

2011

# A Path Analysis of the Behavioral Intention of Secondary Teachers to Integrate Technology in Private Schools in Florida

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## Suggested Citation

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A PATH ANALYSIS OF THE BEHAVIORAL INTENTION OF SECONDARY  
TEACHERS TO INTEGRATE TECHNOLOGY IN PRIVATE SCHOOLS IN  
FLORIDA

by

John P. McCombs

A dissertation submitted to the College of Education and Human Services  
in partial fulfillment of the requirements for the degree of

Doctor of Education in Educational Leadership

UNIVERSITY OF NORTH FLORIDA

COLLEGE OF EDUCATION

August 10, 2011

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## DEDICATION

This work is dedicated to four important women in my life.

...to my daughters Kelly and Kate, in the hopes they understand that education is a journey that should never end, and the challenges presented along the journey are what make life interesting; if not meaningful.

...to my wife Ann, who has been my partner in our globetrotting life and who has supported my work throughout. Thankfully, she has helped me find the reasons to stay the course.

...and to my mother, who at 97, has known me the longest and continues to teach me lessons on fortitude, perseverance, and perspective.

## ACKNOWLEDGMENTS

I would like to acknowledge my committee for their contributions in the completion of this document. I appreciate that Dr. Daniel agreed to join my committee and found the time among his many responsibilities to assist a doctoral candidate in time of need. I am thankful for his timely guidance in deciphering the path analysis, for his support of my use of a new analytical tool, and his encouragement of that learning process. I appreciate Dr. Paulson's insight into organization theory and his encouraging and supportive words about the work. I appreciate Dr. Cavanaugh's contributions concerning current thought on educational technology, and his willingness to join the committee after the loss of Dr. Foti. Most importantly, I would like to thank Dr. Kasten for her expertise in quantitative methodology, factor analysis, APA style, and the English language. The hours Dr. Kasten has spent on the document made a significant contribution in making a complex study accessible to the reader. Lastly, I would like to thank The Bolles School Professional Development program for the financial support of this work.

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## ABSTRACT

This research was designed to investigate the behavioral intention of a sample of teachers to develop curriculum based projects that require students to use technology.

This research employed a quantitative study design of an educational version of the Universal Theory of Acceptance and Use of Technology model. The UTAUT model was expanded to include factors from the Theory of Planned Behavior, and Social Cognitive Theory.

The sample was composed of 251 private school teachers in Florida who completed an on-line survey instrument based upon the UTAUT model. The results were analyzed with confirmatory factor analysis that identified several factors that contributed to the behavioral intention of the teachers to integrate technology. In the final factor analysis, Social Influences, Effort Expectancy, and Anxiety all proved to be very strong factors. Attitude, Performance Expectancy, and Facilitating Conditions were moderate to strong factors in this final analysis.

The relationships between the identified factors were determined through the development of a path model using partial least squares analysis. The constructs having the strongest relationship with Behavioral Intention, and hence, having a stronger effect were Attitude ( $\beta=.775$ ,  $p < .001$ ), Performance Expectancy ( $\beta=.698$ ,  $p < .001$ ), and Effort Expectancy ( $\beta=.667$ ,  $p < .001$ ). The structural model also supported that Behavioral Intention is strongly related to actual Use ( $\beta=.561$ ,  $p < .001$ ). The construct of Facilitating Conditions had a weak and negative relationship with Use ( $\beta=-.131$ ,  $p = .16$ ).

The moderating effects of several attributes were also tested. While there were several notable affects only the presence of a curriculum guide proved to have a statistically significant influence.

The present study contributes to behavioral intention research by confirmation of the model and providing a new context for the adapted UTAUT (Venkatesh et al., 2003) that was developed for a teacher acceptance and use of technology in an educational setting. Several implications for practice are offered in addition to further directions for research in this area. The approach to technology adoption requires an understanding of how leaders of an organization, as well as individual teachers, approach technology use.

## CHAPTER ONE: TECHNOLOGY INTEGRATION IN SECONDARY SCHOOLS

The advent of computer technology has been one of the most significant influences in the field of education over the last three decades. The 1983 report titled *A Nation at Risk* recommended computer science as one of the five basics to be included in high school graduation requirements. New technologies have been developed and adopted at a rapid pace, with even newer technologies reaching the market each year. Over those three decades, as much as 50% of all capital investment in organizations has been spent on information technology (Westland & Clark, 2000). According to Dickard (2003), American schools have made improvements in their technological capacity, assisted by public and private investments of more than \$40 billion dollars in infrastructure, professional development, and technical support. By 1997, 98% of U.S. schools contained computers with a student-to-computer ratio of 10 to 1 (Coley, Cradler, & Engel, 1997). When computers found their way into schools, the teachers faced learning a new set of skills. Teachers first needed to master the early productivity tools such as word processing and spreadsheets. These innovations were followed by curriculum-based materials on CD ROMs that soon entered the market. As interest in technology grew, school leaders responded with the purchase of computers, and student/computer ratios in schools became a measure of technology readiness. During this time, teachers were introduced to the integration of computer technology into their

pedagogy, and as they adjusted to this concept, the Internet appeared on the scene. In 1994, only 35% of the public schools had Internet access. By 1999, 99% of all public school teachers had computers available in their schools, and 84% of teachers had Internet access in their classrooms (U.S. Department of Education, 2000). In 2003, nearly 100% of public schools in the United States had access to the Internet (National Center for Education Statistics, 2003-04).

Private schools have experienced a growth in technology development as well. In private schools in the United States, there was an average of six students per computer in 1998, which was an improvement from nine students per computer in 1995. Within private schools, religious schools had a ratio of nine students per computer while non-sectarian schools had a ratio of six students per instructional computer. Catholic schools have shown improvement in the ratio of students to computers from 2000 to 2006. In 2000, the student-to-computer ratio was 8:1; by 2006 the ratio had improved to 4.5 students per computer. Over the same timeframe, the public school ratio of students to computers was 6:1 and improved to 3.8:1 (Brooks-Young, 2006). In 1995, the Internet was available in only 5% of private schools; by 1998, 25% of private schools had Internet access. However, in 1998, 51% of public schools had Internet available in the school. In 2006, 60% of all Catholic schools had laptop computers available for instructional purposes. Within private secondary schools in particular, 72% had laptops on campus (Brooks-Young, 2006). The result of this growth has been improved accessibility to computer technology for teachers and their students.

The Internet created new possibilities such as email, better research capabilities through online databases, and publishing opportunities. Today, many schools are

employing wireless technology that when combined with a laptop computer allows individual connectivity. Wireless availability in public schools increased from 23% in 2002 to 32% in 2003 (Parsad & Jones, 2005). New tools, such as blogs and wikis, have been introduced into schools, and hundreds of public, independent, and parochial schools have initiated 1:1 computing programs in which each student uses a laptop computer throughout the day (Peneul, 2006). These new developments continue to pressure teachers to decide which technologies they are going to use in their work. When teachers make these decisions, the teachers must be convinced of the feasibility of using a particular technology before its adoption and integration (Office of Technology Assessment, 1995).

Unfortunately, the use of technology by teachers has not kept pace with the development of technology. After all the promotion of technology, many teachers are only occasional users (at least once a month) or nonusers of technology (Cuban, Kirkpatrick, & Peck, 2001). Norris, Sullivan, and Poirot (2003) reported that 14% of U.S. K-12 teachers do not use computers for instruction, and 45% use it fewer than 15 minutes per week; only 18% of the sample reported using computers for instruction more than 45 minutes per week. The adoption of technology is a complex social developmental process and is built upon teacher perceptions of the technology that influences teacher intentions (Straub, 2009). Teachers do not make these decisions in isolation but are influenced by the attitudes and beliefs of school leaders towards technology use and the consequential school policies that direct technology use in their schools. The decision by teachers to use computer technology with their students can be influenced by several factors, and it was the intent of this research to investigate those

factors that may be predictors of teacher intention to integrate technology into their curriculum. These variables are important aspects of this research and will be discussed in detail in subsequent sections.

One of the purported purposes of technology use in schools is to increase student learning. Several comprehensive studies have concluded that computers have had a minor, or even an adverse, effect on student learning (e.g., Russell, Bebell, O'Dwyer, & O'Connor, 2003; Cuban et al., 2001; Waxman, Connell, & Gray, 2002). On a positive note, many analyses (Baker, Gearhart, & Herman, 1994; Kozma, 2003; Kulik, 1994; Mann, Shakeshaft, Becker, & Kottkamp, 1999; Scardamalia & Bereiter, 1996; Sivin-Kachala, 1998; Wenglinski, 1998) have indicated improvement in attitudes toward learning, achievement scores, and depth of understanding when computers were integrated with traditional learning modalities (Kay, 2006). Other research has indicated that the addition of computer-aided instruction with an active learning component had a positive effect on students' acquisition of basic mathematics skills (Tienken & Wilson, 2007).

Even though the impact of technology on student achievement has not been determined, technology literacy is becoming more integrated into the prescribed curriculum, and this requires adoption of technology (Barron, Kemker, Harnes, & Kalaydjian, 2003). The decision to have students use technology in a class is most often determined by the teacher. Teachers are the gatekeepers of the activities that take place in a classroom, and the differences in technology use by teachers has been studied in order to develop an understanding of technology integration in schools (Cuban et al., 2001; Mardis, Hoffman, & Marshall, 2008). This present study focused on the factors



that affect the teachers' intention to develop curricular activities that require student use of technology. My intent was to investigate the perceptions of teachers towards the many factors that may have an impact on their intention to develop curricular activities that require students' use of technology to access, manipulate, or present information. The teacher/student model of interest was the traditional setting of a teacher with students in a school building and does not include online classes. I focused on secondary school teachers, which includes grades 6 through grade 12. The conceptual models and theoretical frameworks upon which this research is founded are explained in the following sections.

### **Categories of Technology Use by Teachers**

The three categories of technology use that are integrated into educational settings are (a) administrative tools, (b) teacher presentation tools, and (c) student learning/presentation tools. The three categories have differences of complexity, and each category impacts teaching and learning differently (Cuban, 1993). The most common use of technology in schools is in the area of administrative software that maintains the school's databases, including student schedules, grades, and attendance. These databases are maintained by office personnel such as the registrar; however, teachers use technology to supply information to these databases via attendance programs, grading programs, and curriculum programs. In a 2009 national survey of teachers, the NCES reported that teachers indicated that a network was available for viewing the following administrative records: grades (94%), attendance records (93%), and results of student assessments (90%). Of these teachers the percentage using it sometimes or often, was 92% (grades), 90% (attendance), and 75% (student assessments;

Gray, Thomas, & Lewis, 2010). It is necessary to maintain properly updated records, and the use of these tools by all teachers has often been mandated by the school administration.

The use of technology by teachers as a tool to prepare and deliver lessons to their classes has been accepted by many teachers who have mastered the use of presentation software (Cuban, 1993). The ability to present content to their classes via technological tools has great potential to impact student learning; however, this technology use requires access to hardware, such as data projectors or interactive whiteboards, not available in all schools. Another technology use in this category is the use of the Internet to access information to create lessons or to find lesson plans already created by other teachers who are willing to share. This second category of technology use by teachers is an important component. In the 2009 NCES survey teachers reported using word processing software (96%), spreadsheets and graphing programs (61%), software for managing student records (80%), software for making presentations (63%), and the Internet (94%) (Gray et al., 2010). Although the use of technology as a presentation tool may improve the lessons, it is still not considered a high-level use of technology according to Cuban.

The third category developed by Cuban (1993) in which technology may have the greatest impact on student learning is the use of the technology by students themselves. Use of technology by the students is considered a high level use of technology and the core component of the integration of technology. In the 2009 NCES survey the teachers reported that their students used computers in the classroom during instructional time often (40%), or only sometimes (29%). Teachers reported that their students used computers during instructional time; often (29%), sometimes (43%), and or not at all

28% (Gray et al., 2010). The percentages indicate that use of the technology by the students is below what would be possible.

The International Society of Technology in Education (ISTE) defined the integration of technology in the National Educational Technology Standards (NETS) as follows:

Effective integration of technology is achieved when students are able to select technology tools to help them obtain information in a timely manner, analyze and synthesize the information, and present it professionally. The technology should become an integral part of how the classroom functions—as accessible as all other classroom tools. (ISTE, 2002, p. 3)

In this use of technology in a school, the role of the teacher is to develop lessons that require students to use technology in their learning. The use of technology can occur in the classroom, in a computer lab, or on student laptop computers. Teachers' perceptions of the factors that may influence their intention to develop and implement activities that require student use of technology is the topic of interest of this research.

### **Statement of the Problem**

The purpose of this study is to examine the factors that affect secondary teachers in the implementation of curriculum activities that require student use of technology in private schools in Florida. This research is based upon several research questions focused on seven aspects of the behavioral intention of the teacher to develop curriculum projects that require students to use technology. The present study adapted the Unified Theory of Acceptance and Use of Technology (UTAUT) model for use in secondary educational settings to measure teachers' perceptions about their intention concerning the

use of technology by their students. One aspect of this research was to investigate the factors that influence teacher intention to developed curriculum activities that require the student use of technology. The intention of an individual to use technology is referred to as *behavioral intention* in the literature. Behavior intention to use computer technology to complete a task is one of the most significant indicators of the ultimate behavior to use the technology (Alshare, Freeze, & Kwun, 2009; Venkatesh, Morris, Davis, & Davis 2003). Several factors have been identified in the literature that may affect the intention of a teacher to integrate technology. This research attempted to clarify the relationships among the factors that may affect a teacher's decision to develop curriculum activities in which students integrate technology. The four research questions guiding the research are presented in Chapter 3.

### **Theoretical Frameworks in the Field of Technology Use**

Several theoretical frameworks have been applied to the factors that impact end use of technology. The frameworks have focused on different areas of interest, and the models have changed as new research became available. Researchers have applied an activities system framework (Lim, 2007), a social system framework (Ajzen & Fishbein, 1975; Bolster, 1983; Stoneman & Diederer, 1995), an organizational culture framework (Adamy & Heinecke, 2005), a personal beliefs framework (Ertmer, 1999; Sanderlands & Stablein, 1987), and a policy implementation framework (Bellamy, 2005; Carpenter, 1977; Spillane, Reiser, & Reimer, 2002). The varying conceptual frameworks that have driven much of the research have incorporated several of the same factors. Throughout the recent history of technology research, these components have been incorporated into several models that have indicated the relationships among the factors that will impact

eventual technology use. Research into technology use has been completed in fields such as corporate use of technology (Venkatesh & Davis 2000; Venkatesh, Maruping, Brown, & Bala, 2006; Venkatesh et al., 2003; Venkatesh & Speier, 1999), and the findings have transferability to other fields such as education.

The recent conceptual frameworks have evolved from the contributions of earlier research that investigated factors which may impact the use of technology by an individual. Rogers (1962) included the constructs of ease of use, visibility, compatibility, and results into his diffusion model. Ajzen and Fishbein (1975) developed an early technology-use model named the Theory of Reasoned Action (TRA). This model contained attitude toward behavior and subject norms as the two main constructs. The Theory of Planned Behavior built upon the TRA by adding the construct of perceived behavioral control (Ajzen, 1991), and a study using the Social Cognitive Theory (SCT) determined that the factors of Self-efficacy and Anxiety towards computer use influenced Behavioral Intention, (Bandura, 1986; Compeau et al., 1995, 1999). Davis (1989) developed the Technology Acceptance Model (TAM) which included attitude toward behavior and the new factors of perceived usefulness and perceived ease of use. Venkatesh and Davis (2000) enhanced the TAM model by adding a subject norm as a predictor of intention of technology use. An attempt to unify the theories is the UTAUT by Venkatesh et al. (2003). The UTAUT model used four constructs that predict Behavioral Intention to use technology: Performance Expectancy, Effort Expectancy, Social Influences, and Facilitating Conditions. Each model is discussed in greater depth in Chapter Two.

## Definitions

Several terms are specific to the study of behavioral intention to use a particular technology. To assist the reader in understanding the use of the terms in this research, definitions are provided:

Technology Integration: Effective integration of technology is achieved when students are able to select technology tools to help them obtain information in a timely manner, analyze and synthesize the information, and present it professionally. The technology should become an integral part of how the classroom functions -- as accessible as all other classroom tools (ISTE, 2002).

Computer Technology: In the present research, the term *technology* refers to computer technology that incorporates computers and the applications they access, including the Internet. Computer technology may be available in the classroom, in a computer lab, or in a library. Computer technology may also be available on individual laptop computers.

Independent Schools: An independent school (or private school) is a school that does not depend on money from the government. Because it does not receive its funding through taxation, an independent school is typically run by a board of trustees and not by elected officials. An independent school receives its financial support primarily through tuition, fundraising, and sometimes endowments.

UTAUT Model: The Unified Theory of Acceptance and Use of Technology is a synthesized conceptual model of technology use that contains four constructs that affect behavioral intention towards system use (Venkatesh et al., 2003). In the present research, system use is defined as implementing curriculum activities that require student use of technology.

Facilitating Conditions: Facilitating conditions refer to individual perceptions of the availability of technological and/or organizational resources (e.g., knowledge, resources, and opportunities) that can remove barriers to using a system (Venkatesh et al., 2003).

Facilitating Conditions are defined by a teacher's belief that the school has organizational support and technical infrastructure to support integration of student technology projects.

Social Influence: Social Influence is the construct that refers to the degree to which a teacher perceives that important others believe they should integrate student technology projects. This construct is based upon the idea that teachers' behavior is influenced by the way in which they believe others (including school leaders) will see them as a result of their using the technology (Venkatesh et al., 2003).

Performance Expectancy: Performance Expectancy is defined as the degree to which teachers and administrators believe that integrating student technology projects will assist them in improving the instruction in their classes. The creators of the UTAUT (Venkatesh et al., 2003) indicated that this construct has the greatest influence on Behavioral Intention. This result has been reinforced by others researching models that investigated Behavioral Intention to use technology (Agarwal & Prasad, 1998; Compeau & Higgins, 1995; Taylor & Todd, 1995).

Behavior Intention: Behavior intention is an individual's self-reported subjective probability of performing a specified behavior based on cognitive appraisal of volitional and non-volitional behavioral determinants (Morris & Venkatesh, 2000).

System Use: System use has been conceptualized in different ways in the literature with the three measurements of use being duration, frequency, and intensity (Davis, 1989; Morris & Venkatesh, 2000; Straub, Limayem, & Karahanna-Evaristo, 1995; Taylor &

Todd, 1995). Duration of use is the measure of the actual time spent using a technology; frequency is how often the technology is used; intensity is the complexity of the technology use. In the present study use was defined as the development of curricular activities by the teacher that requires the student use of technology to access, manipulate, or present information.

### **Methodology**

The objective of this study was to adapt the UTAUT model to measure teacher perceptions of the importance of several factors (Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Attitude, Anxiety, and Self-efficacy) of influence in their intention to develop curriculum activities that require students to use technology. In the present research the term technology refers to computer technology as defined in the definition list. This study was not intended to measure teacher perceptions toward the use of technology for administrative functions or the presentation of lessons. The many factors that have been identified as influential in technology use by individuals in a corporate setting have been identified in the UTAUT model developed by Venkatesh et al. (2003). The study population of interest was composed of the secondary teachers of private schools in Florida. The study population was restricted to teachers and did not include administrators of the schools because of their leadership role in technology use in schools. The influence of leaders towards teacher use of technology was incorporated into the items that measure the constructs of Social Influence and Facilitating Conditions in the research model.

Schools were invited to participate via an introductory email to the school director. Approximately 70 schools were invited. Upon receiving permission from the



school director, the teachers of the school were individually contacted via email. The intent was that teachers of the participating schools would take the on-line survey resulting in a minimal overall sample size of 160 teachers. To improve the response rate, there were two follow-up emails sent to the teachers. Teachers were given the option of requesting a paper copy of the survey if they preferred that method; however, none did. The final outcome was a useable sample of 251 completed surveys.

The data were analyzed using exploratory factor analysis to test the validity of scores on the instrument and also to identify the latent variables or factors. The latent variables measured were also analyzed using partial least squares (PLS) regression. PLS regression is a multivariable technique which hypothesizes relationships between variables expressed as path diagrams. The PLS regression model has two steps: a confirmatory factor analysis to develop the measurement model, and a path analysis to develop the estimations model.

