used for learning? When discussing what technologies were required of students to complete assignments and how those technologies were used by the students, several topics where routinely mentioned by the interview participants. Through the coding process, two themes emerged from this line of questions: a connection between students and the material and developing critical thinking skills.

Four of the interview participants spoke at length about using social media, smart phones, blogs, and webpages in the classroom to facilitate a connection between the students and the material. Technology in the classroom was used to help “develop a connection to the material” and to “create experiences where learners connect.” This connection was spoken of in terms of students connecting with other students and helping students find the “relevance” in what they were learning. This connection to other students and to the material created a learning environment that encouraged student involvement in the learning process.

Participant A reflected on a comment made by one of her students saying “They said they enjoyed it [Pinterest] because it was relevant, because it was what they are using in their everyday life and it made it more interesting and interactive.” Participant B spoke of a desire to help students develop skills that would help them in their future careers. This participant made the connection between technology used for learning and everyday life as developing technology skills necessary for a position in the workplace saying:

> The undergrad students in technical writing…they are going to produce infographics and websites. They are going to produce the physical, the public service announcement videos. They will have a lot less of the essay writing and a lot more of the 'here is the digital object I made and here is the oral presentation that explains it'. My visualization of those students is that they are opting for those technical writing classes because they hope to have careers in those areas.

Participant G mentioned she had her students use their smart phones a great deal in class. As part of lab activities, students could use their phones to look up resources that would normally not be available if the student did not have all of their course materials with them. She relayed a story about a field experience saying,

> They just take technology for-granted. I'll give you an example…one class I teach is very field-based. So we were out on the river yesterday and we took a water temperature reading and our results were in Celsius. So I said 'you need it in Celsius from a scientific perspective but I want you to have a sense of what that is in Fahrenheit so somebody look that up.' So somebody took out their phone and looked it up. When I first started teaching that wouldn't have happened.

Another interesting theme that arose during this line of questioning was the student's lack of critical thinking or reasoning skills. All of the nine participants thought their students lacked the ability to recognize valid, academic resources versus any material found on the Internet. When asked about the role of technology in the classroom, all nine of the participants mentioned the need to address sources and using critical reading skills within the context of using the Internet as a resource. In response to a follow up question of "Do you find that your students have a hard time making the connection between what is real and what is not when it comes to material found on the Internet?" all participants said they did. Participant G used a personal example to illustrate this point:

> We spend a lot of time on that. One of my main goals is that they understand what a newspaper says and what scientific research says might be very different. I want them to

> be able to read an article in the paper and understand that they have extrapolated this information. Maybe correctly, maybe not and trace it back. I have an assignment where they [students] looked up different resources. I had some really terrible ones that they looked up and some really good ones and got them to think about and write about how they can tell the good from the bad. This is the first time I've done that, but this is a major goal of mine. That they walk out of there and know how to ask the right questions and know how to find out if this is a legitimate course or not. I did all of this because my son, who is a freshman in college, came home one day and told me about some wild statistic about the U.S. population. I was doing the math in my head and told him that it couldn't possibly be true. He said it had to be because he read it on the Internet. I thought 'where have I failed you'. 'Did you really just say that?' So I made him look it up and it was a tongue-in-cheek site, but he had read it really seriously. I don't want my students to think that so we talk a lot about critical thinking and critical reading.

When asked if her students have trouble distinguishing what is a fact when they find information on the Internet, Participant E echoed Participant G's response saying, "Yes. Absolutely! Absolutely! Which is why I differentiate between what is popular culture versus academic. I have a librarian come in each semester and talk about plagiarism and public domain. We spend a lot of time talking about resources. We also have in class debates on various social issues where they can look up factual academic arguments." Participant B said,

> I do this open source pedagogy where I don't require students to buy textbooks. I work with the library to pull sources from all over the place. Then I can talk about open source and shared sources and online licensing and how just because it is on the Internet, it doesn't make it true or free. How licensing works and about theft. We can have these deep conversations about fair use and fair citation.

Establishing a connection between students and the material was an important theme to make "learning more interesting and interactive." This connection creates "an experience where they [students] connect with something and they start to think about things differently." However, a lack of understanding of academic content, popular culture content, and the students' ability to critically think about material posted on the Internet revealed a need to address critical thinking and reading skills. All participants spent instructional time trying to develop the students' critical thinking skills by discerning between valid academic Internet sites and Internet sites used in social settings or everyday life.

Research Question Four

What opportunities do content professors provide for student to use technology for learning? Similar to research question two, the emerging themes related to this question centered on technology used for student engagement, which adds value to the learning experience, and technology used for production, which improves efficiency. Four of the nine interview participants gave specific examples of assignments and projects where students are required to use technology for learning. Six of the nine interview participants answered this question in terms of production skills showing there is still a lack of understanding of how to use technology for student learning; therefore a lack of opportunities for secondary education students to practice technology integration prior to their methods courses and student teaching experience.

Participants A, B, C, and G mentioned specific opportunities students have to practice technology integration through various assignments and projects. Participant B mentioned,

> Students have to write narrative essays that explain their design choices, their rhetorical choices, who their audience might be. They don't get to just make fun things but I try to swap out the conventional 'here's a book report' with 'here's an infographic. You still have to do the research, but here is a digital way of reporting it or here is a visual way of reporting it.

Participant A assigned projects using social media to help with language learning and role immersion games to help students make cultural connections. These projects create experiences that help students "get to see other cultures and get to see other ways of doing things in the world. If is these different connections they have made with the outside world that makes them start to reflect and think of things differently." Participant C had his students answer questions using clickers or a student response system to "see if they can benefit from a discussion with their neighbor" before moving on. As previously mentioned, Participant G had students look up information on their smartphones for real-time interpretation of scientific data.

The other five participants responded that students were required to use production tools such as Microsoft Word to write reports, Microsoft PowerPoint for presentations" or "web access." One participant said he did not "require any technology beyond the basic technology that should be required of every college student, which is a working computing device and Blackboard." Participant F responded,

> Just web access generally. They need to get on Blackboard Learn. But anybody with basic access and the ability to use a browser that doesn't have every possible block or pop-up blocker. They are usually fine. I'm not here to train them about those things. They need to be able to type on a word processor. That is not complicated. So I'm not worried about it.

Participant G spoke of a project she tried to do with her class that required the use of Microsoft Excel but realized many of her students did not know the basic production skills needed for the assignment. She recalled,

> I have one lab assignment in an introductory class where they need to use Excel. I would like for them to make graphs using Excel but the first time I did this lab, I found out that some people where so befuddled by the use of Excel that they didn't do the assignment. I said my job is not to teach you Excel. I'm assuming everyone coming into college knows how to use it, but I'm not going to let that be the reason you don't complete this assignment. So sometimes it is actually a hurdle when I realize they don't have some basic skill they really need and that is going to be an additional thing they are going to have to learn.