### **Assumptions and Limitations**

An assumption of this study is that the UTAUT model captures constructs and variables of interest and is applicable to an educational setting. A limitation of this research is found in the method of data collection. The data were collected through a self-reporting survey, considered an accepted limitation in research (Creswell, 2003). The data were collected through a survey that has been accessible via the Internet, and this use of technology may have a tendency to select teachers that are more comfortable with the use of technology. However, teachers had the option of requesting a paper copy of the survey if they preferred that method.

The study was delimited to only secondary private schools in Florida by sampling only private schools. Another limitation of the study was the use of a particular instrument (an adapted UTAUT instrument) delimited the study to a specific set of constructs. The definition of technology integration in this study is also a limitation. I delimited technology integration to include only curriculum projects that require students to use computer technology. The definition does not include other uses of technology by the teacher such as the use of technology to present lessons or to complete administrative tasks. An additional limitation is the study does not address the physical location or the quantity of the technology present in the school.

Venkatesh et al. (2003) determined that behavioral intention of a user to use a technology is a determinant of use. In education, the teacher is the gatekeeper who makes decisions regarding use of technology by the students. Although students may choose to use technology outside of class, the teachers make the decision to incorporate use of technology into the lesson. As a result, it is the behavior intention of the teacher that impacts the use of the technology by the student in a classroom.

### **Overview of the Study**

Chapter One has been a brief introduction to my area of investigation. The impact of computer technology on schools, and the response of teachers to computer technology were discussed. Several theoretical frameworks that applied to technology use by individuals were discussed in Chapter One. Finally, a brief discussion of the methodology was presented.

Chapter Two is a literature review that discusses research that has been published in the area of technology use. The focus of my research was the factors that influence the

behavioral intention of the user (in this case the teacher) to implement technology use by their students into their classes. As research into the use of technology developed, new models were created that included new constructs that have an influence on technology use. Several prominent technology use models, and the frameworks upon which they were developed, will be discussed in the second chapter.

Chapter Three is a discussion of the methodology that has been used to collect and analyze the data. An adapted UTAUT instrument was used to measure the importance of the constructs in the field of secondary schools. The data were analyzed using partial least squares, a form of structural equation modeling that includes a factor analysis followed by a path analysis, and this is discussed as well.

Chapter Four presents the results of the analysis of the data. The research design included the use of a survey as the instrument to collect input from secondary school teachers. The data collected in the survey represent the insights of teachers into several factors that hypothetically affect their behavioral intention to integrate technology into their curriculum. The factors were originally identified in the UTAUT theory (Social Influences, Effort Expectancy, Performance Expectancy, and Facilitating Conditions) and in social cognitive theory (Attitude, Anxiety, and Self-efficacy). The results are presented in three sections that follow the three steps of the analysis. Chapter Four includes the demographics of the sample, the results of the factor analysis, and the path diagram that was created using partial least squares analysis. The path diagram from the PLS presents the relationships between the items and each factor in the “outer” measurement model, as well the relationships between each dependent factor and the independent factor of Behavioral Intention in the “inner” structural model, including the

affect of moderators. The path diagram also indicates the relationship between behavioral intention and actual use.

Chapter Five includes the discussion of the data and the conclusions that can be drawn from the data. The findings are discussed in relation to the individual research questions. Implications of the results for each research question are discussed as they may relate to practical applications in educational institutions. Chapter Five also includes recommendations for further research in the Behavioral Intention of teachers to integrate technology.

## CHAPTER TWO: A REVIEW OF THE LITERATURE

The literature review supports the underlying concepts of the research into the behavioral intention of secondary teachers to integrate technology into their curriculum. The decision by a teacher to develop curriculum activities that require students to use technology is affected by a wide range of interrelated influences. The influences that may affect technology acceptance and intention to use a technology are grounded in several different conceptual frameworks. These frameworks include innovation diffusion theory (Rogers, 1962), individual attributes theory (Ajzen, 1991, Ajzen & Fishbein, 1975; Davis, Bagozzi, & Warshaw, 1992), social cognitive theory (Bandura, 1977; Compeau & Higgins, 1995, Spillane et al., 2002), as well as behavioral intention theory (Venkatesh et al., 2003).

While the present study concerned the educational use of technology, many of the user acceptance studies have been completed in corporate institutions. Researchers have approached the use and acceptance of technology through a variety of theoretical frameworks, and several influential factors have been identified. Earlier theories and models were adjusted over time leading to unified models in which the terminology was modified. This literature review will attempt to explain the subsequent models that were developed from those conceptual frameworks. The final section of this chapter will discuss the development of the Unified Theory of Acceptance and Use of Technology and its application to the present research.

This review of the literature discusses the many individual factors that are presented in models. The review is divided into several sections that will each explain a particular approach to understanding technology use in an institution. Part I is a review of technology use in education including the standards that are the baseline for technology use in education. The standards of use have been developed at national, state, local, and private levels. The standards are often adopted by an organization and become the goals that technology use is meant to achieve.

Part II is devoted to discussion of the personal factors of individual teachers and organizational culture, which may affect teachers achieving technology standards. In this section the importance of teachers' attitudes and beliefs is introduced. The diffusion of technology within an institution is based upon the organizational culture and context of the diffusion. Within this section, the impact of leaders upon the adoption and diffusion of technology by individuals is discussed.

Part III of this review discusses the conceptual frameworks for technology use, teacher beliefs toward technology use, and organizational characteristics that may affect higher level use of technology. Several theoretical frameworks are discussed, and several of the frameworks have similarities to each other. The terminology for a particular factor may vary between frameworks while the concept may be the same. An attempt has been made to identify such similarities or overlaps in the terminology.

Part IV introduces the many models that have been developed over the last three decades that have incorporated the conceptual frameworks into working models. The models that have an impact on technology-use research have been grounded in a variety of theoretical foundations, and the contribution of each is presented. Included in the

models is a discussion of the Unified Theory of Acceptance and Use of Technology that is the model that has been adapted and employed in this research. Venkatesh et al. (2003) expanded the Technology Acceptance Model (Davis, 1989) into the UTAUT model that included user acceptance in a framework of independent factors and also defined moderators of each factor. In this research an adaptation of the UTAUT model has been chosen to measure the technology acceptance by secondary teachers.

The models introduced above have been developed in a wide variety of corporate organizations. This study investigated teachers' intention for student technology use in an educational setting. Because the organizational setting has an influence on technology use, it is important to discuss the policies that may have an impact on technology use in a particular educational setting.

### **Part I: Technology Use in Education**

The advent of computer technology has been one of the significant influences over the last three decades in the field of education. The availability of computers and Internet connections has increased substantially over this time period. The ratio of students per computer dropped from 10 to 1 in 1995 to 5 to 4 in 2000 in public schools. In 2003, the ratio of students to computers that also included Internet access in public schools was 4.4 to 1, a decrease from the 12.1 to 1 ratio of students to computers with Internet access in 1998 (Parsad & Jones, 2005). In the United States, the percentage of public schools that have Internet access increased from 35% in 1994 to 99% in 2002 (Barron, Kemker, Harmes, & Kalaydjian, 2003). In the 2009 NCES survey Internet access was available for 93% of the computers located in the classroom, and 96% of the computers that students had access to in the school. The ratio of students to

computers in the school was 5.3 to 1 (Gray et al., 2010). As computer access increased, use of computer technology has been championed by many as a solution to many of the problems with student achievement. However, the technology tools available to teachers have increased in quantity and quality within a relatively short timeframe, leaving teachers little time to assimilate the new tools. As teachers were being introduced to the basic operation of computers and integrating them into their pedagogy, the Internet exploded on to the scene. Before many educators were competent with the new technology, they were faced with a new challenge. The new challenges were beyond the technical ability of many teachers, and use of the technology was not widespread. Jaspersen, Carter, and Zmud (2005) reported that even though organizations had invested large amounts into technology, there was limited use of the available technology by individuals. Even when technology was used in some schools, it was not fully embraced. Moersch (1995) measured teacher perceptions of technology use in the classroom and developed teacher profiles that indicated the level of technology implementation, personal use, and instructional practice with six levels from non-use to integration. Moersch found that 49% of the teachers were working at the second lowest level which is only one level up from non-use, and these teachers were a long way from the highest level in which a teacher is integrating technology with a learner-based curriculum.

Today, many schools are employing wireless technology that allows connectivity that has not been seen before. These changes in new technology have all occurred within a timeframe of the career of many teachers. These teachers may have not kept their skills current with the technological changes and, therefore, do not apply technology effectively. In contrast, students grew up in this digital age and became more



comfortable with technology. Prensky (2001) has identified students as “digital natives” because they have lived their entire lives in the digital age. The digital age began in the second half of the twentieth century and was based on information in a digital format. Many teachers are identified as digital immigrants by Prensky because the digital world is not their native language. Prensky stated that teachers often have digital accents as a result of having learned the new language of the digital world while still preferring more traditional methods. Printing an email to read it is an example of what Prensky described as a digital accent.

Teachers had to learn several computer-based innovations, with varying success in the use of those applications. The teachers that attempt innovations are often supported; however, there may be minimal effort to spread the innovation throughout the organization. In spite of improved access to computers and Internet access and support for use of computers in the curriculum, few teachers have integrated the technology into their curricula (Becker, 2000; Marcinkiewicz, 1996). School leaders tend to emphasize inventions and innovation, rather than the diffusion of innovation, and policies have the ability to improve the diffusion process (Anderson & Dexter, 2005). One would expect that as particular technology uses were introduced, institutions would attempt to develop policies that would increase the diffusion of the technology use (Cuban et al., 2001). The use of policy instruments such as written curricula that integrate technology, technology plans, and evaluation of technology use may increase the intention of teachers to use technology.

The investment in educational technology in schools led to the discussion of the purpose and goals for the instructional integration of technology. Technology standards

were introduced in the 1970s, and many states began to set benchmarks for computer literacy but did not require mastering the standards by the students as a requirement for graduation. Barron et al. (2003) concluded that more integration of technology is needed before performance benchmarks will be met. The federal law No Child Left Behind, enacted in 2001, included the “Enhancing Education through Technology Act of 2001” that increased interest in technology standards. Part D of the Act defined the standards for integration of technology into the curriculum in order for schools to receive grants. The International Society of Technology Education (ISTE) first published the National Educational Technology Standards (NETS) for students in 1998 and for teachers in 2000 (ISTE, 2003). The U.S. Department of Education now includes technology as an important component of a high quality education (US DOE, 2003).

As the standards movement gained momentum, interest increased in the technological skills that involved the integration of technology, and interest in student-to-hardware ratios diminished. When ISTE first published their standards, 29 states adopted the standards. The National Educational Technology Standards (NETS) specify six areas of technology competencies for students: (a) basic operations, (b) social and ethical issues, (c) productivity tools, (d) communication tools, (e) research tools, and (f) problem solving tools. The categories include grade level and performance benchmarks that are often applied in both public and private schools that have adopted the standards.

Three organizations have conducted studies to determine how teachers actually use technology in their instruction: the National Center for Education Statistics (NCES), the Center for Research and Information Technology and Organization, and the Consortium on Chicago School Research (Barron et al., 2003). The NCES reported that

61% of teachers assigned student work that required word processing or spreadsheets, 51% of teachers assigned student work that required Internet research, 50% of teachers assigned student work that required technology to practice drills, and 50% assigned projects that required students to use technology to solve problems (Smerdon, Cronen, Lanahan, Anderson, Iannotti, & Angeles, 2000). Ravitz, Becker, and Wong (2000) concluded that technology integration is most likely to occur in self-contained elementary classes or in high school classes that are specific to technology. In core academic courses (science, social studies, English, and mathematics) teachers only integrate technology into lessons at a minimal level (Ravitz et al., 2000). The Consortium on Chicago schools (Hart, Allensworth, Lauen & Gladden, 2002) surveyed the Chicago public school teachers, and with a 75% response rate reported the following: 29% of teachers reported no integration of technology into their teaching; 19% of teachers reported limited integration of technology into their teaching that included only low-level tasks such as word processing, drill, and research on the Internet once or twice a month; 24% of teachers were moderately integrated including uncommon tasks up to once or twice a month; 11% of teachers integrated basic tasks once or twice a week such as uncommon tasks related to analyzing or graphing data or creating presentations; 6% of teachers were highly integrated, indicating weekly to daily use of complex activities such as demonstration, email, programming or webpage creation. The greatest percentages of teachers (41%) were not integrating technology into their lessons at all. In addition, The Apple Classroom of Tomorrow (Apple Computer Inc., 1995) was a significant study that used qualitative longitudinal research to investigate the process of technology integration. The study determined that technology develops new student-teacher

interactions, engages students in high order cognitive tasks, and requires teachers to question their viewpoints about their instruction (Dwyer, 1995). Tienken and Wilson (2007) have shown that the learning of basic computational skills can be improved through the use of web-based drill and practice exercises. Becker (2000) reported that in areas such as science, social studies, and mathematics that require acquiring, analyzing and communicating information, technology use occurs in only a minority of secondary school classes.

The 2009 NCES survey reported actual use of technology by secondary students in seven categories (Gray et al., 2010). The data presented in Table 1 indicates that teachers allow students to use technology for research, to write text, and prepare visual displays. Fewer teachers have incorporated projects that use newer tools such as blogs, wikis, or social networking websites.

Continued improvement in the physical components required for successful integration of technology such as access, staff development programs, and supportive policies has occurred, and this should have led to greater use of technology (Anderson & Dexter, 2000). Chan Lin (2007) reported that even though the components are in place in many schools, most of the technology use is low level, indicating that barriers still exist. One of the barriers may be the teachers themselves. Little disagreement exists that the attitudes that the teachers hold will affect their behavior in the classroom (Pajares, 1992).

Table 1

*Student Technology Use (NCES national survey, 2009)*

<b>Technology use assigned by teachers</b>	<b>Never</b>	<b>Rarely</b>	<b>Sometimes or Often</b>
Prepare written text	13	20	67
Create or use graphic displays	17	24	59
Learn or practice basic skills	26	21	53
Conduct research	11	20	69
Correspond with others	36	24	40
Contribute to blogs or wikis	71	16	13
Use social networking websites	81	12	9

Note: Gray et al., 2010

Individual teachers often have different concerns concerning technology. The development of a teacher's attitude towards technology is multifaceted. The teachers who are concerned about the physical management of technological resources often have a tendency to be able to manage these issues. However, teachers who are concerned about how technology use affects student experiences will manage the resources only if it benefits academic interest (Jackson, 2005). Staff development and incentives need to be directly related to teachers' needs and experiences in order to be effective (Chan Lin, 2007; Gray & Thomas, 2001). Williams and Robinson-Horne (2000) pointed out that technology applications need to be meaningful in order to encourage teachers to develop technology skills, but determining teacher needs has been more problematic. This is discussed further in the following section.

While new legislation and state policies support technology use, the adoption of standards by a school or district does not mean that integration into the classroom exists. Instructional computer use appears to be increasing (often by self-reported data), but the use is incremental, teacher-centered, and low level, and it is removed from best practices

as advocated by scholars and professional standards (Becker, 1994; Berg, Benz, Lesley, & Raisch, 1998; Dede, 1998; Dexter, Anderson, & Becker, 1999). The evidence appears to indicate that technology is not being fully integrated in education. Technology adoption in an organization needs to address several factors including cognitive, emotional, and contextual concerns surrounding teachers (Straub, 2009). User acceptance of technology is a field of research that has isolated several of the factors that may impact a teacher's intention to have students use technology. Factors reported in the literature that may impact a teacher's decision to integrate technology into their classroom are discussed further in the next section.

## **Part II: Factors that Influence Technology Use**

Several factors that have an influence on user acceptance of technology have been identified by many researchers (Agarwal & Prasad, 1998; Ajzen, 1991; Compeau & Higgins, 1995; Davis, 1989; Taylor & Todd, 1995; Venkatesh & Davis, 2000). One assumption is that the beliefs and attitudes of users towards technology are important factors in the adoption of technology into an organization (Venkatesh & Davis, 2000). This section will discuss the findings in the literature regarding teacher attitudes, organizational culture, and organizational leadership as they relate to technology use.

Organizational culture has been shown to be influential on technology use. Elementary and secondary schools have cultures that are different based upon methods of teaching and learning subject matter. Secondary education is organized by content area departments, and this has an influence on education and reform (Grossman & Stodolsky, 1995; McLaughlin, Talbert, & Bascia, 2001). The department areas are actually subsets that often develop their own attitudes and beliefs about what content is taught and how

content is taught (Beane, 1995). These content areas can have their own traditions on how content is taught, and this may also limit the use of technology (Ball, 2003).

The investigation into teachers' decisions to utilize technology depends partly on their own beliefs and attitudes towards technology use. Sanderlands and Stablein (1987) concluded that what the teacher does in the classroom is determined by the teacher's personal beliefs, practices, and attitudes. The formation of personal beliefs, the ability to change those beliefs, and the effect those beliefs have on technology use is discussed in the following section.

### *Teacher Attitudes and Technology Use*

The attitudes that teachers develop towards the implementation of technology are based upon a complex set of beliefs that the individual teacher possesses. Several researchers have reported a relationship between teachers' beliefs concerning the importance of technology and the amount of technology they will use in the classroom, indicating that technology use is an intentional behavior and beliefs can limit or enhance their technology use (Chan Lin, 2007; Moore & Benbasat, 1991; Sugar, Crawley, & Fine, 2005).

Rokeach (1968) developed a concentric model that states a person has a core set of beliefs that are personal and have been supported by society and, therefore, are difficult to change. Another layer of beliefs in this model are those which are personally developed and can be changed by the individual, but are not susceptible to persuasions. Personal beliefs that are based on trustful authorities are changeable if the persuasion originates from an authority figure. The most superficial beliefs are those that are the easiest to change and are commonly referred to as personal taste. Ertmer (2005)

supported this view by stating that personal beliefs become consistently reinforced and eventually become difficult to change. All beliefs are created social constructions, reinforced by the culture, but the beliefs can also be formed by chance (Pajares, 1992). These beliefs can have a significant impact on behaviors, but the magnitude of the influence on behavior depends on the nature of the beliefs (Nespor, 1987).

Sugar et al. (2005) found that teachers generally have the understanding that there is widespread support from school leaders as well as parents for use of technology. Yet other beliefs could be affecting teachers' attitudes towards technology, and those beliefs may be related to external criteria. Three main experiences that affect the beliefs of teachers are personal experiences, vicarious experiences, and social cultural influences (Ertmer, 2005; Nespor, 1987; Rokeach, 1968). Early experiences are held in episodic memory and will affect the teachers' beliefs. These early experiences, either positive or negative, will affect the perceptions long into their careers (Nespor, 1987). Sugar et al. (2005) stated that it is important to research teacher attitudes and employ interventions that will help to reverse negative attitudes toward technology use.

School leaders need to determine the areas in which teacher beliefs can be influenced in order to increase technology use. The first step is to understand the pedagogical beliefs of the particular teachers and where the teachers are in their adoption of technology. Prensky (2001) stated that teachers will learn new technology as digital immigrants; the new technology has been seen as something foreign to the teachers' methodology. In the past, poor access was the reason given for limited use of technology by teachers, but the U.S. Department of Education (Parsad, & Jones, 2005) reported 81% of teachers had good access to computers as more schools have computers as well as



Internet access. However, Ertmer (2005) reported that teachers perceived that they had a minimal level of technology skills, and 85% felt only “somewhat well prepared” to use technology in their classrooms. For example, many teachers perform a low level of technology use (such as use of technology for email or recording grades), but this is the foundation that higher level uses must be based upon (Sandholtz, Ringstaff, & Dwyer, 1997).

Teachers may have particular beliefs toward technology use, and understanding of the attitudes of teachers by leaders may improve the amount of technology that is used in the classroom. One of the central points is to develop teachers’ ability and confidence in the use of technology (Prain & Hand, 2003). This is based upon the fact that the integration of technology is firmly rooted in teacher beliefs, experiences, and interests. As discussed in several studies, the internal factors about teachers’ willingness to change from current experiences are critical in integrating technology into classrooms (Kiridis, Drossos, & Tsakiridou 2006; Zhao, 1998). When teachers have the willingness to learn the required skills, they are more likely to integrate technology into their classrooms. As they build their experiences with technology, they have become more confident and consequently have incorporated more technology into their teaching (Chan Lin, 2007).

Social and cultural factors have an effect on technology beliefs of teachers. These include attitudes of leaders, the social value of integrating technology, technology trends, and support from peers. The problem is that teachers may not feel they have any control over those factors. Wiske, Sick, and Wirsig, (2001) have indicated that social factors and sharing of experiences are important. From a community perspective, ongoing support from colleagues is definitely an important incentive to provide some help in developing

and building teachers' experiences and competence in integrating technology into classrooms. Teachers isolated from support by their colleagues may be less willing to use technology and less capable of managing the social issues (Chan Lin, 2007; Smith & Robinson, 2003). This indicates that many barriers are present that may be connected to the teachers' attitudes. It is important to investigate technology attitudes of teachers and to develop interventions to improve attitudes that are counterproductive (Sugar et al., 2005).

Ertmer (2005) reported that in order for teachers to integrate technology, they need to have adequate access to the technology, develop skills in its use, possess some choice in curriculum, and hold personal beliefs and attitudes that are in sync with constructivist pedagogy. Sugar et al. (2005) reported that preferred teaching practices will impact teachers' use of technology and that separating attitudes towards technology from overall attitudes towards education often presents a challenge. Nespor (1987) stated that belief systems are different from knowledge systems. For example, teachers may have the same content knowledge about technology but have different beliefs toward the use of the technology. Ertmer stated that more research should examine the relationship between general pedagogical beliefs and attitudes towards technology. Little research has examined the link between social influences and teachers' classroom uses of technology (Ertmer, 2005). While individual factors may contribute heavily to the intention to use technology, the individual does not work in isolation, but within an organization. The organization will have a particular culture with a particular view toward technology use. The following section will discuss the components of the organizational culture that may contribute to user acceptance of technology.

### *Organizational Culture and Innovation Adoption*

Many studies have indicated that organizational culture will affect policy decisions that ultimately affect the implementation of technology in education (Culp, Honey, & Mandinach, 2003). Organizational technology use requires careful planning and assessment. Carpenter (1997) reported that technology assessments by an organization are positive indications that the technological decision makers are finding it important to broaden the planning process.

The organizational culture within a corporate or educational institution is an important factor in the acceptance of technology. Stoneman and Diederer (1995) researched the policies of technology diffusion, the impact of the policies, and why policy intervention is needed. Others examined the role of organizational culture in the use of technology such as the allocation of resources by the organization, the interaction of teachers with organizational technology leaders, and the impact of the organizational culture on technology use (Adamy & Heinecke, 2005). The impact of organizational climate on technology assessment including impact analysis and policy analysis has also been an area of technology research (Adamy & Heinecke, 2005; Carpenter, 1977). The organizational factors and situations that influence individual user acceptance were also investigated by Venkatesh et al. (2003) and were incorporated into their constructs of Social Influences and Facilitating Conditions. These two constructs are measured in the UTAUT model and have been included in this study.

All organizations, including educational organizations, consist of individuals who have their own attitudes toward organizational goals. Adamy and Heinecke (2005) indicated that innovation adoption by organizations is different from innovation adoption

by individuals. They stated that it is not possible for a single person to adopt innovation until the organization itself adopts the innovation. A useful policy for an organization is the support of early adopters in the form of rewards because the incentives are also related to the rate at which new users adopt the innovation. Stoneman and Diederer (1995) concluded that policy intervention is desirable only to the point where the benefit is equal to the social cost of the policy. A policy that is unpopular may result in negative attitudes toward the policy as well as toward the leaders. Adamy and Heinecke indicated that a substantial amount of research concerning effective models to assist integration by teachers has been reported, but a limited amount of research use has been completed about how organizational culture is related to computer technology use. Much of the research literature focused on factors of the individual, and there is limited research into the organizational culture's impact on the diffusion process of technology innovations (Bellamy, 2005).

### ***Diffusion of Innovation in the Organization***

When new technology innovations are available for educators to use in their classrooms, often the innovation has limited diffusion throughout the institution. The literature indicates that effective models have been identified in the improvement of technology use by teachers. A useful typology of technological change was offered by the Schumpeterian trilogy: (a) invention and the generation of new ideas, (b) innovation and the development of those ideas through to the first use of that technology, (c) diffusion and the spread of the new technology (Stoneman & Diederer, 1995). Decisions teachers make concerning the use of technology may relate more to pedagogical issues than to technological issues because teachers may not see a relationship between

technology and pedagogy. Teacher attitudes towards technology may be influenced more by pressure from the school district, or availability of resources, than by student needs or practices. Lim (2007) reported that the Ministry of Education plan (Singapore) included strong curriculum and instruction, teacher development, and technological infrastructure, and was proven to provide a strong foundation for improvement of technology use. In an application of Rogers' (1962) theory, Stoneman and Diederer (2010) reported three factors that will improve learning of technological skills by teachers are the following: (a) that potential adopters learn new knowledge by observing the present adopters; (b) potential learners learn from demonstrations by others; and (c) the potential adopters actually seek out information independently. Lim reported that to have diffusion and effective integration, all teachers must be adopters. However, Rogers (1962) did not claim that all individuals would need to become users for an innovation to be successful in an organization. Teachers will teach in the style by which they were taught, and they carry this methodology with them throughout their careers. The technology use model that they are taught will follow them as it influences their methodology for years. As a result of this influence, teacher education programs have an important impact on technology use by teachers (Adamy & Heinecke, 2005). Because private schools do not require teacher certification, many private school teachers may not have had any instruction in educational technology.

People often resist change, and the turbulence created by change is unsettling and often causes stress in teachers. One of the most difficult barriers to overcome is the unwillingness of teachers to partake in the change. Cultural change represents the emergence of new norms and new ways to function and this can be threatening (Owen &

Demb, 2004). All technology innovations are only useful if the teachers and principals are willing to engage the innovation. Teachers can be presented with new technology innovations, then return to the classroom and teach the same way they always have (Reeves, 2005). Leaders can have an important influence on teachers in these situations. Anderson and Dexter (2005) concluded that technology leaders have a greater impact on technology outcomes than infrastructure and expenditures. The decision to buy technology is only a single component of a coherent strategy (Stoneman & Diederer, 1995). The purchase of the hardware is only the first step, and the school leaders can have an influence on the appropriate use of the hardware. Managing major organizational change such as technology means evaluating strengths and weaknesses, using a method to develop goals and strategies. The process should have a sequential pattern to change initiative in order to create reachable goals (Alfred & Carter, 1998; Heifetz, 1993).

The decision to promote an innovation in organizations, including educational institutions, tends to occur in a series of stages. The organizational context in which technology innovation takes place is important, and making change occur in an organization is often challenging. Invention is the generation of new technologies, innovation is the application through first-use adopters, and diffusion is the adoption of the technology as it spreads through the organization. The following section discusses the importance of leaders in the diffusion of technology uses.

### ***Leadership and Technology Use***

Computer technologies have been introduced into educational institutions over the last three decades, and with little warning teachers faced new challenges. Most educators

understood the challenge and felt that technology could be an important tool for students. As a result, many teachers have attempted to remain current with the technologies (Barr & Tagg 1995; Holmes, 1999, cited in Owen & Demb, 2004). Unfortunately, the goals and purpose of technology use may have not been made clear to educators. The purported purpose of technology has been to support teaching, learning, and assessment in schools. Each of the three components has its own end use, and each has been met with varying success. All three components require leadership in technology as it relates to use in classroom instruction (Anderson & Dexter, 2000; Reeves, 2005).

It is critical that leaders in an organization have an understanding of their role in the use of technology by teachers. Sugar et al. (2005) concluded there is an influential connection between administrators' and teachers' use of technology. Understanding this relationship between administrators and teachers will enable leaders to plan strategic support to facilitate technology integration. Yurov and Potter (2006) concluded that information technology leaders have a motivational influence on the intent of subordinates, and constructive leader-follower relationships increase the willingness of the followers to maintain interest in informational technology initiatives.

ISTE (2009) has created a set of standards for administrators that include the components that support teaching, learning, and assessment in schools. The standards include components that address visionary leadership, digital age learning culture, excellence in professional practice, and systemic improvement. Educational administrators are encouraged to inspire and lead with a vision for integration of technology that promotes excellence and supports diffusion of technology through the organization. They should create a digital-age learning culture that provides an engaging

education for all students. Educational administrators must support an environment that allows educators to enhance student learning through the use of technologies.

Additionally, they should provide leadership through their own effective use of information and technology resources.

Leadership is a component of the organizational context that can have an influence on teacher use of technology. Anderson and Dexter (2005) investigated the role of technology leaders on educational technology utilization in schools using three outcome indicators: (a) net use, (b) technology integration, and (c) student tool use. The outcome was based on the number of teachers who were integrating technology into teaching activities, as reported by the technology coordinator. Actual student tool use measured the amount students used computers during the school year to do academic work. Anderson and Dexter determined that many factors affect the ability of a teacher to accept technology and develop student-based projects. Those individual factors are related to individual teacher attitudes and beliefs, organizational culture, leadership styles, and vision.

One of the recent conflicts in technology has been the problem of the digital divide, and many have implied that the problem could be solved by funding infrastructure, but the evidence is building that support services and technology leadership are more important than infrastructure. Dexter et al. (1999) reported that effective technology implementation required goals that are supported by all organizational levels. Culture and policy can be seen as forming a third-level digital divide inherent in school environments and extrinsic to individuals within the system.



The implication of policy on technology use is that policies that promote the use of a technology will influence individuals' decisions (Mardis et al., 2008).

In general, changes occur rapidly, and as soon as an educator learns a technology application, a new development is often adopted by the organization. For example, many teachers are now confident that they can use email to contact students. Many students, however, rarely use email; they are in constant contact with their friends via social networking websites such as Facebook™. A common feeling is that technology has not reduced the workload, but rather has increased it. Many feel that the money would be better spent on tutors or smaller classes to improve student learning (Owen & Demb, 2004).

To increase technology, use leaders must engage a series of activities that will support technological innovation. Owen and Demb (2004) isolated several activities that leaders can adopt such as a centrality of strategies, a distribution of leadership, support of innovation through financial rewards, and the communication of achievements. However, these dimensions do not highlight the importance of the school leaders' commitment to the diffusion of technology innovation. Reeves (2005) pointed out that often technology directors cannot effectively translate new technologies they have experimented with to the school principals and teachers. As a result, administrators cannot develop appropriate policies that promote technology diffusion. While policies do have the ability to improve the diffusion process, the literature is limited on the impact of policy on technology diffusion (Stoneman & Diederer, 1995). Leadership is generally acknowledged as a significant influence on a school's effectiveness (Hallinger & Heck, 1996; Leithwood & Riehl, 2003). Technology personnel, or early adopters, often spend

their efforts chasing the latest innovation without securing the diffusion of past skills, and a foundation is never constructed. This disconnect often passes as technology leadership when actually it can become a barrier in itself.

Yukl (1989) reported a difference between the effect of social influence and the role of formal leaders in organizations. Some researchers believe that leadership is not different from the social influence of all the members of a group (Venkatesh et al., 2006; Venkatesh et al., 2003). Yukl's view assumes that social leaders may have more influence than formal leaders and therefore they have some leadership responsibilities to the organization. The existence of two leadership points may help diffuse technology if both social and formal leaders are conveying the same message.

Most schools also have technology leaders in the role of network specialists whose role is to maintain the hardware and network within the school system. This person might not have a background in education and may have limited insight into the requirements of the use of technology in education. Reeves (2005) determined that technology leaders need to be firmly rooted in curriculum development and not just in a technology management group. An educational technologist has a role that is directly related to use of technology in the classroom but may have limited influence on the technology direction in a school system. All technology leaders must understand both the technological and instructional pressures to incorporate technology and their leadership role in those demands.

Technology leaders should view technology adoption and diffusion in the larger lens of organizational change. Owen and Demb (2004) used a community college change model developed by Alfred and Carter (1998) that uses five key dimensions for managing

change: understanding fundamentals, forging strategies, identifying champions, supporting innovation, and communicating and celebrating success. Yurov and Potter (2006) indicated that an interaction exists between transformational leadership style and a subordinate's learning orientation towards new technology knowledge. Higher level managers need to create a vision for technology implementation that indicates their commitment to technology use. A school-wide shared vision for technology will ensure that the resources, coordination, and climate are in place to realize it (Anderson & Dexter, 2005; Owen & Demb, 2004). The development of a vision for technology use requires training for administrators in the field of technology use.

Some private schools provided training for administrators in a wide range of areas in technology, according to National Center for Educational Statistics NCES (2003-2004). In private schools, training in technology management was offered in 26.2% of the schools, training in technology use for planning and budgeting was offered in 28.9% of the schools, training in evaluation was offered in 31.4% of the schools, and training about technology in the curriculum was offered in 39.2% of private schools (NCES, 2003-2004). In a 2009 NCES survey it was reported that for technology training 61% of teachers reported using professional development activities outside of their school, 61% used training provided by school staff responsible for technology support, and 78% of teachers used independent learning to prepare to make effective use of educational technology for instructional purposes (Gray et al., 2010).

To effectively increase the use of technology in a school, it is important to have policies that can guide technology use. Anderson and Dexter (2005) reported that a school's technology efforts are limited unless high level administrators, such as principals

and school directors, become active technology advocates in a school and develop policies that promote technology use.

### ***Technology Policy and Change***

Administrators who are just beginning to take responsibility for technology should begin with an audit to determine the progress with technology goals, policies, budgets, committees, and support groups. With the upper leaders supporting technology innovation through the audit and definition of goals, the leadership can be diffused to planning teams. A critical need is to communicate priorities of the vision in order to set the foundation, include these policy statements in strategic plans, and include performance indicators (Owen & Demb, 2004).

Technology implementation in education is grounded in change theory and aspects of change. Cuban (1988) stated that most reforms that have attempted to significantly alter the status quo of schooling have failed because the reforms are not true to their original intent. In many cases the reform becomes altered in order to adapt to what already exists, or the new reform is ignored, allowing the existing process to remain essentially untouched. Often the success of a policy implementation rests upon the acceptance of that policy by the teachers. Spillane et al. (2002) indicated that a fundamental component of successful implementation is whether the implementing agents (i.e., teachers) understand their practice and will change their beliefs and attitudes in the process. Changes that occur in education often arrive as simple reforms of the existing policy. Often the reforms may be intellectually demanding, and these demands may challenge the attitudes and beliefs of the teacher. Spillane et al. developed a strategy by looking at how teachers interpret the requirements that are being asked of them. Their

approach was focused upon a singular factor, the implementation agents' sense-making with regards to the reform initiative. Teachers develop a meaning for policy reforms based upon the relationships between the cognitive structures of knowledge, beliefs, and attitudes, the particular situation, and the policy signals. The interaction of the three constructs (cognitive structures, the situation, and policy signals) determines how the teacher interprets the message of the policy and the expectations of that policy.

Technology leadership in an organization can be introduced and directed through a comprehensive technology plan. Technology plans must identify potential barriers and possible champions (Burgelman & Sayles, 1986) and have support from institutional leaders (Freed & Klugman, 1997). A feedback loop is important to insure continuous assessment and realignment of the change process (Senge, 1990). According to the ISTE Standards for Administrators, technology leaders must have a plan for teachers learning to use technology. In addition, leaders must develop a plan to support students' learning needs with technology (Anderson & Dexter, 2005). There are 13 states that test student knowledge of technology due to policy-making that addresses No Child Left Behind Act's goal of technology literacy by grade eight (Hightower, 2009).

Another approach to enhancing technology system use is to reduce the impact of negative behavioral expectation for the new technology. One way to do this is to reduce the uncertainty teachers' associate with a new system. From a managerial perspective, this could mean increasing the type and amount of training sessions, providing demonstrations of the new system, and providing information about the new technology. Organizational support and resources related to the system that allow employees to have

additional hands-on opportunities to use the system prior to implementation are recommended.

Stoneman and Diederer (1995) stated that the literature is limited on the impact of policies on diffusion of technology use. One of the concerns of this research was to investigate the attitudes and beliefs of teachers and the influence of administrative policies toward high level technology use in schools such as the use of technology plans and curriculum guides that include technology integration

In Part II the general areas of individual attitudes, organizational culture including organizational leadership, and policies that influence technology use were described. The four areas are further dissected and defined in the following section. The factors discussed in Part II have been included in several technology use models that are discussed in Part III. The following sections discuss the models that have been developed concerning behavioral intention of an individual to use technology.

### **Part III: Research in Behavior Intention of Technology Use**

Technology use by individuals in an organization has been the focus of a stream of research that has changed over time. In this section, the evolution of this stream of research is presented. Venkatesh et al. (2003) have identified a sequence of eight models of acceptance of technology by end users in organizations. Each of the models contains identified central constructs that are significantly different and represent components that influence technology use. The newer models built upon predecessors by extending or adapting the previous models. The eight models were incorporated into the Unified Theory of Acceptance and Use of Technology (UTAUT), a simplified model and instrument that captured the factors that affect an individual's intention to use technology

(Venkatesh et al., 2003). Although the research of Venkatesh et al. was completed in business organizations, the models can be, and have been, adopted in the field of education (Marchewka & Liu, 2007; Moran, Walters, & Puetz, 2009; Wang, Wang & Wu, 2009). The models are individually discussed in the following section, sequentially in the order of their development.

### ***Model One: Concerns-Based Adoption Model***

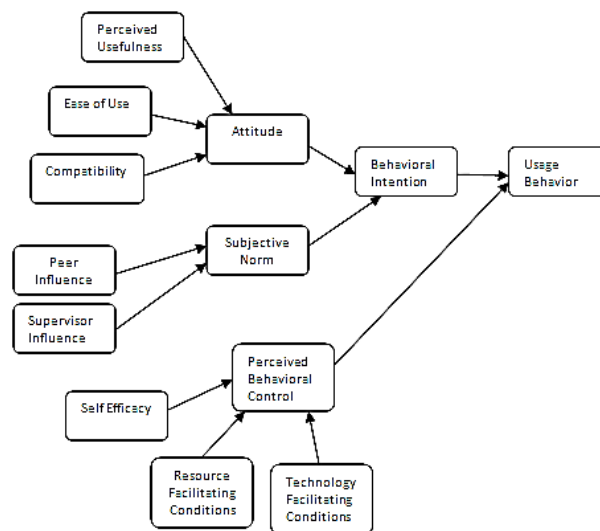
The Concerns-Based Adoption Model (CBAM; Hall, 1974) is a representation of the innovation process used in education. It considers adoption as a developmental process that is influenced by the dynamics between the user, the organization, and the available resources. The user's development and advancement to higher levels of use and concern is a developmental process. Interventions are then developed to meet the specific needs of the user (Cicchelli & Baecher, 1990; Hall, 1974). The CBAM has been applied to curriculum change and technology change and adoption (Straub, 2009).

### ***Model Two: Theory of Reasoned Action***

The Theory of Reasoned Action (TRA) was developed by Ajzen and Fishbein in the 1970's. This model was developed from the frame of social psychology and was adapted to study technology acceptance. The model core contains two core constructs, attitude toward behavior and the subject norm that were determinants of technology use. Attitude toward behavior is the individual's feeling toward the acceptance of a new technology, and subject norm is the perception that the people important to the user think the acceptance of the new technology is important (Ajzen & Fishbein, 1975).

### ***Model Three: Social Cognitive Theory***

Social cognitive theory (SCT) was developed by Bandura (1977) and modified for technology use by Compeau and Higgins (1999). This model also predicted technology use, and it was framed with five core constructs: performance outcome expectations (job-related performance); personal outcome expectations (individual esteem and accomplishment); Self-efficacy (one's ability); affect (liking of technology use); and anxiety (towards technology use).



*Figure 1.* Theory of planned behavior. Reproduced with permission (Ajzen, 1991)

### ***Model Four: Theory of Planned Behavior***

The Theory of Planned Behavior (TPB) is an extension of the Theory of Reasoned Action (TRA) developed by Ajzen (1991). The TRA constructs of attitude towards the behavior and the subject norm are directly related to the behavioral intention of the use. The Theory of Planned Behavior (Figure 1) also includes the construct of



perceived behavioral control. Perceived behavioral control is the perceived difficulty of using the technology (Ajzen, 1991) and also the perception of the internal and external constraints (difficulty) of using the technology (Taylor & Todd, 1995).