While four of the nine participants gave examples of how they create meaningful opportunities for students to practice integrating technology through required assignments, the other five participants still think of technology as a tool for communication, Internet access, and production. Two participants mentioned trying to assign a project requiring technology with the assumption that students possessed technology skills they did not. Others viewed technology, other than basic production tools, as separate from their content area and not an integrated part of content.

Research Question Five

How do content area professors reflect on their experiences in the classroom? Participants were asked if they reflected on their teaching and to relay an experience with technology, either good or bad, that stood out to them and what they learned from that experience. Nine of the ten participants reported spending a great deal of time reflecting on what they taught, how they taught it, and the way in which students responded. From these reflections, the themes of self-evaluation of teaching methods and materials and evaluation of student engagement emerged. Nine participants replied that they did some sort of self-evaluation in addition to the student evaluations provided by the university. Only one participant mentioned using just the student evaluations completed at the end of the course as the only means of evaluation of the course or of teaching performance. Nine of the ten performed some sort of critical analysis of lecture materials while eight of the ten included some form of student engagement as part of their self-evaluation process. The researcher sensed most participants wanted their students to learn the material in an engaging manner, regardless of technology.

Participant D stated, “I tweak lectures according to new information that is known about the topic and I tweak labs based on what worked and what failed miserably every semester”. Participant H asks himself “did I engage effectively? Did I present the material clearly? Did people understand the material? Do they see how the material can still apply to what they see today?” after each class. Participant B recounted her self-evaluation process:

> I design a class with outcomes and I design assignments with links to those outcomes and at the end of each semester, I pull reflections from students and then I write a reflection based on their reflection and I put those in a file. I do that for every major project. At the end of the class, the students write a reflection and I write a reflection. I pull it all

> together and when I get their course evaluations, I look at the whole package. Then I go back through the grades and I think about common problems. I'll do a presentation to the class and go through the common problems I found in the papers so we can review those common problems. Then I'll look at the assignments and see how I can go back and teach the material differently to address those common problems the next time. Sometimes if the class isn't going well, I'll do an anonymous, impromptu assessment just to take the temperature of the class.

Participant G said, "I tell my students that I want to hear what I'm doing wrong, what they liked, what they didn't like. There is the standard evaluation, but I tell them that I want their constructive criticism; not 'you're awful' or 'you're fantastic.' That is not helpful." Participant A recalled: "if something messes up it kind of helps me re-think it and if it does really well, then I reuse it, but maybe tweak it if it needs to be. So I use those experiences to guide activities in the future."

When asked to relay an experience with technology that stood out to the participants and what they learned from that experience, eight of the nine participants mentioned some sort of evaluation of student engagement in their self-evaluation or reflective process.

Participant A tries to "give them [student] a survey at the middle of the semester just to say hey, let's talk. Where are we? What do you like? What do you not like? What do you want to do more of? What's not working?" Participant G said, "Sometimes if I do choose to do a PowerPoint and they [student] start to get glassy-eyed, I question would I have been better off not using it. Maybe I'm a little more critical about the use of technology and when it is appropriate and when it is not."

It was obvious to this researcher that the content area professors who were interviewed for this project took great pride in their teaching and wanted to do well, both in their eyes and in the eyes of their students. All participants perform some type of self-evaluation of the teaching methods and materials. Eight of the nine participants went beyond the end of course evaluations completed by students for the university and sought more immediate, constructive feedback from students.

Research Question Six

What makes content professors change the way they teach? This research question was answered through the emerging theme discovered during a line of questions about change. Participants were asked to reflect on examples of technologies used by their professors either in their undergraduate or graduate program; what would make you change the way you teach; and if modeling technology integration is important in an Arts and Sciences classroom. This line of questioning was directly related to the research that shows faculty members tent to teach in the manner in which they were taught (Golde & Dore, 2001; Stein & Short, 2000) and learning experiences leading to questioning and critical reflection expand both current habits and frames of references (King, 2004).

During this line of questioning, one overarching theme became evident: transformative experiences can lead to change. Specific examples of change revealed the subthemes of mentoring and failure as the impetus for the transformative experiences mentioned by the participants.

When asked the series of questions about change, three of the nine participants recounted transformative experiences that had a profound effect on their teaching. Two participants recounted experiences with a faculty mentor that fostered change in their point of view about how technology could be used in the classroom. Another participant recalled a particular training event that exposed him to a different way to use technology for student learning.

Participant A mentioned a major professor in her Ph.D. program as providing the foundation for changing her teaching methods. Participant A said,

> When I taught high school, I was much more boring and straight from the book. We just did the exercises. The only technology I used was PowerPoint and maybe a document camera. I just didn't use much. And then I got here and my advisor is really big into technology. I've always enjoyed technology outside the classroom but never connected the two. It never really dawned on me until I started working with her. I love it outside the class. They love it outside the class. It is ubiquitous. Why wouldn't I try to use it in the class? That is when it kind of connected and my teaching pretty much turned upside down. It is much more student centered and less teacher focused and it is more them using the technology to gain new knowledge and work together. Working with her changed my thinking about how I can use technology in the classroom.

Participant A also mentioned "experience" as a change agent and that "people view things differently when they have had an experience where they connect with something and start to think about things differently. When they have been challenged to think of things differently." Participant B echoed these thoughts when she recalled studying under pedagogists and compositionists in rhetoric who encouraged her to

> Fuse what I know about technology with what the field thinks of as good pedagogy. So I started being a better teacher because I started thinking about it is not a cult of personality. It is about teaching discrete competencies and building those discrete competencies on top of each other in a way that students can leap from brick to brick and also follow along in a way that is reciprocal.

Participant C revealed a seminar he participated in as a graduate student that he credited with impacting his use of clickers as more than just an assessment devise, but rather a gauge of student involvement. Participant C said, "This was based on Astronomy education research based in part on a couple of things that happened a couple of decades in Physics research 10-15 years ago. When I learned it would work, I've kept on using it and refining it and trying to leverage it more."