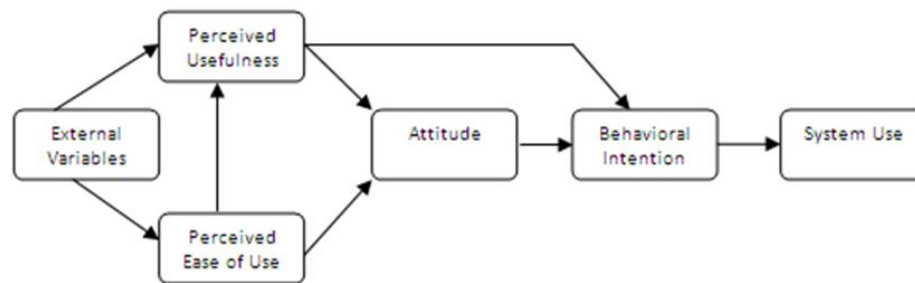


Figure 2. Technology acceptance model. Reproduced with permission (Davis, 1989).

#### ***Model Five: Technology Acceptance Model***

Davis (1989) developed the Technology Acceptance Model (TAM) specifically to predict the acceptance of technology in an organization. The TAM model did not include the construct of attitude toward behavior as does the TRA. Two constructs of this new model that were determined to be predictors of behavioral intention to use a technology system included perceived usefulness and perceived ease of use (Figure 2). The perceived usefulness is a measure of how much a person believes that using a technology would improve their job performance. The perceived ease of use is a measure of how an individual perceives the effort required to learn the new technology (Davis, 1989). Venkatesh et al. (2003) used the TAM as the foundation for their model, and determined that the explanatory power of the TAM improved as extensions were added to it.

The TAM model was enhanced by Venkatesh and Davis (2000), as indicated by Figure 3. The TAM model was also expanded to include several factors that affect the perceived usefulness. Subject norm was a third predictor of intention of use in the case where use was mandatory. Also, the measures of experience and voluntariness are the first appearance of moderators of the relationships in behavioral intention research. Moderators are characteristics of the participant, or the organization, which have been found to influence the construct's effect on the dependent variable (behavioral intention). This has been an extremely popular model and has been applied in a wide range of research. The TAM has been applied in several educational settings such as technology adoption by student teachers, implementation of a laptops program, and online learning (Straub, 2009).

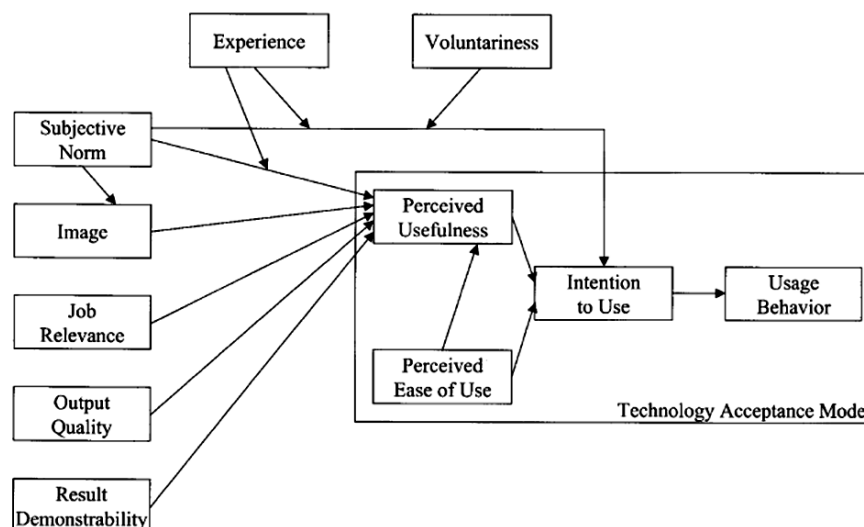


Figure 3. Technology acceptance model. Reproduced with permission (Venkatesh & Davis, 2000).

### ***Model Six: Motivational Model***

The motivational model is built upon general motivational theory and has been included in the discussion of technology adoption by many (Davis et al., 1992; Vallerand, 1997; Venkatesh & Speier, 1999). Ford (1992) created a model of human motivation using 32 motivational constructs that included several goal categories and motivational processes. The motivational model includes the constructs of intrinsic and extrinsic motivation as predictors of technology use. Extrinsic motivation relates to a reward the individual receives, other than the task itself, such as recognition or rewards. Individuals motivated by intrinsic motivations will accept new technologies for no reward other than the results of the activity itself.

### ***Model Seven: Model of PC Utilization***

Thompson, Higgins, and Howell (1991) developed a model of PC utilization (MPCU) that is often seen as contradictory to the Theory of Reasoned Action and the Theory of Planned Behavior models. The model is a derivation of theory of human behavior (Triandis, 1977) that has been modified to predict PC acceptance and use. The MPCU is framed within the six following constructs: job-fit, complexity, long term consequences, and affect towards use, social factors, and Facilitating Conditions (Thompson et al., 1991).

### ***Model Eight: Innovation Diffusion Theory***

Rogers (1962) developed the Innovation Diffusion Theory (IDT) that has been used to investigate many different innovations in a wide range of organizations. This theory has been modified to investigate individual technology acceptance by Moore and Benbasat (1991). The constructs of this theory are relative advantage (whether the

innovation is better than the traditional practice), ease of use, image (perception of status of the new innovation), visibility (use by others), compatibility (consistency with values and experiences), results of new innovation, and voluntariness of use (Moore & Benbasat, 1991). Straub (2009) noted that, in the IDT, the adoption process and the diffusion process are the same.

Each of the preceding models contains several factors that have an influence on a person's use of technology. Venkatesh et al. (2003) combined the eight models into a single model that measured the behavioral intention of a person toward the use of a particular technology as depicted in Figure 4. Behavioral Intention is defined by Warshaw and Davis (1985) as the degree to which a person has formulated conscious plans to perform or not perform some specified future behavior. Behavioral use is defined using three commonly employed conceptualizations of system use: the duration, frequency, and intensity of use (Davis, 1989, Venkatesh et al., 2003). Behavioral use is of secondary interest in this research. Venkatesh et al. have indicated that Behavioral Intention is a direct indicator of behavioral use and Behavioral Intention is itself a dependent variable. This model is entitled the Unified Theory of Acceptance and Use of Technology, and is discussed in the following section.

***Model Nine: Unified Theory of Acceptance and Use of Technology Model***

In an attempt to develop an empirical comparison of the eight models of technology use acceptance, Venkatesh et al. (2003), completed longitudinal studies in organizations that were introducing a new technology. Several findings were reported from the analysis. All the models included constructs that explained the intention of individual acceptance from a range of 17% to 42% of the variance. The various models

have performed quite well in explaining Behavioral Intention to use a system (Venkatesh et al., 2003). The UTAUT model explained over 70% of the variance in Behavioral Intention to use a system but only about 40% of the variance in system use. In voluntary settings social influences were not significant, whereas in mandatory settings social influences were significant. Venkatesh et al. determined there were also moderating influences that affected the constructs in the models. They were identified as experience, voluntariness, gender, and age. An important difference that emerged in the studies was whether the use of the technology in the organization was voluntary or mandatory.

### ***The Components of the UTAUT Model***

The Unified Theory of Acceptance and Use of Technology used four constructs that were found to be significant predictors of user acceptance (primarily behavioral intention) and usage behavior (Figure 4). These four constructs are performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2003) and were defined in Chapter One. In the development of the UTAUT model, attitude toward using technology, self-efficacy, and anxiety were determined not to be predictors of intention of use. In addition to the four constructs, Venkatesh et al. (2003) have identified four key moderators that have an influence on the four constructs. Moderators are characteristics of the participant, such as gender, that have an influence on the relationship between constructs and the dependent variable. The moderators are gender, age, voluntariness and experience. The UTAUT instrument will have different results depending on gender, age, experience of the user, and whether the technology use is mandatory or not.

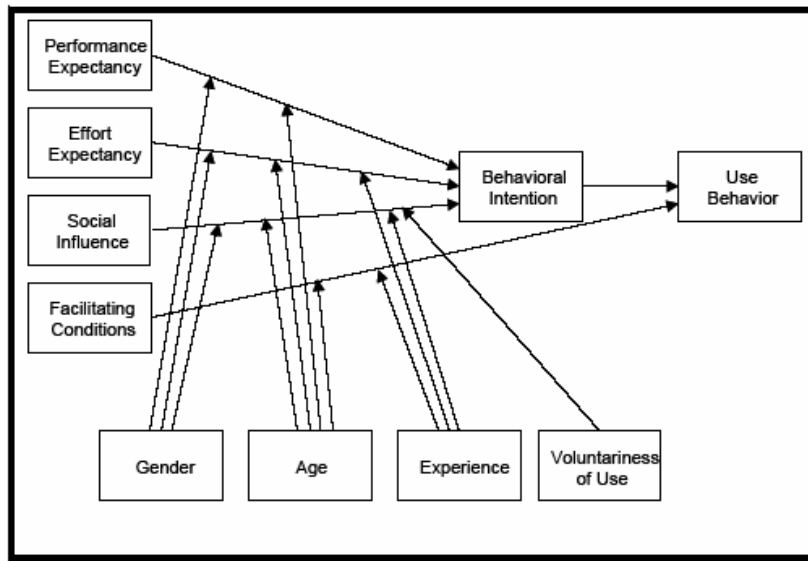


Figure 4. Unified theory of acceptance and use of technology. Reproduced with permission (Venkatesh et al., 2003).

Venkatesh and Davis (2000) reported that the social influence construct is not significant in voluntary situations; however, social influence becomes significant when use is mandated by the organization. In an organization, technology use can be mandated through policy instruments. Technology integration is often incorporated into a written curriculum that is a mandate, and this increases the adoption of technology use (Barron et al., 2003). The difference between the two settings may be attributed to compliance in mandatory contexts that requires social influences to have a direct effect on behavioral intention. In voluntary situations social influence operates only by influencing perceptions about the technology use (Venkatesh & Davis, 2000). Jones and Clarke (1995) found that structured educational experiences in mandated use of technology may moderate individual attitudes toward technology. If technology use is required and mandatory, use increases, but the actual usefulness may not be felt by the individual (Iivari, 2005). There are mandatory situations where the technology use is not included in written policies but is suggested within the organization. Rai, Lang, and Welker

(2002) defined “quasi-volitional IT use” as technology use that is not mandatory but is used because social pressure may suggest that it should be. Social influence has an impact on individual behavior through three mechanisms: compliance, internalization, and identification (Davis et al., 1992; Venkatesh & Davis, 2000).

Social influences could include the formal and informal leaders of a school recommending that teachers use more technology with their students. In order to comply with the recommendations, teachers may have to alter their individual belief structure (internalization and identification). The individual can change personal behavioral intentions in order to comply with the social influence. Individuals will comply with others’ expectations when those others have the ability to reward the desired behavior or punish the noncompliance (French & Raven, 1959; Warshaw, 1980). This is consistent with other research that concluded “others” are only important in mandatory settings (Barki & Hartwick, 1994), especially in the beginning stages of development, when an individual’s opinions are relatively uninformed (Agarwal & Prasad 1998; Barki & Hartwick, 1994). The social pressure will lessen over time as a teacher new to the innovations gains experience (Venkatesh & Davis, 2000).

In summary, the UTAUT model theorizes that three variables (performance expectancy, effort expectancy, and social influence) are direct determinants of the behavioral intention of technology use. Behavioral intention and facilitating conditions are direct determinants of use behavior. The model also incorporates four moderating factors (gender, teaching experience, technology experience, and voluntariness), each of which may have influence on the four primary constructs. In other words, the UTAUT

model has condensed the 32 variables found in eight existing models into four main constructs and four moderating factors.

### ***UTAUT Internal Consistency Reliability***

The items used in estimating the original UTAUT survey are listed in Appendix A. Table 2 lists the internal consistency reliability values of data obtained by Venkatesh et al. (2003) using a measure of the constructs and all are valued above .80, indicating the degree to which the responses to a set of items are similar. Internal consistency reliability is a measure used to determine the consistency of results on an instrument. The premise was that an individual taking the test should have had the same, or similar, answers for the questions that are similar. If the construct has internal consistency of values above .60, that indicates a moderate level of internal consistency and the researcher can be moderately sure that instrument is measuring the construct consistently (Fornell & Larcker, 1981). An internal consistency of 1.0 was the best rating a construct could have. The scores were shown to have acceptable internal consistency with data collected in all three of the administrations of the test (T1, T2 and T3) by Venkatesh et al. (2003).



Table 2

*Reliability Measures for Scores on the Constructs of the UTAUT Instrument*

Construct Names	Number of items within survey	Original Source of items	Internal Consistency Reliability		
			T1 n=215	T2 n=215	T3 n=215
Social Influence	6	UTAUT 1-6	.88	.94	.92
Facilitating Conditions	5	UTAUT 7-11	.87	.83	.85
Performance Expectancy	6	UTAUT 12-17	.92	.91	.91
Effort Expectancy	8	UTAUT 18-25	.91	.90	.94
Attitude	5	TPB 26-30	.84	.77	.81
Behavioral Intention	5	UTAUT 31-35	.92	.90	.90
Self-efficacy	4	TPB 36-39	.89	.89	.90
Anxiety	4	SCT 40-43	.82	.79	.82

*Note:* Venkatesh et al., 2003.

***Modifications to the UTAUT Model***

The UTAUT Model has been applied by others in a variety of organizational settings since its development in 2003 (Eckhardt, Laumer, & Weitzel, 2009; Koivimäki, Ristola, & Kesti, 2008; Marchewka & Liu, 2007; Moran et al., 2009; Verhoeven, Heerwegh, & De Wit, 2010; Wang et al., 2009). The model continues to develop as others test the model.

The UTAUT model is an effective model for determining Behavioral intention of use; however, there has been limited reference to the use of variables to predict use behavior. Behavioral intention is an individual's plan to use technology and is a good predictor of actual use. Venkatesh et al. (2003) and Davis (1989) indicated that duration

of use, frequency of use, and intensity of use are all valuable measures of actual use. The only construct that is reported to have a direct impact of use behavior, other than behavioral Intention, was facilitating conditions in the UTUAT model.

#### **Part IV: The Research Model**

The purpose of this study was to examine the factors that affect secondary teachers in the implementation of curriculum activities that require student use of technology in private schools in Florida. The literature reviewed in this chapter discussed several models that incorporated many factors that have been found to influence the technology use behavior of individuals. The factors that influence technology uses by individuals in a corporate setting have been identified in the UTAUT model developed by Venkatesh et al. (2003; see Figure 4). The UTAUT model was adapted for this research, and in the present study the model is referred to as the research model (Figure 5).

Figure 5 presents the research model that includes the constructs and anticipated relationships that have been reported in the literature, and each construct is discussed in detail in Chapter Three. The arrows of the model indicate hypothesized relationships between the construct and dependent variable of Behavioral Intention and are explained, along with the research questions, in Chapter Three. The relationships indicated on the model may be moderated by the four variables along the bottom of the diagram of the model (Figure 5). Moderators are categories that define characteristics of the participants, and these categories may impact the relationship between the constructs and the dependent variable. Each relationship could be moderated by any number of the four moderators. The relationships found by Venkatesh et al. (2003) that are influenced by the moderators can be found in Figure 4.

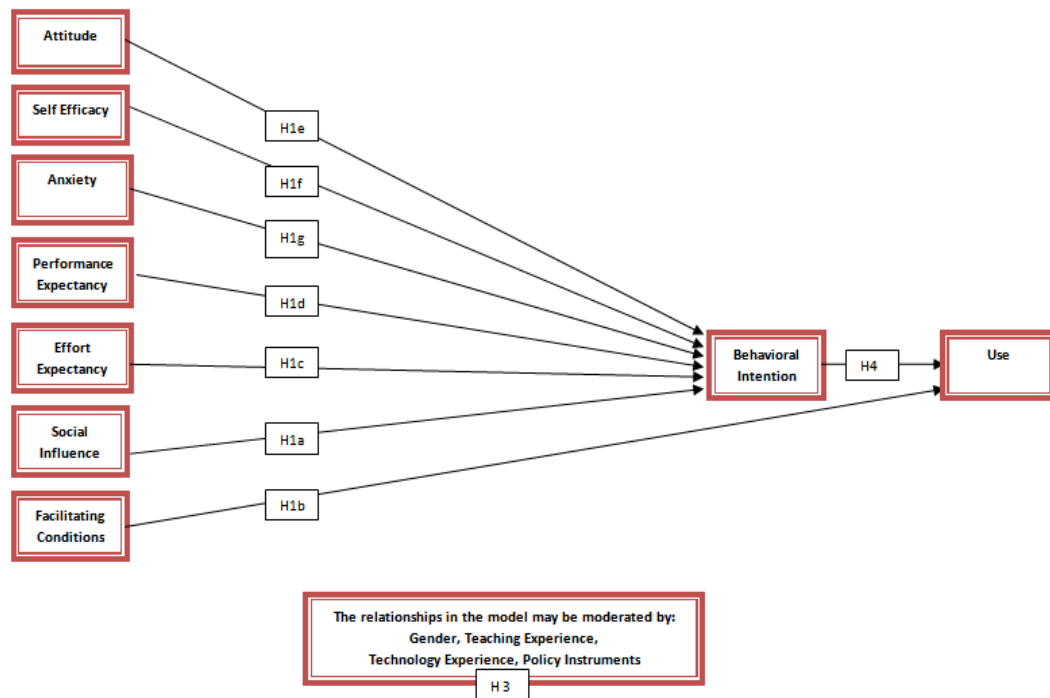


Figure 5. The research model.

The research model contains constructs that have origins in several theoretical models and are discussed in detail in Chapter Three; however, it may be useful to indicate in which models the constructs have been reported. The constructs of performance expectancy, effort expectancy, social influence, and facilitating conditions are included in the UTAUT model. The constructs of self-efficacy and attitude toward use are included in the Theory of Planned Behavior (Ajzen, 1991). The construct of anxiety was reported in the Social Cognitive Theory (Compeau & Higgins, 1999). The UTAUT model and each of the three preceding models (TPB, TRA, and TAM) have included technology use as a variable dependent on behavioral intention. The UTAUT model tests the behavioral intention to use a particular technology and in this research *behavioral intention to use* is defined as the *behavioral intention of a teacher to implement activities that require student use of technology*. Student use of technology in this research is defined as the use

of computer technology by students to obtain, analyze or present information to complete a project or activity concerning curriculum-based topics. This is aligned with the International Society for Technology in Education (ISTE) definition as follows:

The definition of technology integration by the International Society for Technology in Education (ISTE) is the ability of students to be able to select technology tools to help them obtain information in a timely manner, analyze, and synthesize the information, and present it professionally. (ISTE, 2000, p. 6)

Tests of the UTAUT model have found only four constructs that are significant in the behavioral intention of the individual to use technology. This research is designed to investigate the relationship between the many variables and constructs that may influence the behavioral intention of the teacher to integrate of student technology projects into the classroom.

Even though the students are the actual users of the technology, it is the teachers who make the decision to integrate technology into the lesson, and it is the teachers' behavioral intention that has been investigated in this research. As discussed in the literature review, user acceptance of technology as a behavior intention is a mature field of research; however, there is limited research on the actual use of technology (duration, frequency, and intensity) and the present research has also measured use.

The research has provided evidence to support the importance of the constructs of social influences and facilitating conditions (such as leadership and policy implementation) by measuring particular constructs in the area of integration of student technology use in classrooms. The results provided by the research model indicated that the model itself could be used by the leaders of educational institutions to understand the

behavioral intention of teachers towards technology use and to improve the diffusion of technology use in their schools as Venkatesh supports. The UTAUT thus provides a useful tool for managers needing to assess the likelihood of success for new technology introductions and helps them understand the drivers of acceptance in order to proactively design interventions (including training and marketing) targeted at populations of users that may be less inclined to adopt and use new systems (Venkatesh et al., 2003, p. 425).

### **Chapter Two Summary**

Adamy and Heinecke (2005) indicated that there is a substantial amount of research concerning effective models to assist integration by teachers but a limited amount of research about organizational culture in technology use. Instructional computer use appears to be increasing (as measured by self-reported data), but the use is incremental first order and it is removed from best practices as advocated by the literature (Becker, 2000). Determining teacher needs in increasing technology use has been more problematic. By viewing the concerns of teachers in a developmental lens, the research model can guide organizations in helping teachers adopt new change. The ISTE standards for administrators include effective practices in the study of technology and its infusion across the curriculum (ISTE, 2009). While a goal is to have students use technology in their learning, it is the teacher, as a gatekeeper, that makes the decision whether to incorporate technology into a particular lesson. In this research, I have measured the intention of the teacher to include student use of technology in the curriculum.