Another potentially transformative experience mentioned by four of the participants was failure. Failure as a change agent was identified by participant F who said, "people change or adapt because they felt failure." Participant E understood that "failure" can facilitate change, but either in a positive or negative way, depending on the person, saying, "You can fail and quit or you can fail and say OK, let's try a different way. Failure can affect people both horribly and wonderfully." Failure was also viewed as a positive experience by Participant A who described a classroom experience with technology that she viewed as a growth experience saying, "I grew up with technology so if something doesn't work, I don't mind tinkering with it. If I don't understand something, I'm like that's fine. We'll just mess with it and see if we can figure it out." Participant B said a 'failure' in the classroom caused her to grow as a teacher by becoming more flexible saying,

> I think every teacher has had that moment when teaching brings you to your knees and you think I must be the worst teacher who ever lived. Everything that could go wrong did and some things that I didn't know could go wrong, went wrong. I was having problems with this one class in particular and asked my supervising professor to come observe the class and help me figure out what I was doing wrong. After the class, I went to her office with my lesson and my charts and the this and the that. She just waived it off and said 'You know what? You did everything you could. Somedays you don't win.' That is what I learned from failure…somedays it is not you.

Failure viewed negatively, was reported by two of the participants. Participant D stated that every time the computer failed she had to "cancel class because I do not remember the details of my lecture. Then I wish I could teach more on the chalkboard or from memory. Not going overboard on technology makes my life simple and the students more focused." This failure led to a negative experience that impacted this participant's view of technology.

When participants were asked what they remembered about the technology used in the classrooms by their professors either in their undergraduate or graduate programs. Eight of the nine participants reported minimal use of technology by their professors. "Overhead transparencies" and "chalkboards" were mentioned by five of the participants. "Blackboard learning management system," "PowerPoint," and "email" were mentioned by the other four participants. The participants in this study have had very little exposure to what technology integration in a classroom looks like in a real world setting. Without a transformative experience provided by a mentor or an event, faculty members are unlikely to expand their frame of reference or the habits of what they have been doing in the past.

The importance of a transformative experience that includes modeling technology integration is evident in the three participants who spoke of how those mentor effected their teaching. The three faculty who view technology as an integrated part of the content and pedagogy understand the importance of modeling technology and how it can impact student engagement and learning. When asked if modeling technology integration is important, Participant A said,

> I think in everything but especially technology, when they see us do it, they are going to replicate it and maybe do it even more. So if you aren't using technology but you are telling them to use technology then there is going to be a contradiction. I also think that seeing us do it teaches them how to do it too. And I think it is important in the 21st century that they be able to use technology because it is not going away. If students leave the university and can't use technology because they never saw us use it and we never had them use it, then that is kind of a disservice to them as well.

Participant B stated,

> We want technology to be so ubiquitous and so simple that it just moves through our lives and we don't even notice it. But it is so complicated and so beyond us that we can't even understand it. It can't be both of those things and yet it is both of those things. For our students we need to pick one and start pulling those strings and start helping them unravel what technology is for them. One way to do that is through modeling in the classroom.

Participant E summed up the need for modeling technology integration in the classroom by saying, "Absolutely. Maybe because of that students have a need to do and feel and touch and see. The dynamics of the classroom have changed."

The other six participants view technology as a tool or as an 'add-on' do not see the need to show students new and different ways to use technology in the classroom because technology is just a tool and there is a perception that students already know how to use those tools. For example, Participant D said, "Probably not. In general I think technology is a crutch for students.

I don't think I use it in any ways that they aren't already familiar with." Participant F held a similar view of modeling technology saying, "They [students] are savvy for the most part. They know what they are doing. But I don't know if modeling technology is necessarily a plus. They are usually pretty good about it already." Participant I echoed that thought saying, "No, because they know more than I do already. I'm behind the curve on a lot of that stuff."

Three of the nine participants reported a change in their teaching because of a transformative experience. This transformation occurred over time by the exposure to modeling of technology integration by graduate school faculty for two of the participants. The third participant experienced a revelation when shown a new way to use existing technology. The remaining participants view technology as a production or communication tool. Several of these participants held the view that students know as much, if not more about technology than they do.

Summary

In summary, while survey participants indicated that they possess the knowledge and ability to incorporate technology into pedagogy and content, interview participants indicated there is a gap between integrating technology for student learning and using technology for productivity and communication. The participants who embraced technology and all it brings to the classroom, were able to recalled a transformative experience that changed the way they thought about and used technology in the classroom. This shows that expanding the possibilities of technology through critical reflection and modeling to form new habits and new ways of knowing is possible.

CHAPTER V:

DISCUSSION, CONCLUSIONS, AND RECOMMENDTIONS

Introduction

The purpose of this study was to examine the results of the HE-TPACK survey taken by faculty in the College of Arts and Sciences who taught courses required or recommended for students majoring in Secondary Education. Those results were compared to themes generated by the coding of interviews of participants who volunteered to share their thoughts about their use of technology in the classroom and the process of change. It was the goal of this research to find out if secondary education students are exposed to technology integration through modeling by faculty members outside of the College of Education.

Summary of the Study

Colleges of Education (COE) have developed educational technology courses which focus more on technology integration for student achievement than on production skills. Demonstration of technology integration is required for the accreditation of COE's and the certification of teachers. While Harris and Hofer (2010) offer ideas of how and when technology integration should be addressed, there is little evidence on how student learn to integrate technology to improve student achievement rather than increase production (Schmid, Bernard, Borokhovski, Tamim, Abrami, Wade, Surkes, & Lowerison, 2009; Ottenbreit-Leftwich & Bruch, 2011; Jones, Buntting, & deVries, 2013). There is still a need to leverage teaching technology skills with demonstrating how technology can be integrated into the classroom to improve student learning (Ottenbreit-Leftwich & Brush, 2011). Since secondary education students take up to ninety hours in core and content courses, this can be done by examining technology integration by content faculty, usually in the College of Arts and Sciences.

This study looked at the gaps between the HE-TPACK self-assessment and the ways technology is used in an Arts and Sciences classroom. This was done through the HE-TPACK survey and interviews with Arts and Sciences faculty. During the quantitative part of this study, the researcher collected and analyzed descriptive statistics for each domain of the HE-TPACK survey, including Pedagogy Knowledge, Technology Knowledge, Content Knowledge, Pedagogy Content Knowledge, Technology Pedagogy Knowledge, Technology Content Knowledge, and Technology Pedagogy Content Knowledge, as well as Technology Training. A five point Likert scale was used in the HE-TPACK survey. During the qualitative part of the study, the researcher coded and analyzed the responses of nine participants obtained during semi-structured interviews. These data were evaluated to gain an understanding of faculty perceptions of technology, the role of technology in the classroom, and what makes people change the way they teach.

Discussion

This explanatory-sequential mixed-methods study was guided by six research questions and viewed through the lens of transformative learning. A mixed-methods approach was chosen because the researcher wanted a more in-depth look at the transformative aspect of technology integration from the viewpoint of the faculty member.

Research Question One

What are faculty self-assessments of HE-TPACK in the secondary education content areas of English/language arts, mathematics, science, foreign languages, and social sciences? In the self-assessment of HE-TPACK, the majority of participants agreed or strongly agreed with the survey items in all eight domains of the HE-TPACK. This indicates the faculty have a positive view of their knowledge in each HE-TPACK domain and report an understanding of the role of technology in the classroom. This result agrees with the previous HE-TPACK survey results (Garrett, 2014) and may suggest faculty may overestimate their HE-TPACK knowledge (Lux et al., 2011). In this study, higher means in the areas of Technology Pedagogy Knowledge (TPK) and Technology Content Knowledge (TCK) indicated the participants were not as confident in those domains. This agrees with Koehler and Mishra’s (2008) assertion that TPK is the most difficult domain to improve. Lower means in the domains of Pedagogy Knowledge (PK), Content Knowledge (CK), and Pedagogy Content Knowledge (PCK) indicate a higher level of confidence in these areas. This is to be expected since content faculty are considered experts in their fields.

The majority of participants’ lack of TCK examples in their own learning experiences along with the mention of very specific transformative experiences prove the value in “investigating, thinking, planning, practicing, and reflecting” (Ness, 2005, p. 511) on instructional practices. Fostering these experiences can improve TPK and TCK. This is reflected by the descriptive statistics for the TPACK domains for the HE-TPACK survey results for this study as shown again in Table 14.

Research Question Two

How do content area professors address the possibilities of technology integration in content courses? Analysis of the interview data collected during the qualitative phase of this study revealed content area professors view technology as either a tool for student learning or a tool for production and communication.

Four of the nine interview participants use technology in the classroom in innovative ways to promote student learning. All four participants mentioned a mentor or professional development seminar that sparked this new point of view in their own teaching. These faculty members were able to incorporate these new ways of thinking into their teaching and into assignments required of their students. The other participants viewed technology as a tool requiring basic production software such as Microsoft Word and Microsoft PowerPoint. These participants viewed technology as a distraction or a necessary evil in the classroom. This finding agrees with previous research that many faculty training programs focus on how to use technology and not when or why to use technology to affect student outcomes (Johnson, Wisniewksi, Kuhlemeyer, & Krzykowski, 2012) and that higher education faculty tend to teach in the same way in which they were taught (Golde & Dore, 2001; Stein & Short, 2000).

Research Question Three

How do content area professors make connections between technology used in everyday life and technology used in the classroom? Establishing a connection between students and the material was an important theme for student engagement. This connection creates a foundation for students to begin thinking about how the technology they use every day can also be used in new and different ways for learning. However, a lack of understanding of academic content, popular culture content, and the students' ability to critically read material posted on the Internet showed a need for the ability to discern technology used in social settings or everyday life and technology integration used for learning.

Four of the interview participants specifically mentioned using social media, infographics, webpage design, and smartphones regularly in their teaching and for student projects. These same four participants mentioned emphasizing critical thinking and reasoning skills when making the connection between Internet sites used in everyday life versus those used in the classroom. This agrees with the research that concerns about critical thinking, privacy, credibility, security, and ethics are lacking in students and should be addressed in post-secondary education (Lorenzo & Dziuban, 2006).

This agrees with previous research that found while millennial students are comfortable with technology, and are in fact immersed in technology, that does not necessarily translate into having the skills teach with technology (Bull, 2003). This is one reason modeling of learning supported by technology is so important (Bennett, Maton, & Kervin, 2008).

Research Question Four

What opportunities do content professors provide for students to use technology for learning? The same four participants mentioned previously regularly assigned projects to their students that required the use of technology for learning. The other participants required technology for communication (email) or production (word processor). The findings of this study agree with previous research that teachers who are unsure of how to use technology to promote learning and higher order thinking skills often focus on technology for production (Jones, et al, 2013), and faculty members tend to teach in the same way that they were taught (Golde & Dore, 2001; Stein & Short, 2001).

The five other faculty members interviewed for this study still view technology for production or communication. This finding agrees with previous research that a focus on production skills will not lead to a change in technology integration (Zhao & Bryant, 2006; Vu & Fadde, 2014). The four participants who spoke of concrete ways in which they use technology for learning each mentioned a transformative experience that directly affected their views of technology in the classroom. This agrees with King's (2004) study that discovered learning experiences and people are the best ways to foster transformative learning.

Research Question Five

How do content area professors reflect on their experiences in the classroom? All interview participants reflected on their classroom experiences to some degree or another through a self-evaluation of their teaching methods and materials as well as evaluation of student engagement. Only one participant mentioned using only the course evaluation required by the university. The majority of participants perform formative assessments throughout the semester, reflecting on how to improve the class immediately and in the future. This shows a desire on the part of the faculty to improve their teaching and the students' learning experience. The ability to critically reflect for the purpose of expanding one's frame of reference or to create new meaning is the vital first step to transformative learning (Kreber, 2004; Yost, Sentner, & Forlenza-Bailey, 2000; Taylor, 2011). The dedication these faculty members showed to improving their teaching skills and their students' engagement with the material show openness to experiencing a transformative change.

Research Question Six

What makes content professors change the way they teach? This research question was answered by asking participants to reflect on their experiences, what acts as a change agent, and if the modeling of technology integration in the classroom. Several participants in this study changed their teaching because a transformative experience gave them a reason to look at technology in the classroom in a new way. Once faculty have a new way of looking at technology, they are able to facilitate that change in others (Clark, 1992). This supports previous research findings that suggest modeling is an effective way to create transformative experiences with technology (Bennett, Maton, & Kervin, 2008; Kitchenham, 2008; Pellegrino, Goldman, Bertenthal, & Lawless, 2007; Kay, 2006; Howland & Wedman, 2004; Marra, 2004; Kayne-Chaplock, Whipp, & Schwiezer 2004; Whipp, Schewiezer, & Dooley, 2001; Hunter, 1971).

Most participants reported an overwhelming lack of technology, either for production or for learning, in their undergraduate and graduate coursework. In some cases, this was due to the lack of technology that was available, but in others it was a lack of understanding on the part of the participants' professors of how technology impacts the classroom. This agrees with previous research that modeling technology integration helps teachers feel more comfortable and better prepared to teach with technology (Whipp, Schewiezer, & Dooley, 2001; Kayne-Chaplock, Whipp, & Schwiezer 2004). Because of their own transformative experiences, these faculty members were able to facilitate a transformative learning experience for their students (Jang & Chen, 2010).

Some participants reported a transformative experience caused by reflecting on perceived failures in the classroom. Failure was reported as a positive, transformative experience if it promoted growth through reflection. This type of reflection is critical for a transformative experience (Mezirow, 1997).