One of the challenging tasks that technology leaders face is how to determine the best method to enhance technology use among the teachers at a school. To assist in this

practice, it is important for leaders to understand and predict employees' technology use behaviors (Venkatesh et al., 2006). In addition to providing a more accurate prediction of future use relative to existing use, leaders can develop interventions designed to reduce the uncertainty associated with technology use and enhance behavioral intention. An individual's uncertainty, and the consequential lowering of behavioral intention, implies that an individual will not put forth the required efforts to improve their skills and increase their use of technology (Venkatesh et al., 2006).

The need for effective leadership in the area of technology is important if the momentum behind the technology wave is to be directed. As technology use exists today, a substantial amount of innovation has been accomplished by a few educators. The majority of teachers remain indifferent to the uses of technology innovation for several of the reasons explained in this chapter. The literature review supports the need for research into the complex relationships that surround technology integration in secondary schools.

The theoretical change theory framework in which technology integration is grounded follows the Schumpeterian trilogy: (a) invention and the generation of new ideas, (b) innovation and the development of those ideas through to the first use of that technology, and (c) diffusion and the spread of the new technology (Stoneman & Diederer, 1995). As discussed in this chapter, several models have been developed to define the relationships between the factors that affect Behavioral Intention and technology use. Over time, as research into technology use progressed, the models began to incorporate more factors. Venkatesh et al. (2003) completed longitudinal studies in organizations that were introducing a new technology in an attempt to compare the eight

existing models of technology use acceptance. The result was the Unified Theory of Acceptance and Use of Technology (UTAUT).

The UTAUT model used four constructs that were found to be significant predictors of user acceptance (primarily behavioral intention) and usage behavior. These four constructs are performance expectancy, effort expectancy, social influence, and facilitating conditions. The four constructs are affected by the four moderators: gender, teaching experience, technology experience, and voluntariness of the technology use. While this research has measured all the factors, social influence is of particular interest because this construct contains the items that measure attitudes of the leaders, the social value of integrating technology, technology trends, and support from peers in an organization. The present research has examined the influence of leaders on technology use by teachers through constructs of social influences, facilitating conditions, and moderators such as the use of policy instruments and voluntariness (Venkatesh et al. 2003). Adamy and Heinecke (2005) indicated that there is a substantial amount of research concerning effective models to assist integration by teachers but a limited amount of research about organizational culture in technology integration. Additionally, to improve technology use by teachers, it is important for leaders to understand and predict employees' technology use behaviors (Venkatesh, 2006).

Technology integration implementation in education is grounded in change theory and the aspects of change. Spillane et al. (2002) indicated that a fundamental component of successful implementation is whether the implementing agents, (i.e., teachers) understand their practice and will change their beliefs and attitudes in the process. Spillane et al. concluded by indicating that as teachers process new information, they are

attempting to conserve their existing frames of knowledge rather than transform them. The situational differences interpreted by leaders in an organization with varying viewpoints can have a direct influence on the teachers' viewpoints (Spillane et al., 2002).

The intent of this present research was to identify the relationships between the constructs that affect behavioral intention of teachers to develop curriculum projects that require students to use technology. The literature review provided evidence to support the importance of social influences and facilitating conditions, such as leadership and policy implementation, by measuring particular constructs and moderators in the area of integration of student technology use in classrooms.

The following chapter presents the research methodology that has been applied in this research. Chapter Three will discuss the research model, the population of the study, the method of data collection, and the method of analysis for the data. Chapter Four presents the research findings, and Chapter Five includes a discussion of those findings.



### CHAPTER THREE: METHODOLOGY AND RESEARCH DESIGN

This research had tested an adaptation of the UTAUT model and conceptual framework in a private secondary educational setting. Venkatesh et al. (2003) investigated user acceptance of new technological innovation in a corporate setting, yet this model has promise in its applicability to a secondary education setting. The UTAUT model and survey instrument have been adapted and successfully applied in a variety of educational research (Marchewka & Lui, 2007; Moran et al., 2009; Wang et al., 2009).

The research presented includes the collection of data using an adaptation of the survey instrument based upon the UTUAT model (Venkatesh et al., 2003). Permission to use the instrument was requested from Venkatesh and granted in July of 2009. The present research model contains three adaptations to the original UTAUT model. In each item of the survey, the UTAUT instrument uses the term *use the system*, and this term has been changed to *teacher implementation of curriculum activities that require students to use technology*. This research adopted all other terminology as used by Venkatesh et al. (2003). The second adaptation of the UTUAT model and theory is the addition of three constructs that represent affective attributes of the teacher. These attributes are anxiety as a result of technology use, attitude toward technology use, and Self-efficacy in relation to technology use. The constructs are discussed in greater detail in a later section. The third adaptation is the addition of the use of policy instruments as possible moderators of the relationship in the model. The use of policy instruments defines the voluntariness of technology use in an organization. Venkatesh (2006) suggested that researchers

investigate the impact of interventions such as management support by studying their effects on employee adoption. Figure 5 presents a graphic representation of the research model that is incorporated into the conceptual framework that was tested in this research.

### **The Research Questions**

Four questions directed this research:

1. Can interpretable constructs be obtained when responses from a sample of private school secondary teachers on the school-based version of the UTAUT are inter-correlated and factor-analyzed using confirmatory factor analysis (CFA)?
  - a. Is the construct of Social Influence significantly related to the Behavioral Intention of the teacher to implement curriculum activities that require students to use technology?
  - b. Is the construct of Facilitating Conditions significantly related to the Behavioral Intention of the teacher to implement curriculum activities that require students to use technology, or will it be significantly related to use?
  - c. Is the construct of Effort Expectancy significantly related to the Behavioral Intention of the teacher to implement curriculum activities that require students to use technology?
  - d. Is the construct of Performance Expectancy significantly related to the behavioral intention of the teacher to implement curriculum activities that require students to use technology?
  - e. Is the construct of Attitude of the teacher toward teacher implementation of curriculum activities that require students to use technology significantly related to Behavioral Intention of the teacher to implement curriculum activities that require students to use technology?

- f. Is the construct of Self-efficacy of the teacher, concerning teacher implementation of curriculum activities that require students to use technology, significantly related to Behavioral Intention of the teacher to implement curriculum activities that require students to use technology?
- g. Is the construct of Anxiety toward teacher implementation of curriculum activities that require students to use technology significantly related to Behavioral Intention toward teacher implementation of curriculum activities that require students to use technology?
2. To what extent does the research model specifying path relationships among a series of predictor variables, Behavioral Intention, and technology use behavior fit actual perception data gathered from a sample of private school secondary teachers on the school-based version of the UTAUT?
3. Within the larger context of the research path model, to what extent does each predictor variable contribute to the Behavioral Intention to implement technology after the moderating effects of gender, teaching experience, technology experience, and policy are taken into consideration?
4. Within the larger context of the research path model, to what extent is Behavioral Intention to implement technology related to technology use behavior as specified by frequency, duration, and intensity of use behavior. The research questions, written as hypotheses, are presented in Appendix B.

### **Discussion of the Constructs of the Research Model**

The model employed in the present research (Figure 5) has been adapted from the UTAUT (Venkatesh et al., 2003; see Figure 4). In this section, the constructs and

moderators of the research model are discussed. The present research contains six constructs that are hypothesized to have an influence upon the behavioral intention of a teacher to integrate technology: social influence, performance expectancy, effort expectancy, attitude toward technology use, self-efficacy, and anxiety toward technology. The seventh construct is named facilitating conditions and is hypothesized to be significantly related to use. The relationship between each construct and behavioral intention is hypothesized to be moderated by gender, teaching experience, technology experience, and voluntariness of use as implied by use of policy instruments that refer to technology use. Each of the constructs is discussed in greater detail in the following section.

### ***Behavioral Intention***

Research into individual acceptance of technology has included several areas of focus. One line of research uses behavioral intention as the dependent variable (Compeau & Higgins, 1995; Davis et al. 1992; Marchewka & Lui, 2007; Venkatesh et al., 2003; Wang et al., 2009). The theoretical model that I have used in the present research includes behavioral intention as a key dependent variable. Behavioral intention as a predictor of behavior (usage) is important and has been well-established in technology use literature (Ajzen 1991; Sheppard, Hartwick, & Warshaw. 1988; Taylor & Todd, 1995; Warshaw & Davis, 1984; Venkatesh et al., 2003). This study used behavioral intention as a dependent variable, and the constructs of the research model were hypothesized to be determinants of behavioral intention to implement curriculum activities that require students to use technology. Behavioral intention is defined as ~~an~~ an individual's self-reported subjective probability of his or her performing a specified

behavior based on his or her cognitive appraisal of volitional and non-volitional behavioral determinants” (Warshaw & Davis, 1984, p.4).

In the integration of technology there may be a sequence of events that will determine the actual completion of the intended behavior. The motivational drive to integrate technology begins with a teacher’s internal evaluation of the behavior. This internal evaluation results in the formation of a behavioral intention (Ajzen & Fishbein, 1980; Boden, 1973; Ryan, 1982). After developing a behavioral intention, an individual evaluates the factors that may be barriers to performing the behavior (Warshaw & Davis, 1984). Harrison (1995) pointed out that the probability of performing a behavior (i.e., behavioral expectation) is a function of the behavioral intention toward one task compared to the behavioral intention toward other tasks.

System use has been conceptualized with the three measurements of use being duration of use, frequency of use, and intensity of use (e.g., Davis et al., 1992; Straub et al., 1995; Taylor & Todd 1995; Venkatesh & Davis, 2000). In the present study, system use is defined as the use of technology by students to complete a curriculum activity. In the area of technology research, one group of researchers focused on acceptance of technology by using behavioral intention or use as the dependent variable (Compeau & Higgins 1995; Davis, 1989). Venkatesh et al. (2003) confirmed the role of behavioral intention as a predictor of use that had been previously reported (Ajzen 1991; Sheppard et al. 1988; Taylor & Todd 1995). The relation between behavioral intention and use was also been tested in the present study. The UTAUT model identified only three constructs that have a significant determination of behavioral intention of technology use (Venkatesh et al., 2003). These three constructs are (a) social influence, (b) performance

expectancy, and (c) effort expectancy. A fourth construct, facilitating conditions, has been found to be a direct determinant of usage (Venkatesh et al., 2003). Behavioral intention along with the construct of facilitating conditions is a predictor of use behavior (Venkatesh et al., 2003). A study using the Theory of Planned Behavior determined that the factor of Attitude towards computer use influenced behavioral intention (Ajzen, 1991, 2001), and a study using the Social Cognitive Theory (SCT) determined that the factors of self-efficacy and anxiety towards computer use influenced behavioral intention, (Bandura, 1986; Compeau & Higgins, 1995, 1999).

### ***Social Influence***

Social influence is the construct that refers to the degree to which teachers perceive that important others (both formal and informal leaders) believe they should complete a particular task, in this case, integrate student technology projects. This construct is based upon the idea that teachers' behavior is influenced by their beliefs about how other teachers will view them as a result of using a technology. Venkatesh and Davis (2000) indicated that social influence is significant in mandatory adoption settings, and social influence appears to be important only in the first stages of the program. Voluntariness of use has been defined as a moderator by Venkatesh et al. (2003) and is measured in the UTAUT instrument. It was an important component of this study to determine the influence of technology policies as a possible moderator of the relationships between the constructs and behavioral intention, especially the construct of social influence. Because this construct has survey questions concerned with leadership and organizational culture, it was one of the constructs of particular interest in this study.

### ***Performance Expectancy***

Performance expectancy is defined as the degree to which the teachers believe that using a particular technology will help them complete a task. In this research, the task is defined as integrating student technology projects with the expectancy to improve the instruction in their classes. The creators of the UTAUT (Venkatesh et al., 2003) indicated that this construct has the greatest influence on behavioral intention. This result has been reinforced by others researching technology use models (Agarwal & Prasad, 1998; Compeau & Higgins, 1995; Taylor & Todd, 1995).

### ***Effort Expectancy***

Effort expectancy is defined as the degree of ease associated with the use of a particular technology. In this research effort expectancy refers to the amount of effort a teacher must expend for the integration of student technology projects. Venkatesh et al. (2003) indicated that effort expectancy is moderated by experience and gender. For example, effort expectancy is a stronger determinant of an individual's behavioral intention for older workers (Morris & Venkatesh 2000) and for women (Venkatesh & Davis, 2000; Venkatesh & Morris, 2000).

### ***Facilitating Conditions***

The construct of facilitating conditions is defined as teachers' beliefs that the school has organizational support and technical infrastructure to support integration of student technology projects. In the original research that was developed for the UTAUT, Venkatesh et al. (2003) stated that this variable was not significant as a predictor of behavioral intention. However, this construct was included in the UTAUT model as a significant contributor to use behavior. Taylor and Todd (1995) argued that a lack of

facilitating conditions can be a barrier to the intention of use; however, the presence of favorable facilitating conditions may not lead to intention of use on its own.

### *Affective Constructs*

In addition to the constructs of the UTAUT, the present study has included several constructs from earlier models (Ajzen, 1991; Davis, 1989; Davis et al., 1992; Taylor & Todd, 1995). The UTAUT model does not include attitude toward use, self-efficacy, or anxiety as determinants of behavioral intention because Venkatesh and Davis (2000) determined they were indirect determinants of Behavioral Intention as components of perceived ease of use. This construct eventually became labeled effort expectancy in the UTAUT model. Attitude toward use, self-efficacy, and anxiety are constructs that have been measured in this study to determine their importance in an educational setting. These constructs are discussed individually in the following sections.

#### *Attitude Toward Technology Use*

Conflicting results have been reported from a variety of studies concerning the construct of Attitude toward use (Ajzen, 1991; Davis, 1989; Davis et al., 1992; Taylor & Todd, 1995). Attitude toward technology is defined as the individual's overall reaction to the use of a particular technology and has been found to be significant predictor of Behavioral Intention (Alshare et al., 2009; Davis, 1989). Attitude was found not to be significant in other studies (Ajzen, 1991; Compeau & Higgins, 1995; Taylor & Todd, 1995; Thompson et al., 1991). According to Yang, Mohammed, and Beyerbach (1999), attitude toward computers is problematic for teachers when integrating technology into educational programs, but Yang et al., stated that attitude is one of the main reasons for teachers' limited use of technology. In an empirical study designed to investigate the



effects of educational technology integration on the attitudes of instructors and students, Christensen (2002) found that teachers' attitudes toward technology improve with a perceived importance of computers, in addition to the technology skill level of students. Ball and Levy (2008) reported that attitude toward computer use was not a significant predictor of technology use. Venkatesh and Davis (2000) proposed that constructs that measure attitude are significant only when performance and effort expectancy are not involved in the study. Given that attitude toward technology use has had varying significance in the literature; the construct was investigated in this research.

### ***Self-efficacy Towards Technology Use***

Self-efficacy is defined as the judgment of one's ability to use a technology to complete a particular job or task. In the social cognitive theory (SCT), self-efficacy and anxiety were found to be determinants of behavioral intention (Bandura, 1977; Compeau & Higgins, 1995). Venkatesh and Davis (2000) hypothesized that self-efficacy would not have a direct effect on behavioral intention. Compeau and Higgins (1995) confirmed that computer self-efficacy was a valid and reliable construct and that it is a trait to consider. Compeau et al. did find a significant relationship between computer anxiety and actual system usage. According to Compeau and Higgins, there is a positive relationship between computer self-efficacy and behavioral intention to use technology. Understanding computer self-efficacy is an important component in the successful implementation of technology use in organizations (Ball & Levy, 2008). Self-efficacy was included in this study to examine whether it is a determinate of behavioral intention in an educational setting. In the Theory of Planned Behavior, Ajzen (1991) included self-efficacy as a construct that will affect perceived behavioral control. In this present

research, self-efficacy is defined as the perception of teachers of their own ability to carry out the implementation of activities that require student use of technology.

### *Anxiety Toward Technology Use*

In this research, items intended to measure anxiety have been included in the instrument to examine whether it is a determinate of behavioral intention in an educational setting. Anxiety is defined as evoking anxious or emotional reactions when performing a particular behavior. Venkatesh and Davis (2000) hypothesized that anxiety would not have a direct effect on behavioral intention. Others agree that computer anxiety plays a critical role in technology acceptance among instructors (Christensen, 2002; Korukonda, 2006; Venkatesh & Speier, 1999). Computer anxiety is defined as being synonymous with negative thoughts and attitudes about the use of computers. According to Venkatesh and Davis, computer Anxiety is a negative feeling toward technology use and has a significant impact on overall attitude toward technology use. Havelka (2003) found that users with lower levels of computer anxiety had higher levels of computer self-efficacy. Havelka suggested that additional research is needed to determine the relationships between the constructs of computer self-efficacy and anxiety in the context of education. Computer anxiety is not only a barrier for teachers in using new technology in programs but is the main reason for limited implementation of technology by teachers (Yang et al., 1999). Ball and Levy (2008) demonstrated that computer self-efficacy was a significant predictor of technology use. As a result of the varying views on the effect of individual teacher characteristics (efficacy, attitude, and anxiety) on behavioral intention, these characteristics have been included in the present research.

### *Moderators*

Relationships among the constructs of the research model may be moderated to varying degrees by gender, age (teaching experience), technology experience, or policy instruments that affect voluntariness of the decision to use technology. A moderator is a characteristic of the individual that affects the relationship between the independent variable and the dependent variable (Wu & Zumbo, 2009). Four moderating factors (gender, age, technology experience, and voluntariness) have been determined to have an impact on behavioral intention (Venkatesh et al., 2003). The present research tested gender, teaching experience, technology experience, and the use of policy instruments as possible moderators. Venkatesh et al. (2003) indicated that voluntariness is a moderator that affects behavioral intention, and it should be included if there is variance in the voluntariness of use in the organization. The moderators of primary interest are the use of policy instruments to guide technology use and direct the voluntariness of the integration of student technology projects. The present study used policy instruments as a moderator instead of voluntariness. It is proposed that voluntariness in a school could be identified with the availability of a technology plan, inclusion of technology use in the school curriculum, or the inclusion of technology use in annual teacher evaluations.

Experience plays an influential role in technology acceptance (Taylor & Todd, 1995; Thompson, Compeau, & Higgins, 2006; Venkatesh et al., 2003). Venkatesh et al. (2003) found experience to be a moderator of other variables in the earlier models as well as in the UTAUT model. Thompson et al. (2006) defined an individual's experience as exposure, as well as the skills, to use a technology. The effect is that training, along with

the voluntary decision to adopt the technology, can moderate perceptions that negatively influence Behavioral Intention to use a technology.

Other moderators may have an impact on the overall results; for example, gender has an effect on performance of jobs that are predominately task-oriented (Minton & Schnieder, 1980). Therefore, men could be more motivated with a task and have stronger performance expectancy (Kirchmeyer, 2002). Concerning age, younger users are more motivated to external rewards (Fields & Shallenberger, 1987; Morris & Venkatesh, 2000) and users of older age are motivated by internal rewards. Younger users may find it easier to learn new technology, and this involves the effort expectancy as it is related to a new technology (Plude & Hoyer, 1985). In this research, years of teaching experience is included rather than age, as years of working in the field of education may be more useful than chronological age.

### **The Research Design**

I developed a survey based upon the UTAUT instrument that measured the constructs listed in the preceding section. I modified The UTAUT instrument by changing the dependent variable from system use to teacher implementation of curriculum activities that require students to use technology. The dependent variable in the UTAUT model is the user's behavioral intention to use a technology, and in this research the dependent variable was the teacher's intention to develop curriculum activities that required students to use technology. The survey method was used in this research because a survey is an efficient method to gain numerical data that ideally represents a large population from a smaller sample. A survey design has provided a

quantitative description of the perceptions of the population by studying a sample of that population (Creswell, 2003).

### ***Instrument Pilot Study and Internal Reliability***

The questions of the survey were tested for clarity in the spring of 2009 with two graduate classes at the University of North Florida comprised of teachers from local schools and school districts. The sample size of the pilot was 29 students, and the result was used to test the internal consistency reliability of the instrument subscales. Subscale scores with a Cronbach alpha above .60 were retained as they demonstrate a moderate level of internal consistency reliability (Creswell, 2003). All items were measured on a seven point Likert scale, where 1 = *completely disagree*, 2 = *moderately disagree*, 3 = *somewhat disagree*, 4 = *neutral (neither disagree nor agree)*, 5 = *somewhat agree*, 6 = *moderately agree*, and 7 = *completely agree*.

The data were entered into SPSS software in order to test the internal reliability of scores. The 1 through 7 Likert scale employed needed to be coded such that high scores consistently represented a more positive response by the subject. Several of the items (9, 24, 25, 40, 41, 42, 43, 44, 45, 46, 47, 49, and 50) were reverse coded prior to the analysis.

The internal consistency reliabilities of scores on the several constructs and the total scores were estimated using Cronbach's alpha. The internal consistency reliability of the total score was calculated including all 50 items and resulted in a Cronbach's alpha of 0.923 indicating high internal reliability consistency (see Table 3). The Cronbach alpha was also calculated for scores on each of the four factors from the UTAUT instrument (Social Influence, Facilitating Conditions, Performance Expectancy, and Effort Expectancy), as well as factors that originated in the Theory of Planned Behavior

(TPB) model (Attitude, Behavioral Intention, Self-efficacy, and Anxiety). In conclusion, the scores were found to have an acceptable level of internal reliability using data from the pilot test.

### *Sampling*

The participants of this study were secondary teachers working in private schools in the state of Florida at the time of data collection. The teacher is the unit of measure in this study. The individual responses of each teacher have been placed in an institutional context with the questions identified in research question 2. The research model includes three questions that have determined the use of policy instruments with the organization that affect voluntariness of use. At the time of the study approximately 70 independent secondary schools operated in Florida and were listed in the Florida Council of Independent Schools directory. Secondary schools include schools that contain a high school (grade 9-12), a middle school (grades 6-8), or both. Schools that had a secondary school population of at least 250 students were invited to participate. The sample included the schools and teachers that volunteered to participate. The population was defined as teachers in private schools in Florida. This study investigated the factors that may affect a teacher's decision concerning technology use in private schools. Private school teachers have an autonomy that may not be available to public school teachers. Given that autonomy, the study may provide insight into the individual teachers' intentions, as well as the impact of institutional policies on their decisions. This study is delimited to private school secondary teachers because my experience in private schools has given me a particular connoisseurship in the area and may have helped me gain the participation of the schools of interest.

Table 3  
*Internal Reliability of the Research Instrument*

<b>Scale</b>	<b>Number of items</b>	<b>Cronbach alpha</b>	<b>Item number</b>	<b>Reverse Coded</b>	<b>Origin of Items</b>
Overall	N=50	.923	1-50	9,24,25, 40-50	Research Model
Social Influence	N=6	.866	1-6	None	UTAUT
Facilitating Conditions	N=5	.556	7-11	9	UTAUT
Performance Expectancy	N=6	.779	12-17	None	UTAUT
Effort Expectancy	N=8	.844	18-25	24 and 25	UTAUT
Attitude	N=5	.727	26-30	None	TPB
Behavioral Intention	N=5	.599	31-35	None	TPB and UTAUT
Self -efficacy	N=3	.602	37-39	36 omitted	TPB
Anxiety	N=4	.797	40-43	40-43	SCT
Technology Use	N=3	.596	48-50	48-50	UTAUT

The schools were invited to participate through an email invitation to the school director (Appendix C). The invitation requested permission to contact the teachers via email. A list of teacher emails was requested from the schools. When the email addresses were received, the teachers were contacted via email with instructions for participating in the survey. Teachers were then able to access the survey site via that email. The survey was cross-sectional with the data collected only once during a 30-day period. The responses of the individual teachers were not associated with the individual teacher or school. The use of the email prevented multiple responses from a single individual.

A response rate of 30% was predicted, resulting in approximately 25 secondary schools to survey. Assuming an average of 50 teachers at each school, the total possible

sample size would be 1250. Again, a predicted return rate of 30% would result in a sample size of 375 individuals (Bartlett, Kotrlik, & Higgins, (2001). The required sample size can be affected by the estimation method that researchers use and the normality of the data (Schreiber, Nora, Stage, Barlow, & King 2006). Alshare et al. (2009) successfully employed structural equation modeling with a sample of 175. Neufeld, Dong, and Higgins (2007) used partial least squares (PLS), a structural equation modeling method, with a sample size of 209. Ball and Levy (2008) used regression analysis with a sample of 111. Chen, Wu, and Yang (2008) analyzed their data sample of 153 with regression analysis. The primary test (PLS) of the UTAUT by Venkatesh et al. (2003) had a sample of 213, while the validation of the model had a sample of 133. A sample of 375 was determined to be sufficient for the chosen method of analysis. The actual data collected is presented in Chapter Four.

### ***Data Collection***

The survey was web-based and was hosted by the University of North Florida. The Vovici Survey Software used for the present study allows a person conducting research to create surveys and download results. In addition to the electronic copy, participants had the option of requesting a paper copy of the survey that could be sent to the participant via postal mail with a return address envelope. There were no requests for paper surveys during the collection of the data for the present research. In the email the participants were directed to the website to take the survey. The website itself received the participants input and kept a tally of the input. The individual participants were not associated with their input to the survey.



### *Data Analysis Methodology*

The data were collected using a modification of the UTUAT survey. In this study the four primary constructs of interest are Performance Expectancy, Effect Expectancy, Social Influence, and Facilitating Conditions from the UTAUT model. The research model also includes three additional constructs; Attitude toward use, Anxiety, and Self-efficacy that originated in the TPB model. The analysis determined the relationships between the constructs and Behavioral Intention. Additionally, the relationships were tested to determine whether the relationships are affected by the moderators.

The UTUAT model has been tested in a variety of research with the data subjected to a range of different analysis. Venkatesh et al. (2003) used partial least squares regression procedures to develop the measurement and structural models. Others have employed simple correlation analysis (Marchewka, 1996), or linear regression (Chen et al., 2008). Neufeld et al. (2007) used partial least squares in the adaption of the UTAUT to investigate IT leadership. Davis (1989) used path analysis with the original TAM instrument.

The analysis of the data in the present study proceeded with four steps: (a) a determination of descriptive statistics to describe the sample, (b) confirmatory factor analysis to provide evidence of internal consistency reliability of the scores on the UTAUT, and (c) a partial least squares regression analysis to develop the measurement model as well as the structured path model for the path analysis. The descriptive statistics, factor analysis, and the linear regression were computed using SPSS software and the partial least squares regression and path analysis were determined with Smartpls software. These methods will each be further explored in the following section.

Factor analysis is a group of methods used to examine how underlying constructs influence the responses on a number of measured items. Factor analyses are performed by determining the pattern of correlations (or covariance) between the observed items. Measures that are highly inter-correlated are likely influenced by the same factors, while those that are uncorrelated are likely influenced by different factors. There are several types of factor analysis, such as R-factor analysis or Q-factor analysis. These labels refer to the arrangement of the variables and observations. R-factor analysis is appropriate when the variables (items) are arranged as the columns of the data set and the observations (participants) are in the rows.

Factor analysis can be exploratory, or confirmatory, in nature. Exploratory factor analysis (EFA) is used when a new model is being developed. Exploratory factor analysis is often not purely exploratory in nature because the researcher affects the analysis through selection of variables, determination of the factors, and the naming of the factors. EFA can also be used to measure the validity of the instrument (Alshare et al., 2009). Exploratory factors can therefore be confirmatory in nature. Confirmatory factor analysis (CFA) often provides a framework for confirming existing ideas about the structure of a set of content. The present study will use confirmatory factor analysis and the process is presented in Chapter 4.

The general methodology currently seen as an umbrella for both EFA and CFA is called structural equation modeling (SEM; Pruzek, 2005). When the constructs have been well tested and are based upon strong theory and strong empirical base, a confirmatory factor analysis (CFA) can be employed.

To begin the structural model, the measurement model needs to be reviewed to determine how well the items associate the theoretically defined constructs. The measurement model of the path analysis can be used to confirm the results of a factor analysis (Alshare et al., 2009). Individual item score reliability is evaluated using the factor structure coefficients greater than 0.7 (Chin, 1998). The Fornell and Larcker (1981) internal consistency measure is considered a better measure of reliability than Cronbach's alpha in structural modeling, and Fornell and Larcker (1981) recommended a minimum composite reliability of .60 (Chin & Gopal, 1995). The type of reliability verifies the extent to which the scores are internally consistent.

### ***The Structural Model***

The second step in an analysis is to create a structural model by analyzing the path coefficients among constructs. Structural paths are theoretical relationships among latent variables, and measurement paths are relationships between a latent variable and its indicators. Factor analytic models can be represented by path diagrams. In a path diagram, convention suggests that each latent variable is represented by a circle, each manifest variable is represented by a square, and an arrow indicates causality (Stevens, 2002). Path analysis is also known as causal modeling, and it examines the web of relationships among measured variables. The strength of path analysis is that it can help researchers understand complex relationships and determine the most significant relationships. Path analysis models are based on correlations, and, as a result, do not show causality, but they can show which models best fits the data (Lleras, 2005).

Path models are models which graphically display the factors or constructs of observed variables and indicate the relationships between these theoretical constructs. In

SEM, independent variables are referred to as exogenous variables and dependent variables are referred to as endogenous variables.

Modeling relationships between latent variables are determined by one of two different methodological approaches: covariance structure analysis (SEM) and PLS path modeling. The partial least squares method (PLS) is a type of structural equation modeling (SEM) that is used for building statistical models. The PLS method has increased use in recent years (Compeau & Higgins 1995; Chin & Gopal, 1995) because PLS can model latent constructs under conditions of non-normality and small sample sizes. PLS can be adapted to complex models and is useful for exploratory research where the focus is on prediction (Jöreskog & Wold, 1982; Neufeld et al., 2007). The partial least squares method does not require normal distribution of variables (Chin, 1998), but still facilitates the analysis of complex path models.

Chin, Marcolin, and Newsted (2003) indicated that PLS is suitable for small samples and does not require normal distribution. PLS has been employed with smaller samples in several studies; for example, Neufeld et al. (2007) had a sample size of 209. PLS was used by Venkatesh et al. (2003) in developing the UTAUT model with 131 subjects. The primary goal of PLS is to produce determinate values for latent variables, and, therefore, PLS is suitable for the present study. Chin (1998) noted that the purpose of PLS analysis is to predict the role of constructs and the relationships between them. The correlations of items with the constructs are the same as structural coefficients in factor analysis, and path coefficients in a PLS model are analogous to standardized regression coefficients or factor pattern coefficients (Neufeld et al., 2007) in that PLS employs a weighted sum of the indicators to form the latent variables (Chin et al., 2003).

To understand the relationships in the present research between the primary constructs and Behavioral Intention required a Partial Least Squares (PLS) regression. As noted previously, the PLS method is known as partial least squares, but it is also referred to as a “projection to latent structure.” The goal of PLS is primarily to estimate the variance of endogenous constructs and, in turn, their respective manifest variables. Goodhue, Lewis, and Thompson (2007) found that PLS was used in 30% of the articles in three top MIS journals between 2000 and 2003.

Path analysis is useful for models that contain moderators. Moderators are variables that have an interaction effect on the relationship between latent variables. Moderators can be qualitative -- such as gender, race, teaching experience -- or they can be quantitative -- such as income. The moderator can affect the strength of the relations between the predictor variable and the dependent variable. Measuring the effect of moderators is useful to illuminate the conditions that have an impact of the relationships in the research. Venkatesh et al. (2003) have found moderators to be important in the UTAUT model; therefore, they have been included in this research as well.

### **Timeline**

An application for the Institutional Review Board (IRB) was submitted in December of 2009 and approved in February of 2010 (IRB#09-167). Participation of private schools was solicited via an email invitation sent to the head of the school. The participants were identified in March 2010, allowing collection of responses during April of 2010. The data were analyzed during summer and fall of 2010.

### **Protection of Participants**

The protection of the participants has been maintained through the process required by the University of North Florida Institutional Review Board. The procedures outlined by the committee are designed to protect human participants during research activities. Teachers were advised on the survey that by taking the survey they have given their informed consent. The names of the teachers who responded to the survey were not related to their answers and their identity was not used. Additionally, the schools themselves were not identifiable from the survey data. Only the aggregate data were reported. The overall data was not released to any third parties. Because the IRB document (IRB#09-167) contains the list of the participating schools it is not included in this document. The results and interpretations, however, will be available to the participating schools with the intent that the results may help schools in their technology curriculum planning.

### **Chapter Three Summary**

This research has tested the proposed research model and conceptual framework in a private secondary educational setting. The model consists of the following constructs: Social Influence, Facilitating Conditions, Performance Expectancy, Effort Expectancy, attitude, anxiety, and Self-efficacy. The measured outcome in the research model is the Behavioral Intention of the user (teacher) towards technology use. The relationship between behavior intention of the teacher and the three components of technology use (intensity, duration and frequency of use) has also been measured. In this research, use is defined as the implementation of activities into the curriculum by the teachers that require student use of technology.

The research instrument was piloted for clarity by two classes of graduate students at the University of North Florida during February 2009. The internal reliability consistencies of the scores were tested using the responses from the pilot testing of the research instrument. The internal reliability of scores on the pilot research instrument ( $\alpha = .93$ ) indicated that the instrument suitable for this research. The schools were invited to participate via an email that explained the study. The instrument used to gather data was made available at an on-line web survey site. The survey instrument included questions based on the Unified Theory of Acceptance and Use of Technology (UTAUT) instrument that have been adapted to fit the focus of this study.

Partial Least Squares regression is a multivariate technique which hypothesizes relationships between variables and was used to produce a path diagram. PLS was used for two steps to develop the model; factor analysis to develop the measurement model, and path analysis to produce the path diagram. The analysis indicated the strength of the relationships between the constructs, the moderators, and the dependent variable.

Chapter Four contains the results of the analysis described in Chapter Three. Results are presented for the confirmatory factor analysis of the survey items that identified the latent variables in the study. The partial least squares analysis produced a measurement model and structural models that are both presented in Chapter Four.

## CHAPTER FOUR: THE RESULTS

This chapter presents the results of the analysis of the data. The chapter begins with a presentation of the demographics of the study sample and the technology use policies present in the schools. The chapter continues with the analysis of the data including the factor analysis process, as well as the partial least squares analysis. The chapter concludes with the presentation of the effect of moderators on the relationships between the independent variables and the dependent variables.

The data collected in the survey represent the insights of teachers into the several factors that hypothetically affect their intention to integrate technology into their curriculum. The theory was conceptualized as Behavioral Intention of the teachers to integrate technology (BI) that could vary with several factors of a school. The factors were originally identified in the UTAUT theory (Social Influences, Effort Expectancy, Performance Expectancy, and Facilitating Conditions) and the Theory of Planned Behavior (Attitude, Anxiety, and Self-efficacy). The results are presented in three sections that follow the three steps of the analysis. In this chapter the demographics of the sample are presented first to provide the reader the context of the data. The second section presents the confirmatory factor analysis (CFA) of the data. Following the identification of significant constructs using factor analysis, a path diagram was created using partial least squares analysis. The path diagram from the PLS presents the relationships between the items and each factor in the “outer” model as well the relationships between each dependent factor and the independent factor of Behavioral



Intention in the “inner” model. The path diagram also indicates the relationship between Behavioral Intention and actual technology use. Lastly, in the third section, the hypothesized moderators and their influence on the relationships are presented.

The sample for the present study was drawn from the population of teachers within approximately 1,500 private schools listed with the Florida Department of Education. The schools for the present study were selected from the list of private schools that had a minimum of 250 students in the secondary school grades (grades 6 to 12). A student population of 250 was chosen to secure schools that would increase the probability of a useful sample by having a greater number of teachers. The number of schools that fit the criteria was 77. The schools were contacted in March of 2010 with an email to the school director or headmaster describing the study and requesting the participation of their school (Appendix C). Of the 77 private school directors contacted, 17 responded favorably resulting in a return rate of 22%. The directors who agreed to allow their teachers to participate represented a possible number of 839 teachers. These teachers were invited via an email describing the study along with instructions for accessing the survey (Appendix D). Of the 839 possible respondents, 315 completed the survey. Of those, 251 had usable data, for a response rate of 29.9%, which is considered acceptable in this type of research (Dillman, 2007). The frequency table of the survey responses is presented in Appendix E.

### **Demographics**

Of the participants who responded to the survey, the majority were female (64.4%), taught in high school (78.5%), and had less than 20 years of experience (73.3%). Responses indicate that 37.5% of the teachers have been implementing

activities that require students to use technology for 1-4 years, and 6% of the respondents have not integrated technology activities (Table 4).

Table 4

*Experience teaching and years implementing activities that require students to use technology*

Years	Teaching Experience	Years implementing technology activities
0	0.0%	6.0%
1-4	16.3%	37.5%
5-9	21.9%	29.1%
10- 14	17.1%	17.5%
15-20	17.9%	10.0%
More than 20	26.7%	0.0%

### ***Technology Use***

In the present study the frequency of implementation of projects that require students to use technology are: once a quarter (35.2%), once per week (22.3%), once per chapter (20.6%), once per semester (17.0%), or once per year (4.9%). When teachers implement technology projects the duration of the projects are: 2-3 class periods (46.6%), 1 class period (31.2%), 4-5 class periods (12.1%), or more than 5 periods (10.1%). The intensity of the projects in which students are required to use technology refers to the complexity of the project and 38.2% of the responses indicated that the project requires teaching of some technology skills, and 61.8% of the teachers rely on existing technology skills when implementing projects that require student to use technology. These data indicate that the majority of teachers implement projects that require student use of technology with a frequency of once a quarter, for a duration of 2-3

class periods, and is of such intensity that the majority of teachers rely on the technology skills the students already have developed.

### *Technology Use Policy*

The following data highlight the context in which the respondents work and the environment in which they address technology use in their classrooms. Questions about the presence of policy instruments that address technology were included in the survey to determine the possible moderating affect of administrative policies. The administrative policies include the presence of a technology plan that includes student technology skills, a curriculum plan that addresses technology use, and the inclusion of technology use in annual evaluation. Of the teachers who responded, 61% reported that their schools had a technology plan that included technology skills that teachers need to master. Additionally, 27.1% of the teachers indicated that their school has a curriculum guide that includes activities that teachers should implement, and 34.3% of the teachers reported a technology use component of their annual evaluation as presented in Table 5.

Table 5

*Percentage of schools that contain policy instruments that refers to technology use*

Response	Technology Plan that includes technology skills	Curriculum Guide that includes technology activities	Annual Evaluation that includes a technology use component
Yes	61.0%	27.1%	34.3%
No	39.0%	72.9%	65.7%

### **Confirmatory Factor Analysis I**

Factor analysis is a technique used to identify the underlying constructs that explain the variations in the measures by reducing several observable items to a smaller number of latent variables. There are two types of factor analyses that are applied, depending on the situation. Exploratory factor analysis (EFA) is employed when the research is attempting to identify new underlying constructs. When the constructs have been well tested and are based upon strong theory and strong empirical base, a confirmatory factor analysis (CFA) can be employed. The present research is based upon a mature field of study of Behavioral Intention and a well-tested model (UTAUT). The survey items have been designed to measure particular constructs, and therefore the constructs have been previously defined and established.

The term *confirmatory factor analysis* is typically used to refer to a type of structural equation modeling focused on the fit of pre-identified structural models (such as the UTAUT model) to sets of data when the researcher desires to identify an underlying set of latent dimensions that account for variance in a set of observable variables. However, O'Rourke, Hatcher, and Stepanski (2005) stipulated that common factor analysis, as opposed to principal component analysis, can be used to confirm the latent factor structure for a group of measured variables in that common factor analysis accounts for the relationships between measured variables, latent factors, and error. Hence, common factor analysis, though regarded by some as exploratory, can be considered a confirmatory technique. As O'Rourke et al. noted, "Factor analysis assumes that the covariation in the observed variables is due to the presence of one or more latent variables (factors) that exert causal influence on these observed variables" (p. 436).

Using this distinction in terms, it is appropriate to say that *confirmatory* factor analysis was the selected method of choice for analyzing constructs underlying the UTAUT items in the present study. More particularly, the confirmatory methodology used herein was maximum likelihood factor analysis, and the factor analysis routine in PASW/SPSS was used to execute the analyses. Maximum likelihood (ML) extraction allows computation of goodness-of-fit and the testing of the statistical significance of factor structure coefficients and correlations between factors. Hence, CFA with maximum likelihood extraction was applied to the data collected.