Limitations

Limitations of this which should be considered included the following:

1. Data collection during the interview phase of this study only included nine participants. It was the original intent to interview one high scoring HE-TPACK participant and one low scoring HE-TPACK participant in each content area. However the research did not anticipate the lack of interests in faculty members

being interviewed. This lack of desire to talk about technology in the classroom might indicate a lack of interest in technology beyond the use of production tools;

2. HE-TPACK self-assessment and themes discovered during interview coding are subject to change as faculty training and experience levels change;
3. The constructivist beliefs of the researcher could influence the themes discovered through the coding process;
4. The study was limited in scope by the participants in the unit of analysis in which this study was conducted. Other faculty members could teach the classes identified in the study at another time; and
5. Certain content subareas were not included because at the research institution those courses are taught in a college other than Arts and Sciences. Since this study focused on Arts and Sciences faculty, those content areas were deliberately omitted (speech, economics).

Conclusions

Four major conclusions can be drawn from the results of this study. This study found that there was no consistency in the exposure to technology integration for secondary education students. Currently, there is no systematic way of knowing what technology a secondary education student is exposed to during their core and content courses in Arts and Sciences. Analysis of interview data show that there are good examples of technology integration within the College of Arts and Sciences by faculty who teach content courses. However, the majority of those interviewed still viewed technology as a production tool and not as an impetus for student learning. Several of those interviewed view technology as a distraction, unreliable, or a barrier to learning.

The second conclusion was that there was a difference between reported HE-TPACK scores and practices reported by the interview participants. The results of this study revealed a gap between the perceived HE-TPACK self-assessment and the themes and practice found during interviews with content faculty. Faculty reported high levels of confidence in all domains, but highest in the areas of pedagogy knowledge (PK), content knowledge (CK), and pedagogical content knowledge (PCK). This is to be expected as content faculty are experts in their fields. Participants were not as confident in the domain areas of technology training, technology knowledge (TK), and technological, pedagogical, and content knowledge (TPACK). The least amount of confidence was reported in the domain areas of technological pedagogical knowledge (TPK) and technological content knowledge (TCK). Based on this HE-TPACK survey, there was still a large percentage of faculty who were not sure how technology would enhance their teaching or the students' learning experience. The means calculated for each domain area of TPACK show that these faculty members are fairly confident in their ability to integrate technology into teaching in a manner that is appropriate for their content area. However, only four of the nine interview participants could give concrete examples of how technology was being used to improve student learning through assignments. The other five participants referred to technology in terms of production or efficiency. The summary table for each of the HE-TPACK domains is included in Table 14 for reference. Because of the Likert values used, a lower mean should be interpreted as a higher level of confidence.

The third conclusion was the faculty is open to departmental technology training if it is relevant to content. However if technology is seen as another production tool to learn or an add-on that is not part of the content, faculty members are not going to take the time to learn about emerging technologies. Training that is focused on production skills will not lead to a change in technology integration (Zhao & Bryant, 2006; Vu & Fadde, 2014). Technology must be relevant and provide an impetus for change.

The final conclusion was transformative experiences can change teaching practices. Based on the qualitative results of this study, faculty who are able to describe ways they integrate technology into the classroom had a transformative learning experience that changed their point of view with regard to technology integration. This transformative experience modeled how planning, effort, and a desire to impact student learning using technology can change teaching. Three interview participants clearly recalled a person or event in their educational experience that was transformative for them. This experience acted as a change agent, and made them rethink the possibilities of technology in the classroom. Because how each person constructs knowledge is influenced by prior experiences and beliefs, it is important to create experiences to foster transformative learning. By creating transformative experiences that begin to change the way faculty think about technology on a systematic level, those faculty can facilitate a transformative learning experience for their students (Jang & Chen, 2010).

Recommendations for Policy and Practice

Based on the findings and conclusions of this study, the following recommendations are made. For the first recommendation, the College of Arts and Sciences and the College of Education should work together to identify key content courses specifically for secondary education majors that would be a natural fit for the integration of technology. These courses could be reviewed to determine if any content courses meet the requirements to be designated as a ‘computer’ core course. After interviewing two faculty members in particular, this researcher feels there are certain courses that would meet the qualifications for this designation, but have not been identified at this time. While this core requirement is met for secondary education students through methods and student teaching courses, these courses are not taken until the end of the program. Earlier exposure to technology integration could be one way to foster a transformative learning experience for secondary education students.

For the second recommendation, before content area faculty can offer learning experiences that have the potential to transform current ways of viewing technology in the classroom, they must experience this for themselves. Based on the findings that participants agree technology training is important if it is relevant, the College of Arts and Sciences and the College of Education should collaborate to develop professional development that includes the modeling of technology integration into teaching. The Faculty Resource Center might be a resource to help facilitate the development of this training. While this training should be voluntary, participation could count towards continuing education or towards tenure and promotion.

This training should be content specific and offered in cooperation and with the support of departmental leadership. This would help faculty better provide learning experiences involving technology as a part of the whole educational experience and not in isolation from the teacher preparation program (Hechter, Phyfe, & Vermette, 2012). By developing training focused on the ‘why’ instead of ‘how’, faculty can move beyond technology for production and develop their TCP and TPK skills. This will create an environment to help with the transfer of knowledge from one situation to another when secondary education students begin taking their professional courses (Johnson, Wisniewski, Kuhlemeyer, Isaacs, & Krzykowski, 2012).

Third, based on the findings of this study that mentoring relationships served as an impetus for a transformative learning experience, faculty members who participant in the proposed professional development or are identified as using technology to promote student learning should be asked to mentor graduate students. By identifying faculty in the College of Arts and Sciences who are integrating technology in new and innovative ways, the college can create a teaching resource for new faculty or graduate teaching assistants. This exposure to new ways of thinking about technology with a mentor might provide the experience or event to encourage change. This mentor could also help participants view failure as an opportunity for growth through reflection and not as a negative experience. This mentoring relationship would be particularly beneficial for graduate students to foster change through transformative experiences.

Recommendations for Future Research

Based on the findings of this study, the researcher recommends the following for future research. First, expand the quantitative portion of this study to all faculty who teach courses required for secondary education majors. This study purposefully looked at only the College of Arts and Sciences faculty who were currently teaching courses taken by secondary education majors during the semester of the study. Expanding this study might to other faculty might present a different picture of when and how secondary education students are exposed to technology integration in the classroom.

Secondly, future research involving a pilot program or case study focused on professional development that fosters transformative learning experiences and technology with graduate students would add to the limited body of research on technology integration by higher education faculty.

Finally, the study could be expanded to include interviews with secondary education students to further evaluate and/or confirm technology integration by content faculty. The student's perspective of technology use in content courses would either confirm the reported HE-TPACK scores or show that faculty overestimate their knowledge of the TPACK domains.

Summary

The purpose of this study was to look at HE-TPACK of faculty within the College of Arts and Sciences and identify and gaps in technology exposure for students majoring in secondary education at a southeastern research university. Quantitative data of descriptive statistics and frequencies of the HE-TPACK survey showed the majority of faculty rate themselves as fairly confident in their ability to integrate technology, pedagogy, and content (TPACK) as well as the domains of Pedagogy Knowledge (PK), Content Knowledge (CK), and Pedagogical Content Knowledge (PCK). A lower level of confidence was found for the domains of Technology Content Knowledge (TCK) and Technology Pedagogy Knowledge (TPK).

Themes generated by the analysis of interview data found a potential gap between HE-TPACK scores and the reported use of technology by the faculty interviewed for this study. Only four of the nine interview participants were able to give concrete examples of integrating technology for student learning rather than for productivity. The other five participants still think of technology in term of production or communication.

Three of the four participants mentioned a transformative experience facilitated by a mentor through modeling or professional development event. This proved transformative learning experiences can change the way technology is used in classrooms. This change in perspective can help move technology used for production and communication to technology integrated into the content areas to improve student learning and engagement.

This research could lead to collaborations between the College of Education and the College of Arts and Sciences to work systematically to identify and expand the exposure students have to technology integrated into content areas while students are taking required core and content courses. Through professional development and the mentoring of graduate teaching assistants, transformative learning experiences should be created to foster new ways to integrate technology for student learning. With the advances in instructional technology over the past few years, it is time to revisit how faculty model technology integration for their students, particularly in the content areas.

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APPENDIX A:

ISTE STANDARDS FOR TEACHERS

Standard		Performance Indicators
Facilitate and inspire student learning and creativity	Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments.	a. Promote, support, and model creative and innovative thinking and inventiveness b. Engage students in exploring real-world issues and solving authentic problems using digital tools and resources c. Promote student reflection using collaborative tools to reveal and clarify students' conceptual understanding and thinking, planning, and creative processes d. Model collaborative knowledge construction by engaging in learning with students, colleagues, and others in face-to-face and virtual environments
Design and develop digital age learning experiences and assessments	Teachers design, develop, and evaluate authentic learning experiences and assessments incorporating contemporary tools and resources to maximize content learning in context and to develop the knowledge, skills, and attitudes identified in the Standards•S.	a. Design or adapt relevant learning experiences that incorporate digital tools and resources to promote student learning and creativity b. Develop technology-enriched learning environments that enable all students to pursue their individual curiosities and become active participants in setting their own educational goals, managing their own learning, and assessing their own progress c. Customize and personalize learning activities to address students' diverse learning styles, working strategies, and abilities using digital tools and resources d. Provide students with multiple and varied formative and summative assessments aligned with content and technology standards, and use resulting data to inform learning and teaching.
Model digital age work and learning	Teachers exhibit knowledge, skills, and work processes representative of an innovative professional in a global and digital society.	a. Demonstrate fluency in technology systems and the transfer of current knowledge to new technologies and situations b. Collaborate with students, peers, parents, and community members using digital tools and resources to support student success and innovation

		c. Communicate relevant information and ideas effectively to students, parents, and peers using a variety of digital age media and formats d. Model and facilitate effective use of current and emerging digital tools to locate, analyze, evaluate, and use information resources to support research and learning
Promote and model digital citizenship and responsibility	Teachers understand local and global societal issues and responsibilities in an evolving digital culture and exhibit legal and ethical behavior in their professional practices.	a. Advocate, model, and teach safe, legal, and ethical use of digital information and technology, including respect for copyright, intellectual property, and the appropriate b. documentation of sources c. Address the diverse needs of all learners by using learner-centered strategies providing equitable access to appropriate digital tools and resources d. Promote and model digital etiquette and responsible social interactions related to the use of technology and information e. Develop and model cultural understanding and global awareness by engaging with colleagues and students of other cultures using digital age communication and collaboration tools
Engage in professional growth and leadership	Teachers continuously improve their professional practice, model lifelong learning, and exhibit leadership in their school and professional community by promoting and demonstrating the effective use of digital tools and resources.	a. Participate in local and global learning communities to explore creative applications of technology to improve student learning b. Exhibit leadership by demonstrating a vision of technology infusion, participating in shared decision making and community building, and developing the leadership and technology skills of others c. Evaluate and reflect on current research and professional practice on a regular basis to make effective use of existing and emerging digital tools and resources in support of student learning d. Contribute to the effectiveness, vitality, and self-renewal of the teaching profession and of their school and community

APPENDIX B:

SECONDARY PROGRAM SHEETS

Secondary Education English Language (SELA)

Semester 1	Semester 2
EN 101	EN 102
TH 114	NATURAL SCI CORE
MATH CORE	FL CORE
PY 101	HISTORY CORE
FL CORE	COM 123
Semester 3	**Semester 4**
APPROVED LITERATURE	APPROVED LITERATURE
NATURAL SCI CORE	EN 205
EN 210	HI OR SB
EN 300	EN 321
COM 101	SPE 300
	EDU 200
Semester 5	**Semester 6**
EN 300 + LEVEL ELECTIVE	BEP/BEF 360
CSE 390	CSE 455
TH 245 OR 246	EN 411
APPROVED EN ELECTIVE	EN 333
JN 436 OR 200	EN 400 LEVEL EL
CSE 493	EN 400 LEVEL EL
Semester 7	**Semester 8**
BER 450	CSE 497
CRD 412	CSE 470
CSE 479	
CSE 489	
CSE 469	

Secondary Education Social Science (SESS) Biology Major

Semester 1	Semester 2
EN 101	EN 102
CH 101 OR 117	CH 102 OR 118
MATH 125 OR 145	MATH 126 OR 146
FINE ARTS CORE	AEM 120
PY 101	COM 123 OR 210
	HI OR SB CORE
Semester 3	**Semester 4**
LITERATURE CORE	PH 102 or 106
BSC 114	BSC 116
BSC 115	BSC 117
CH 231	CH 232
PH 101 OR 105	CH 237
CH 223	
Semester 5	**Semester 6**
EDU 200	HU, L, OR FA CORE
SPE 300	HI OR SB CORE
BEP/BEF 360	CH 462
CH 338	CH 463
CH 340	CSE 390
CH 343	CSE 493
CH 461	
Semester 7	**Semester 8**
BER 450	HI OR SB
CRD 412	PH 333/354/405/411
CSE 486	PH 253
CSE 489	PH 255
CSE 476	GEO 101
CH 413	
Semester 9	
CSE 497	