### ***The Statistics in this Study***

There are several methods that determine whether a factor analysis is appropriate for the data. In the adapted UTAUT instrument there are four to eight items to measure each factor. To confirm the strength of the factors, both the results of the factor analysis and prior knowledge of what the item represents, need to be included. In the present study there are seven theoretical independent factors that should be represented by the items intended to measure those factors. The relationship between the seven independent factors (Social Influence, Effort Expectancy, Performance Expectancy, Facilitating Conditions, Self-efficacy, Anxiety, and Attitude) and the independent construct (Behavioral Intention) as well as the relationship between Behavioral Intention and actual Use was tested with the development of a structural model using with partial least squares (PLS) analysis.

The survey response yielded a total sample of 315; however, only the completed surveys were retained. With the completed surveys, there were a few scattered missing answers. When the analysis was run in SPSS, all missing values were converted to the

item mean for subsequent calculations. The survey included had several items (9, 24, 25, 40, 41, 42, and 43) that required reverse coding due to the phrasing of the question (Appendix D).

The dimensionality of the 46 items from the research model (adapted UTAUT instrument) was analyzed using maximum likelihood factor analysis. The criterion that was used to determine the number of factors to rotate was based on the theoretical hypotheses, the scree test, and the interpretability of the solution. The rotated products are factor structure coefficients (i.e., Pearson correlations between the items and the factor). Choosing the number of variables that identifies the construct is important. Constructs should not be composed of a single measured variable (Thurstone, 1947), but should have a minimum of three to four observed variables for a factor to be defined (Bruin, 2006). According to Green and Salkind (2005), there should be at least four measures for each construct that may prove to be a final factor. The factor solution should ideally not include items that do not correlate appreciably with any factor.

The sample size is also important in factor analysis, and the required sample size is related to the number of variables. The minimum number of observations (participants) per variable should be in the range from 5 to 10 (Gorsuch, 1983). In the present research there were 46 variables requiring a minimum of 230 observations, and the number of observations available was 251 (5:1 ratio). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is a measure that has a range of 0.0 to 1.0; values approaching 1.0 indicate an adequate sample size for the factor analysis. A minimum value of 0.6 is required for factor analysis (Tabachnick, & Fidell, 2001). The KMO value

of the present research data was .897, indicating an excellent sample size ( $n=251$ ) for the factor analysis of these sample data.

The Bartlett's test of sphericity tests the null hypothesis that the correlation matrix is an identity matrix. The intent is to reject the null hypothesis. The Bartlett's test of sphericity converts the determinant to a chi square statistic and tests for statistical significance. In this case, the matrix did not derive from a population in which the inter-correlation matrix ( $p<.001$ ) is an identity matrix and therefore is factorable, so a factor analysis is appropriate for these data.

### ***Estimating communalities***

A factor analysis begins with deriving a communality estimate ( $h^2$ ) for each variable to estimate the amount of the variance that is error free and is shared with other variables in the matrix. The estimate of the communalities determines the proportion of the variance in a variable that is reproduced in the factor. Stated differently, the communality for a given variable can be interpreted as the proportion of variation in that variable explained by the factors. For the present data only 9 of 46 of the communalities are below 0.5, indicating that 50%, or more, of the variance in the majority of variables is accounted for (only 4  $h^2$  values are below 0.40). The average communality for variables in this data set is .605.

### ***Determining the Number of Factors***

The number of factors extracted is seldom based upon a single criterion but determined by using a set of guidelines. The guidelines that have been used in this research are the Kaiser-Guttman rule, percentage of variance, the scree test, the size of the residuals, and interpretability.

The Kaiser-Guttman rule suggests that the number of factors extracted should be equal to the number of factors that have an Eigenvalue greater than 1.0. The Kaiser criterion is accurate when the number of variables is under 40, and the communalities are high ( $>.70$ ; Stevens, 2002). The definition of communality is the proportion of variance of an item that is due to common factors (shared with other items). Communalities should be less than 1.0; if the communality exceeds 1.0, the solution may indicate a small sample or the study has too many or too few factors. Communalities should also be above 0.5 (Field, 2005). In this research there are 46 variables, and 14 of the items have communalities greater than 0.7.

The graphical scree method developed and proposed by Cattell (1996) plots the Eigenvalues against the factor number and it depicts the relative size of the Eigenvalues. The point when the steep slope (first factors) shifts to the horizontal portion of the graphic distribution (weaker factors) can indicate the number of factors to extract. This method generally retains the components which account for a large and distinct amount of variance.

A general rule is that structure coefficients greater than  $|.30|$  are significant (Stevens, 2002). This criterion can be adjusted lower if the sample size and variables increase; conversely the value can increase as the number of factors increases. The first step is to determine the items identified with (or are salient with) each factor. Ideally, there should be a significant factor structure coefficient for each item on a single factor. Doublets occur when a variable is salient with two or more factors. If a variable is not salient with any factor, the item should be removed and the analyses run again. Stevens



(2002) stated that reliable factors should be based upon component saturation and sample size.

1. Factors with four or more salient items above .60 are reliable regardless of sample size.
2. Factors with 10 or more salient items above .40 are reliable as long as sample size is above 150.
3. Factors with only a few salient items should not be interpreted unless sample size is above 300.
4. Factors with three salient items above .80 are reliable.

A .7 level corresponds to about half of the variance in the indicator being explained by the factor but .7 is a high standard and factor structure coefficients above .6 are strong coefficients and those below .4 are moderate.

To interpret the factor solution most studies set a minimum value above which the factor structure coefficient was considered significant. Ford, MacCallum, and Tait (1986) suggested it is important to avoid setting cut off points but instead use them as guidelines. Factors should be interpreted based on knowledge of the variables and an examination of the factor structure coefficients. Determining the factors contains some subjectivity, however using strict cutoffs limits the analysis (Comrey, 1978) and factor labels are more meaningful when the pattern of high and low structure coefficients are included (Rummel, 1970). In the present study the values suggested by Stevens (2002) are used as guidelines to interpret the factors.

### ***Factor rotation***

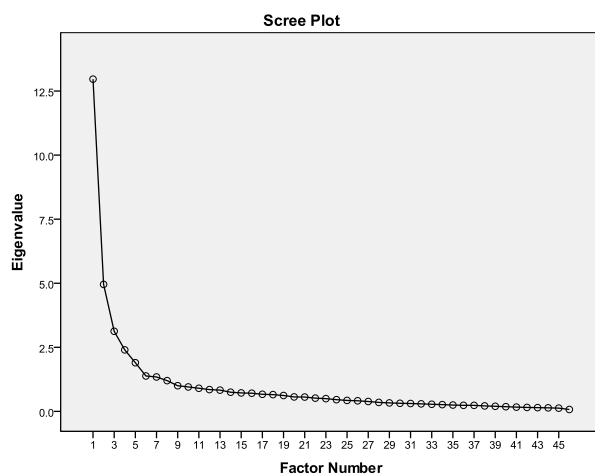
The initial factor analysis matrix is not unique and there are several solutions if the reference axes are rotated. The intent of rotation of the axis is to have a more interpretable solution. There are two types of rotation, orthogonal and oblique rotation. The orthogonal method is used more often than oblique rotation because the latent constructs are not correlated with each other. Oblique rotations are used when the constructs are correlated with each other (Stevens, 2002). There are five basic orthogonal rotation methods, and the Varimax methods are the most commonly used because in Varimax the early factors are typically identified by a smaller number of variables allowing for more items to correlate with later factors. This makes the interpretation easier, and Varimax was used in the present study for this reason. In the following sections the results of the CFA are discussed.

### ***Determination of the Factors with CFA***

When  $N > 250$  and the mean communality  $> .60$ , either the Kaiser criterion (Eigenvalue  $> 1.0$ ), or scree plot, will produce an accurate estimate of the correct number of factors. Also, if the ratio of the number of factors to the number of variables is  $< .30$ , then the Kaiser Test and scree test have greater credibility (Stevens, 2002). In this CFA, the ratio of factors to variables (8:46) is 0.17. It is also important to retain the number of factors that will account for at least 70% of the total variance. However, if a researcher retains too much of the variance it can lead to the problematic retention of a factor that may only be identified by a single variable. For the data in hand there are 9 factors that had Eigenvalues above 1.0, representing 65% of the variance. The scree plot for the CFA supported extracting 9 factors (Figure 6).

### *Internal Consistency Reliability*

Internal consistency reliability is a method used to test internal consistency reliability of the data. Items were grouped according to factors, and internal consistency reliability analysis was conducted on each factor and a Cronbach alpha was determined for each factor. Cronbach's alpha is believed to indirectly indicate the degree to which a set of items consistently measure a single latent construct and was an appropriate statistic for use in this study. George and Mallery (2003) provided the following rules of thumb for alpha values: .90 to 1.0 are excellent, .80 to .89 are good, .70 to .79 are acceptable, .60 to .69 are questionable, .50 to .59 are poor, and below .50 are unacceptable (p. 231).



*Figure 6.* The scree plot of the CFA I.

In this present research the Cronbach alpha values (except for Self-efficacy) are above .70, indicating that the data have relatively high internal consistency. The value for Self-efficacy is .29 indicating that the items are not measuring Self-efficacy as intended. The Cronbach alpha values of the identified constructs are listed in Table 6.

Table 6

*Reliability of Research Data*

Construct Label	Number of Items	Cronbach's Alpha
Social Influence	6	.85
Effort Expectancy	8	.83
Performance Expectancy	6	.77
Facilitating Conditions	5	.72
Behavioral Intention	5	.70
Anxiety	4	.80
Attitude	5	.85
Self-efficacy	4	.29
Entire Instrument	43	.91

***Interpretation of CFA I Results***

A factor structure coefficient is the Pearson correlation between a variable and the factor. The factor structure coefficient matrix, or factor structure matrix, is a matrix of the variables and their factors. The meaning of the rotated factors requires a decision to be made about what is a salient factor structure coefficient. The confirmatory factor analysis was rerun three times in order to develop the strongest model. In the preliminary CFA, 9 factors were extracted with 7 iterations required. The preliminary results of the first confirmatory factor analysis (CFA I) are presented in Appendix F. In a purely exploratory factor analysis, the factors would be named according to the similarities of the items that are salient with a particular factor. Because the items have been related to particular constructs in the adapted UTAUT instrument (as discussed in Chapter Two), the established names for the constructs has been retained in the present research.

Table 7

*Labels Associated with the Factor structure of CFA I*

<b>Factor 1</b>	<b>Factor 2</b>	<b>Factor 3</b>	<b>Factor 4</b>	<b>Factor 5</b>	<b>Factor 6</b>	<b>Factor 7</b>	<b>Factor 8</b>	<b>Factor 9</b>
PE 4 items	SE 2 items	SI	BI 3 Items	FC	PE 3 items	EE 5 items	SE 2 items	None
ATT 5 items	ANX 3 items							

Note: PE = Performance expectancy, ATT= Attitude, SE=Self-efficacy, ANX= Anxiety, BI = Behavioral Intention, EE=Effort Expectancy, SI= Social Influences, FC= Facilitating Conditions.

The nine factors were labeled based on the theoretical constructs that the survey questions were designed to investigate in the original UTAUT and TPB models and are listed in Table 7. The individual factors identified, and named, in the UTAUT and TRB models were intended to measure particular constructs. Each of the named factors are discussed in the following section, including the number of the items identified with each particular factor. There are three constructs in which all of the items are salient with a single factor. A strong construct that emerged is the latent variable labeled Attitude (ATT). There were 5 items that were intended to investigate Attitude, and all five were salient with Factor 1. Social Influences (SI) also emerged as a strong latent variable. There were five items that were intended to investigate Social Influences, and all of the questions were salient with Factor 3. Facilitating Conditions (FC) also proved to be a strong construct with four items that were intended to investigate Facilitating Conditions all salient with Factor 5.

As a result of the preliminary CFA I, a second confirmatory factor analysis was run with the removal of the dependent variables of Behavioral Intention, as well as Use. Item 16 was removed due to its high communality (.961). Additionally, items 6 and 34 did not load on any factor and were also removed from subsequent trials. The analysis

was performed a second time and is referred to as CFA II. The result of the second factor analysis is presented in the following section.

### **Confirmatory Factor Analysis II**

The CFA II is based on the preliminary results of the first CFA. The CFA helped to determine which items to retain for the constructs. Factor analysis is concerned with the portion of the total variance shared by the variables that had been retained in the model. As a result, items that are not related to any variables were eliminated from the CFA. Seven factors accounted for 66.19% of the variance. The percent of variance is another criterion that can be used to determine the factors to retain. Ideally, 75% of the common variance explained would be obtained, but lower values are more common. The second factor analysis attempted to consolidate the factor structure coefficients on interpretable constructs. Seven factors were extracted in the CFA II based on an Eigenvalue above 1.0. The results of the second confirmatory factor analysis (CFA II) are presented in Appendix G.

The correlation matrix contains the correlations between the variables, and variables should correlate with other variables, but they should not correlate too highly. There are two instances where two items are highly correlated, and variables that correlate very highly ( $r > 0.8$ ) or ( $r > 0.9$ ) should be removed. Performance Expectancy item 13 and Performance Expectancy item 14 are correlated highly to each other ( $r = 0.817$ ). Additionally, Performance Expectancy item 16 is highly correlated with Performance Expectancy item 17 ( $r = .894$ ).

Multi-collinearity, or singularity, is the result of high correlation and it is possible to remove variables that contribute to this multi-collinearity. The multi-collinearity can

be determined by the determinant of the R-matrix. The determinant should be greater than  $1.0 \times 10^{-5}$ ; the determinant of the R-matrix is  $1.25 \times 10^{-009}$ . Because the value is not greater than  $1.0 \times 10^{-5}$  there may be concern for multi-collinearity in the data.

The seventh factor has an Eigenvalue of .944, and with the seventh factor the 69% of the variance is accounted for. The scree plot for the CFA II supports extracting 6 factors is presented in Figure 7.

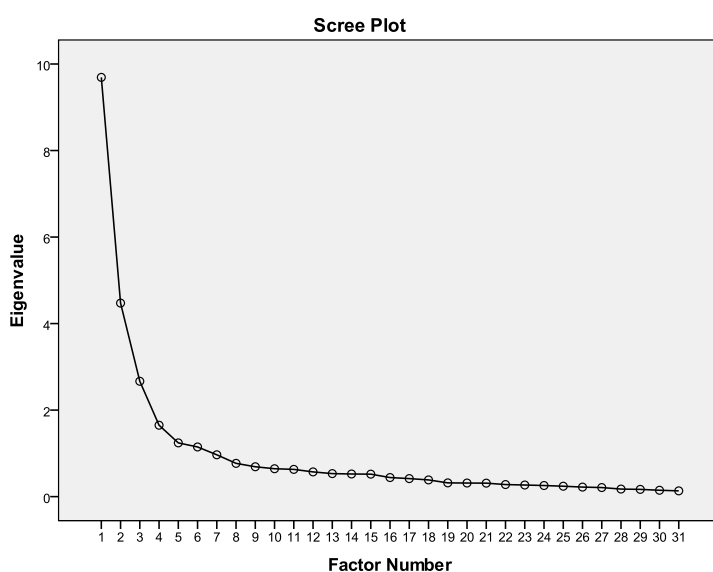


Figure 7. The scree plot for the CFA II.

In the second analysis, Attitude (ATT) and Social Influences (SI) are both moderate to strong constructs. The latent variable of Attitude was measured by five items that all are salient with single factor. Social Influences was measured by four items that also are salient with a single factor. Effort Expectancy was measured by eight items and six of those items are salient with a single factor.

The six factors identified were labeled based on the theoretical constructs that the survey questions were purported to measure (Table 8).

Table 8

## Labels of the Factors of CFA II

<b>Factor 1</b>	<b>Factor 2</b>	<b>Factor 3</b>	<b>Factor 4</b>	<b>Factor 5</b>	<b>Factor 6</b>
EE 5 items	F C 4 items	EE 2 items	P E 3 items	ATT 5 items	S I 4 items
SE 2 items	EE 2 items				
ANX 3 items					

Note: PE = Performance expectancy, ATT= Attitude, SE=Self-efficacy, ANX= Anxiety, BI = Behavioral Intention, EE=Effort Expectancy, SI= Social Influences, FC= Facilitating Conditions.

There are factors that would be considered moderate in strength. Facilitating Conditions (FC) had four items that are salient with a single factor and one item another factor. There were four questions intended to investigate Anxiety and three questions are salient with the same factor. There were two questions that were intended to investigate Self-efficacy, and these both are salient with factor one.

Performance Expectancy proved to be a weak construct in the present data set. There were six items intended to measure Performance Expectancy (PE). Three of the items are salient with three different factors, and three items did not load on any factor.

As a result of the second confirmatory factor analysis (CFA II), several items were removed for various concerns. Item 6 (SI) and 15 (PE) did not load on any variables, items 24 and 25 are both EE and had weak factor structure coefficients as did items 37, 38, and 39 (EE) and item 41 (ANX). Item 16 (PE) was removed due to its high communality value. The above items were removed and a third factor analysis was run in order to arrive at a stronger model.



### Confirmatory Factor Analysis III

A final analysis was run with the removal of additional items discussed in the previous section. The CFA III utilized the remaining 27 items to produce the six factors suggested by the CFA II. This method forced the factor structure coefficients of the items onto the number of factors suggested, rather than relying on Eigenvalues or a scree test. The results of the final CFA III indicated a strong model with moderate to strong factor structure coefficients of all the items onto one of the six factors. The third confirmatory factor analysis is the culminating analysis that resulted in a strong model. The results of the third confirmatory factor analysis (CFA III) are presented in Appendix H.

In the CFA III, the six factors rotated represented 71% of variance, and this was an improvement from the nine factors that represented only 68% of the variance in the CFA II. The scree test also indicated extracting six factors was appropriate (Figure 8).

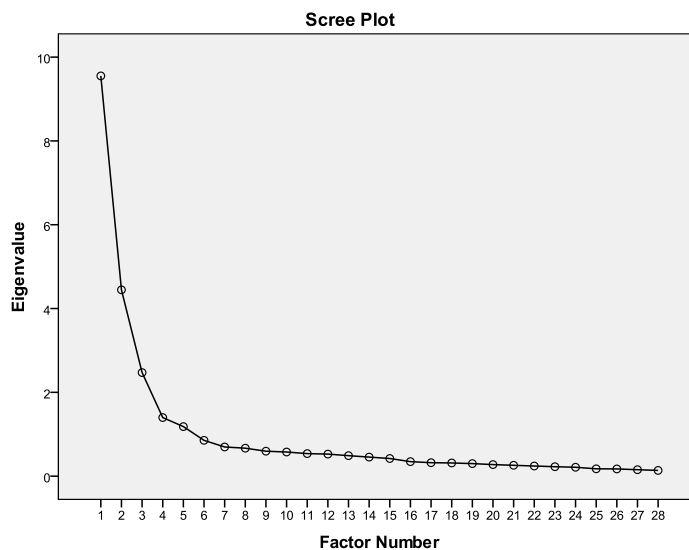


Figure 8. The scree plot of CFA III.

The six factors were labeled based on the theoretic construct that the questions were

investigating. The six factors have been discussed in relation to each particular constructs. Factors with four or more factor structure coefficients above .60 are reliable regardless of sample size (Table 9).

Table 9

*Labels Associated with the Factors in CFA III*

<b>Factor 1</b>	<b>Factor 2</b>	<b>Factor 3</b>	<b>Factor 4</b>	<b>Factor 5</b>	<b>Factor 6</b>
ANX	FC	PE	EE	SI	ATT
3 factor structure coefficients above 0.8	All 4 factor structure coefficients above 0.5 (2 above .7)	All 4 factor structure coefficients above 0.5 (2 above .7)	All 6 factor structure coefficients above 0.5	All 5 factor structure coefficients above .6	4 factor structure coefficients above .4 (2 above .7)
Strong factor	Moderate to strong factor	Moderate to strong factor	Strong factor	Strong factor	Moderate factor

Note: PE = Performance Expectancy, ATT= Attitude, SE=Self-efficacy, ANX= Anxiety, BI = Behavioral Intention, EE=Effort Expectancy, SI= Social Influences, FC= Facilitating Conditions.