Secondary Education Mathematics (SEMA)

Semester 1	Semester 2
EN 101	EN 102
FINE ARTS CORE	NATURAL SCIPH 105 PREFERRED
MATH 125 OR 145	MATH 126 OR 146
PY OR HD 101	HISTORY CORE
HI OR SB CORE	COM 123 OR 210
Semester 3	**Semester 4**
LITERATURE CORE	CS 150
ST 260	MATH 301
MATH 227 OR 247	NATURAL SCI CORE
HI OR SB	MATH 238
MATH 237	EDU 200
	SPE 300
Semester 5	**Semester 6**
CSE 401	HU, L, OR FA CORE
MATH 403	MATH 404
MATH 486	MATH 405
BEP/BEF 360	CSE 406
CSE 390	MATH 470
CSE 493	
Semester 7	**Semester 8**
BER 450	CSE 497
CRD 412	
CSE 483	
CSE 489	
MATH 355	

Secondary Education Social Science (SESS)

Semester 1	Semester 2
EN 101	EN 102
FINE ARTS CORE	NATURAL SCI CORE
MATH CORE	SOC 101
PY 101	HY 102 OR 106
HY 101 OR 105	COM 123 OR 210
Semester 3	**Semester 4**
LITERATURE CORE	HY 110
NATURAL SCI CORE	HY 204 OR 206
PSC 101	EC 110
GY 105 OR 110	HU, L, OR FA CORE
HY 203 OR 205	GY APPROVED 300 LEVEL
Semester 5	**Semester 6**
EDU 200	BEP/BEF 360
SPE 300	CSE 390
EC 111	CSE 493
HY US APPROVED 300 OR 400	HY ASIAN APPROVED 300 OR 400
HY EUROPEAN APPROVED 300 OR 400	HISTORY 300 OR 400 LEVEL
PSC 203	PSC ADVISOR APPROVED
Semester 7	**Semester 8**
BER 450	CSE 497
CRD 412	HISTORY UPPER LEVEL
CSE 487	
CSE 489	
HISORY 300 OR 400 LEVEL	

APPENDIX C:

HE-TPACK SURVEY

Demographic Information

1. Gender
    a. Female
    b. Male
2. Academic Rankings for Arts and Sciences
    a. Assistant Professor
    b. Associate Professor
    c. Professor
    d. Adjunct
    e. Clinical Instructor
    f. Instructor
    g. Graduate Teaching Assistant
3. Tenure Status
    a. Tenured
    b. Tenure-track
    c. Neither
4. Total number of years as full time faculty (i.e. teaching experience)
    a. 0
    b. 1-4
    c. 5-9
    d. 10-14
    e. 15-19
    f. 20+
5. Select your content area:
    a. Language Arts (English, Theatre)
    b. General Sciences (Biology, Chemistry, Physics)
    c. Mathematics
    d. Social Sciences (History, Psychology, Political Science)
    e. Foreign Languages (French, German, Latin, and Spanish)
6. It is important for students to see their instructors use technology in different courses.
    a. Strongly Agree
    b. Agree
    c. Not Sure
    d. Disagree
    e. Strongly Disagree
7. It is important for students to use technology for assignments or projects.
    a. Strongly Agree

b. Agree
c. Not Sure
d. Disagree
e. Strongly Disagree
f.

8. Are you aware of any technology standards required for teacher certification?
    a. Yes
    b. No

Please read each item carefully and then rate to what extent you agree with the statement using the scale below. Each statement will be about your perception of your teaching knowledge and experience.

Using the following scale, to what extent do you agree with the statement below?

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
1	2	3	4	5

HE-TPACK Items
Technology Training
9. Technology training would enhance my teaching.
10. It is the University's responsibility to train me to use technologies that will enhance my teaching.
11. The University should not make technology training a requirement for faculty.
12. Technology training should be offered in each academic department at my university.
PK Domain
13. I have a clear understanding of pedagogy (e.g. designing instruction, assessing students' learning).
14. I am familiar with a wide range of practices, strategies, and methods that I can use in my teaching.
15. I know how to assess student learning.
16. I know how to motivate students to learn.
TK Domain
17. I am familiar with a variety of hardware, software and technology tools that I can use for teaching.
18. I know how to troubleshoot technology problems when they arise.
19. I do not know how to use technology in my everyday life.
20. I recognize that technology use can have positive and negative effects.
21. I cannot decide when technology can be beneficial to achieving a learning objective.
22. I can decide when technology may be detrimental to achieving a learning objective.
CK Domain
23. I have a comprehensive understanding of the curriculum I teach.
24. I understand how knowledge in my discipline is organized.
25. I am familiar with the common preconceptions and misconceptions in my discipline.
26. I can explain to students the value of knowing concepts in my discipline.

27. I can make connections between the different topics in my discipline.
28. I stay abreast of new research related to my discipline in order to keep my own understanding of my discipline updated.
PCK Domain
29. I understand that there is a relationship between content and the teaching methods used to teach that content.
30. I can anticipate students’ preconceptions and misconceptions.
31. I can address students’ preconceptions and misconceptions.
32. I understand what topics or concepts are easy or difficult to learn.
33. I can provide multiple representations of content in the form of analogies, examples, demonstrations, and classroom activities.
34. I can adapt material to students’ abilities, prior knowledge, preconceptions, and misconceptions.
TPK Domain
35. I understand how teaching and learning change when certain technologies are used.
36. I do not understand how technology can be integrated into teaching and learning to help students achieve specific pedagogical goals and objectives.
37. I do not know how to adapt technologies to support teaching and learning.
38. I know how to be flexible with my use of technology to support teaching and learning.
39. I cannot reconfigure technology and apply it to meet instructional needs.
40. I understand that in certain situations technology can be used to improve student learning.
TCK Domain
41. I cannot select and integrate technological tools appropriate for use in specific disciplines (or content).
42. I understand how the choice of technologies allows and limits the types of content ideas that can be taught.
43. I do not understand how come content decisions can limit the types of technologies that can be integrated into teaching and learning.
44. I am aware of how different technologies can be used to provide multiple and varied representations of the same content.
45. I cannot select specific technologies that are best suited for addressing learning objectives in my discipline.
46. I understand that I need to be flexible when using technology for instructional purposes.
TPACK Domain
47. I can effectively integrate educational technologies to increase student opportunities for interaction with ideas.
48. I have different opportunities to teach specific curriculum content topics with technology.
49. I can use appropriate instructional strategies to teach specific curriculum content topics with technology.
50. I cannot determine when a technology resource may fit with one learning situation in my discipline, and not with another.
51. I can flexibly incorporate new tools and resources into content and my teaching methods to enhance learning.
52. I understand how digital technologies can be used to represent content in a variety of formats.

53. I can use teaching methods that are technology-based to teach content and provide opportunities for learners to interact with ideas.
54. I understand what makes certain concepts difficult to learn for students and how technology can be used to leverage that knowledge and improve student learning.
55. I do not understand how to integrate technology to build upon students' prior knowledge of curriculum content.
56. I know how to operate classroom technologies and can incorporate them into my particular discipline to enhance student learning.
57. I know how to integrate the use of educational technologies effectively into curriculum-based learning.

APPENDIX D:

INTERVIEW QUESTIONS

This interview is to help me collect information related to my dissertation on technology use by Arts and Sciences faculty. It is not intended to be an evaluation of you or your teaching, but a way to understand how and when preservice secondary education students are exposed to technology.

Background

1. What courses do you teach for Arts and Sciences?
2. Do you have any teaching experience other than at the college level?
3. Tell me about how you learned to teach adults?
4. How do you define technology?

Technology

5. What technologies do you use in your teaching?
6. How do you use these technologies in your classroom?
7. Why did you choose these particular technologies?
8. What technologies do you require your students to use in your classroom?
9. Thinking back to when you were in school (undergraduate or graduate), what do you remember about the technology used in the classroom by your professor?
10. What role do you think technology plays in your classroom?
11. What technologies does the College of Arts and Sciences provide/support?

Change

12. Why do you think modeling technology use in an Arts and Sciences classroom is important?

13. How comfortable are you with technology in your teaching?
14. In general how have your teaching methods changed in the past five years? In regards to technology? How? Why? What caused you to make these changes?
15. Have you ever experienced a moment in teaching (good or bad) that caused you to reconsider your use of technology? Tell me about that experience.
16. Describe how you evaluate your teaching.
17. What do you think makes people change the way they teach?
18. Are you aware that you teach preservice secondary education students?
19. Do you know what technology proficiencies are required for preservice secondary education students?

APPENDIX E:

CODING MAP

First Cycle Coding- Holistic Codes

- Dynamics of the classroom have changed
- More than just a tool or example
- Helping student learn
- Promote careful thought
- Must fit content
- Connection with material
- Distraction
- Crutch
- Relevant
- Students expectations
- Take it for-granted
- Flexible
- Need to Adapt
- Experiences guide activities
- Reflective process
- Critical thinking
- Promote Critical thinking and reading
- Is the technology appropriate
- Not effective in certain topics
- Production
- Efficient
- Organization
- Communication
- Assessment
- Convenience
- Lack of examples of how to use technology for learning
- Minimal use by professors
- No use by professors
- Failure causes change
- Experiences
- Need a powerful reason to change

Categories

- Active Learning
- Distraction
- Relevant
- Expected
- Flexibility
- Reflective Process
- Modeling
- Change

Themes

- Technology for Student Engagement and Learning
- Technology for Production and Communication
- Lack of Exposure to Technology Integration in the Classroom

Second Cycle Coding- InVivo Codes

- Has to fit the purpose
- Technology keeps student engaged more
- We'll figure it out
- Social Media
- When it connected, my teaching pretty much turned upside down
- I suppose they pick it up through osmosis or by watching us
- When there is a connection, they start to think about things differently
- Breaks the flow of lecture
- I did what my lead professor did
- Students know what they are doing
- There is nothing I can show them that they don't already know
- I am more comfortable from practice

Categories

- Reflective Process
- Flexibility
- Connection to learning
- Experiences can cause change
- Barrier
- Modeling
- Assumption of skill

Themes

- Technology for Student Engagement and Learning
- Technology for Production and Communication
- Connection to Learning
- Self-Evaluation

Third Cycle Coding- Values

- Not afraid to fail
- Advisor changed my thinking
- Transformative experience when learners connect
- Experiences promote change
- Change happens when it is required
- Growth
- Failure causes change
- Hands-on experience
- Professional Development
- Students need 21st Century skills
- Technology makes things easier
- Thoughtful selection of technology
- Thoughtful consideration of students
- I adapt
- Reflection
- Detriment to critical thinking
- Students know more than we do

Categories

- Change
- Production
- Reflection

Themes

- Self-Evaluation
- Evaluation Teaching and Materials
- Lack of Critical Thinking
- Technology for Production
- Technology for Student Engagement

APPENDIX F:

PERMISSION TO USE HE-TPACK SURVEY

Hi Susan!
Thanks for contacting me. Yes, I am happy to grant you permission to use my HE-TPaCK instrument for your dissertation. I ask that you keep me informed of your results and reference my dissertation in your study.

Best to you!
Kristi

Kristi N. Garrett, Ph.D.
Managing Editor for Social Studies Research and Practice (www.socstrp.org)
IT Portfolio
http://thediydoctor.blogspot.com/
YouTube Vlog

On Tuesday, November 24, 2015 11:56 AM, "Huffman, Susan" <susan.huffman@ua.edu> wrote:

Hi Dr. Garrett

I am a graduate student of Dr. Benson's at UA. My dissertation is looking at Arts & Sciences faculty's use of technology specifically in the content areas that are required for secondary education students. Dr. Benson referred me to your dissertation because of the HE-TPACK survey.

May I use the HE-TPACK survey you developed for your dissertation in my research?

Thank you and congratulations on your work last year.

Susan Huffman

APPENDIX G:

IRB APPROVAL LETTER

THE UNIVERSITY OF ALABAMA | Office of the Vice President for Research & Economic Development
Institutional Review Board for the Protection of Human Subjects

February 19, 2016

Susan Huffman
ELPTS
College of Education
Box 870302

Re: IRB # 16-OR-083, "Technology and Preservice Teacher Education: A Study of Technology Integration into Content Courses"

Dear Ms. Huffman:

The University of Alabama Institutional Review Board has granted approval for your proposed research.

Your application has been given expedited approval according to 45 CFR part 46. You have also been granted the requested waiver of written documentation of informed consent for survey participants. Approval has been given under expedited review category 7 as outlined below:

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Your application will expire on February 17, 2017. If your research will continue beyond this date, please complete the relevant portions of the IRB Renewal Application. If you wish to modify the application, please complete the Modification of an Approved Protocol form. Changes in this study cannot be initiated without IRB approval, except when necessary to eliminate apparent immediate hazards to participants. When the study closes, please complete the Request for Study Closure form.

Please use reproductions of the IRB approved stamped consent forms to obtain consent from interview participants.

Should you need to submit any further correspondence regarding this proposal, please include the above application number.

Good luck with your research.

Sincerely,