The strength of the factors was determined by using the guidelines presented by Stevens (2002) to assign a relative strength for the factors based upon the factor structure coefficients (Ford et al., 1987). In the final factor analysis, Social Influences (SI), Effort Expectancy (EE), and Anxiety (ANX) all proved to be very strong factors in the CFA III (Table 9). With the construct of Anxiety, all three of the items that measured Anxiety had factor structure coefficients above 0.8. Factors with only three items are reliable if the three factor structure coefficients are above .80 (Stevens, 2002). Effort Expectancy also proved to be a strong factor in the CFA III. Of the six items that measured Effort Expectancy, all six are salient with Factor 4, and all were above 0.5. Factors with four or more factor structure coefficients above .60 are reliable regardless of sample size (Stevens, 2002). Factor 5, Social Influences, proved to be a very strong factor in the

CFA. There were five items that measured Social Influences, and all five factors are salient with Factor 5 with factor structure coefficients above 0.6.

Attitude, Performance, Expectancy, and Facilitating Conditions are moderate to strong factors in this final analysis. Facilitating Conditions (FC) proved to be a moderate, to strong factor, in the CFA III. Of the four items that measured Facilitating Conditions, all four are salient with Factor 2, and all four factors were above 0.5, with a moderate sample size, and two of the items were above 0.70. I would consider this an interpretable factor, as Stevens (2002) indicates factors with four or more factor structure coefficients above .60 are reliable regardless of sample size. Performance Expectancy proved to be a moderate to strong factor in CFA III. Of the four items that measured Performance Expectancy, all four are salient with Factor 3, and all four factors were above 0.5, with two of the items were above 0.70. Attitude is a moderate to strong factor in the CFA. Four of the factors that measured attitude all are salient with Factor 6. All four factors were above 0.4, but two of those four were above 0.7.

In summary, the use of confirmatory analysis produced a model that is robust, and the items retained defined six latent variables. The confirmatory factor analysis intention was to answer the first research question by creating interpretable constructs. The primary research question was answered by creating a model using confirmatory analysis as described in the first research question. The sub-questions within the first research question each relate to the significance of each potential construct (social influences, effort expectancy, anxiety, attitude, performance, expectancy, and facilitating conditions). self-efficacy did not emerge as a construct.

The constructs identified with the factor analysis and their relationship to behavioral intention of the teacher to implement curriculum activities that require students to use technology was tested in the path model, created through partial least square analysis. Research question four relates to the relationship between behavioral intention and actual use is also tested through the path model. The independent variables of behavioral intention and actual use are two additional constructs analyzed in the path model. The path model created through partial least squares analysis is presented in the following section.

### **Path Analysis**

The last step in the present analysis has been the development of a structural model by analyzing the path loadings between constructs. Path analysis is also known as causal modeling, and it examines the web of relationships among measured variables. Structural paths are theoretical relationships among latent variables, and measurement paths are relationships between a latent variable and its indicators. The strength of path analysis is that it can help researchers understand complex relationships and determine the most significant relationships within a larger network of variables. Partial least squares analysis is a good method to deal with problems in data such as small datasets, missing values, or multi-collinearity. Path analysis models are based on correlations, and, as a result, do not show causality, but the analysis can show which models best fits the data (Lleras, 2005).

The PLS (Partial Least Squares) procedure has the ability to model latent constructs for small to medium sample sizes under conditions of non-normality. PLS is similar to regression, but PLS models the structural paths, which are the theoretical

relationships between latent variables, and measurement paths, which are relationships between a latent variable and its indicators. As in factor analysis, the variables are now viewed as latent variables (constructs) which cannot be measured directly. The multiple indicators for these latent variables are the items from the survey.

The first step in assessing the measurement model involves testing the individual item reliabilities to confirm that the indicators (items) load on the related constructs. Unidimensionality indicates that the related indicators of the construct do measure the latent variable the items are meant to measure. The standardized measurement loadings for unidimensionality are measures of correlations of the measured items with the respective construct. Different threshold values have been suggested by authors (Nunnally, 1978; Raymond & Bergeron, 1997), but loadings should be greater than 0.70 to ensure at least 50% of the variance is accounted for. Examining the weights and loadings for each of the seven constructs (six independent variables and one dependent variable), 32 of the items had loadings of 0.70 or higher whereas four items had factor structure coefficients of at least 0.60 and two items had loadings below .60 (Table 10). PLS is appropriate for research models where the goal is theory exploration and prediction (Neufeld et al., 2007). The loadings of items on the constructs are the same as factor structure coefficients. Path coefficients in a PLS model are like standardized regression coefficients (Neufeld et al.), and PLS employs a weighted sum of the indicators to form the latent variables (Chin, 1998).

Before constructing the path analysis and results from the structural model, the quality of the measurement model needs to be considered. Individual item reliability was evaluated using the standard criterion of factor structure coefficients greater than 0.7.

Table 10 presents the remaining item loadings and weights obtained from the model. Examining the weights and loadings for each of the 7 constructs, 32 of the items had loadings of 0.70 or higher whereas 4 items had loadings of at least .60, and 2 items had loadings below .6.

In the development of the path model the original data set was used. The intent was to confirm the findings of the factor analysis in support of the second research question and therefore included all the factors tested in the original survey. While self-efficacy did not emerge as a factor in the factor analysis it was included in the factor analysis to reconfirm the findings of the factor analysis. The relationship between the constructs of behavioral intention and use was not tested in the factor analysis and the measurement model was needed for those constructs in order to complete the path analysis.

Table 10

*Path Weights*

	ANX	AT	BI	EE	FC	PE	SE	SI	Use
<b>AT26</b>		0.75							
<b>AT27</b>		0.75							
<b>AT28</b>		0.82							
<b>AT29</b>		0.76							
<b>AT30</b>		0.84							
<b>AX40</b>	0.89								
<b>AX41</b>	0.72								
<b>AX42</b>	0.81								
<b>AX43</b>	0.86								
<b>BI31</b>			0.84						
<b>BI32</b>			0.68						
<b>BI33</b>			0.75						
<b>BI35</b>			0.86						
<b>EE19</b>				0.76					

<b>EE20</b>	0.79		
<b>EE21</b>	0.80		
<b>EE22</b>	0.82		
<b>EE23</b>	0.78		
<b>EE24</b>	-0.69		
<b>EE25</b>	-0.74		
<b>FC10</b>	0.74		
<b>FC7</b>	0.75		
<b>FC8</b>	0.61		
<b>FC9</b>	-0.88		
<b>PE11</b>	0.83		
<b>PE12</b>	0.75		
<b>PE13</b>	0.86		
<b>PE14</b>	0.84		
<b>PE18</b>	0.66		
<b>SE36</b>		0.90	
<b>SE39</b>		0.59	
<b>SI1</b>			0.80
<b>SI2</b>			0.81
<b>SI3</b>			0.85
<b>SI4</b>			0.83
<b>SI5</b>			0.73
<b>Dur</b>			-.688
<b>Freq</b>			.799
<b>Int</b>			.449

Note: Dur, Freq, and Int, are abbreviations for Duration, Frequency, and Intensity of Use

Next, the composite reliabilities of latent constructs are reviewed to ensure that the measures have minimized the occurrence of random error. The composite reliabilities of the seven factors were all greater than 0.70, except for the construct of Facilitating Conditions. Discriminate validity indicates the extent to which latent constructs are different from each other and measure distinct concepts (Rivard, Poirier, Raymond, & Bergeron, 1994). This can be tested with the AVE (Average Variance Extracted) statistic. The composite reliability of each scale and measurement model fell in the range between 0.56 and 0.68. The limit for acceptable reliability is .60 as recommended by

Fornell and Larcker (1981), and only three of the constructs have values slightly below this threshold: Effort Expectancy, Facilitating Conditions, and Self-efficacy. Composite reliability offers evidence that the measures used are internally consistent and exhibit satisfactory reliability (Table 11).

The most important interest of the researcher in analyzing the structural model after ensuring a reliable and valid measurement model has two components. The first is to investigate the independent constructs, and the second is to study the size and significance of the path coefficients (Beta weights). The values are indicative of the amount of variance in the dependent (latent) variable that is being explained by the independent variables of model. Facilitating Conditions and Social Influence are two constructs that have an  $R^2$  of less than 0.2, and this suggests improvements in the model may be required.

Table 11

*PLS Statistics of Latent Constructs*

	AVE	Composite Reliability	$R^2$	Cronbach's Alpha	Communality	Redundancy
<b>Anxiety</b>	.68	.89	.30	.84	.68	.18
<b>Attitude</b>	.62	.89	.60	.84	.62	.37
<b>Behavioral Intention</b>	.62	.86	.30	.79	.62	.19
<b>Effort Expectancy</b>	.59	.69	.45	.39	.59	.25
<b>Facilitating Conditions</b>	.56	.47	.02	.20	.56	.01
<b>Performance Expectancy</b>	.63	.89	.48	.85	.63	.29
<b>Self-efficacy</b>	.58	.73	.23	.32	.58	.13
<b>Social Influences</b>	.65	.90	.12	.87	.65	.07

As previously noted the path coefficients in a PLS model are analogous to standardized regression coefficients (beta weights), and the loading of items on the



constructs are the same as factor structure coefficients. All variables are placed in the diagram, either in boxes or ovals. The independent variables have arrows pointing to the dependent variable. The manifest variables are referenced in boxes in the path diagram, and the latent variables are placed in ovals.

### *Interpretation of the Path Model*

The interpretation of the path analysis is based on a few guidelines. There should be at least three manifest variables for each latent variable. For the present data, the path diagram (Figure 9) has only one latent variable (Self-efficacy) that has only two manifest variables. In the path diagram, the path loadings above the arrows between items and manifest variables should be  $\geq .55$ . This criterion is found in the constructs of Social Influences, Effort Expectancy, Performance Expectancy, Attitude, Anxiety, Facilitating Conditions, and Behavioral Intention. The two measures of system use (duration, and frequency,) are  $\geq .55$ , and intensity is .449. The  $R^2$  or variance explained for endogenous variables should be  $\geq .10$  and this is the case for the constructs of Social Influences, Effort Expectancy, Performance Expectancy, Attitude, Anxiety, and Behavioral Intention. The construct of Facilitating Conditions has a negligible variance of 0.017 and explains a small amount of the variance for system use, but Behavioral Intention explains 30.1% of the variance of system use ( $R^2 = .304$ ).

Individual item reliability was acceptable for all items ( $>0.70$ ) that clustered to form the latent variables of Social Influences (SI), Attitude (AT), Anxiety (ANX), and Facilitating Conditions (FC). The following constructs had one or two items below the 0.70 threshold, but above 0.6: Effort Expectancy (one item 0.689), Performance

Expectancy (one item at 0.664), Self-efficacy (but one of two items was 0.689, and one item was .614).

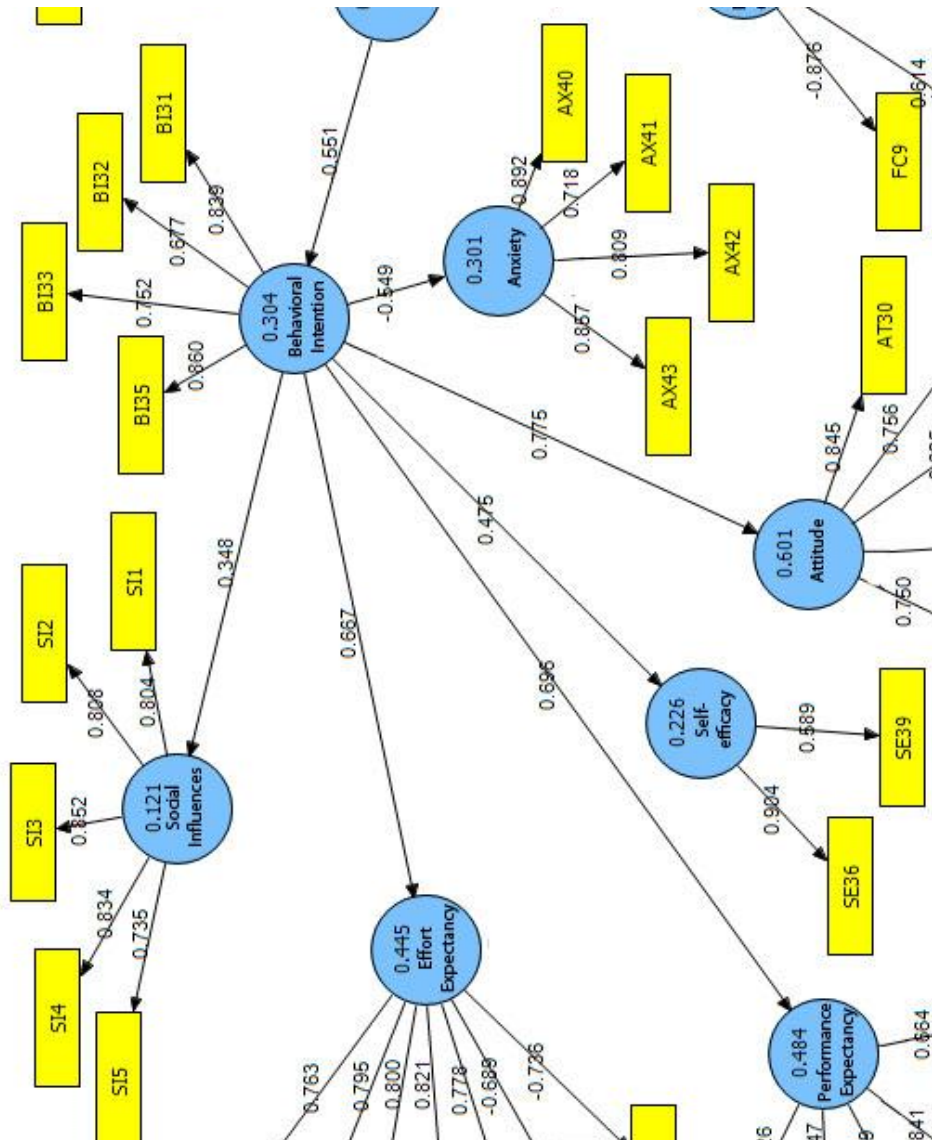


Figure 9. The path model.

The research model explained the amount in variance of the latent variables in the following categories:

Latent Variables (UTAUT Model) as related to Behavioral Intention:

48.4% of the variance in Performance Expectancy ( $R^2=0.484$ );

44.5% of the variance in Effort Expectancy ( $R^2=0.445$ );

12.1% of the variance in Social Influence ( $R^2=0.121$ );

Latent Variables (TPB Model) as related to Behavioral Intention:

22.6% of the variance in Self-efficacy ( $R^2=0.226$ );

60.1% of the variance in Attitude ( $R^2=0.60$ );

30.1% of the variance in Anxiety ( $R^2=0.301$ );

Latent variables (UTAUT Model) as related to Use:

30.1% of the variance in Behavioral Intention, ( $R^2=0.301$ );

1.7% of the variance in Facilitating Conditions, ( $R^2=0.017$ ).

Composite reliability was strong, with internal consistency scores of data for the nine constructs ranging from 0.69 to 0.90; Facilitating Conditions was low at 0.47. The convergent validity was also strong, as measured by the average variance extracted (AVE) scores which are in excess of 0.5 for all constructs (Appendix I). The discriminate validity in the measurement model was acceptable because each item loaded most highly on the construct it was intended to measure (Table 9). The path weights for Attitude are all  $> .75$ , Anxiety are all  $> .71$ , Effort Expectancy are all  $> .69$ , Facilitating Conditions  $> .61$ , Performance Expectancy  $> .66$ , and Social Influence  $> .73$ . The five baseline hypotheses that originated with the UTAUT model were supported in the PLS analysis of the present study, and are presented in the path diagram in Figure 9.

### ***The Structural Model***

The structural model focused on the relationship between the identifiable constructs and the dependent variable of Behavioral Intention (BI). The relationships

were measured by beta values. The strength of the relations is based upon the beta value according to the following categories:  $\beta < 0.2$  is a weak effect,  $\beta$  between 0.2 and 0.5 is a moderate effect,  $\beta > .5$  is a strong effect (Chin et al., 2003, Cohen, 1977).

Table 12

*Path Relationships*

<b>Path Relationship</b>	<b><math>\beta</math></b>	<b>p</b>	<b>Strength</b>
Attitude → Behavioral Intention	.775	< .001	strong
Anxiety → Behavioral Intention	-.549	< .001	strong
Effort Expectancy → Behavioral Intention	.667	< .001	strong
Performance Expectancy → Behavioral Intention	.698	< .001	strong
Social Influences → Behavioral Intention	.348	< .001	moderate
Facilitating Conditions → Use	-.130	.163	weak
Behavioral Intention → Use	.561	< .001	strong
Self-efficacy → Behavioral Intention	.475	removed	

*Effect of the Moderators' Results*

A review of the literature relating to the definitions and role of moderators shows a high degree of variability because the use of moderators is a relatively new technique. Despite this discussion, many researchers agree that the presence of a moderator modifies the strength of the relationship between two constructs. The moderator affects the strength of the relationship through \_\_partitioning the total sample into homogeneous subgroups with respect to the error variance\_\_ (Sharma, Durand, & Gur-Arie, 1981, p. 292). Venkatesh et al. (2003) found four moderators (gender, age, voluntariness, and experience) that have a significant impact on the constructs of the UTAUT. Hence, it was hypothesized in the present study that the relationship between the independent constructs and Behavioral Intention would be influenced by moderators.

*Testing for Moderation Effects*

A feature of Smartpls is the ability to test the obtained relationships for possible moderator effects. It was of considerable interest to investigate whether relationships between each of the six independent factors and the dependent factor of behavioral intention were affected by any moderators. The latent variable identified as self-efficacy is not included in the following discussion due to the limited number of items that measure that construct.

To create a moderator construct, the indicator variables of the predictor and moderator constructs are used to generate new product indicators. These new product terms measure the created interaction term in a reflective measurement model as presented in Figure 10. The new product indicators should be statistically significant, and while the main interaction may have been statistically significant, it is the moderator interactions that were of interest in this analysis.

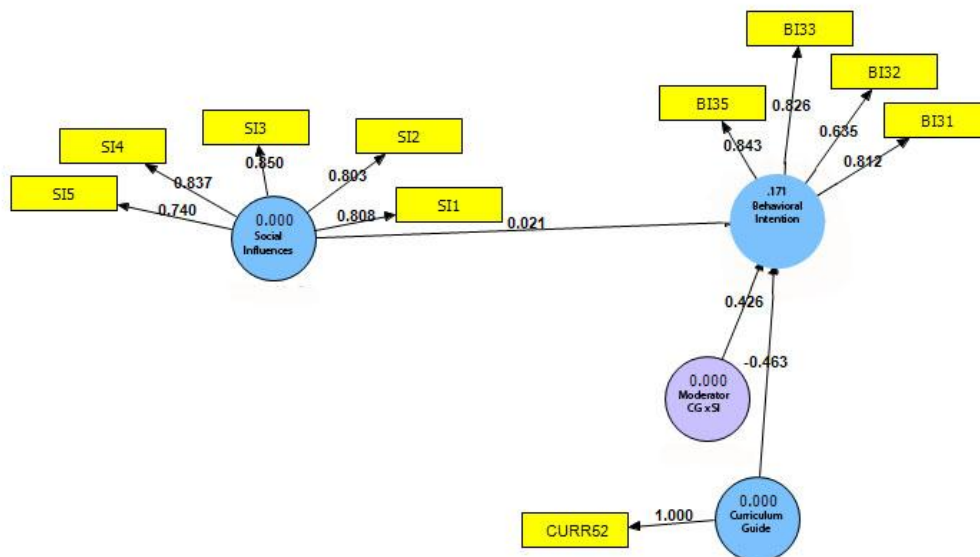


Figure 10. The moderating effect of a curriculum guide on the relationship of Social Influence and Behavioral Intention.

The moderators that have been tested have originated in the UTAUT model (gender, experience, age, and voluntariness). Voluntariness has been identified in this research as a result of institutional policies that include the presence of a technology plan, a curriculum guide that includes technology use, and an annual evaluation that incorporates technology use by teachers. The results of each of the hypothesized moderators are discussed in the following sections. The statistics that describe the moderating effect include the average variance extracted (AVE) that represents the shared variance, composite reliability, beta weights, and  $R^2$ . These values are presented for each product term that represents a moderating effect. With respect to the properties of interaction constructs, the relationships are measured by the beta values, which represent the strength of the relationship. The item loadings should exceed the threshold of 0.49 according to Chin et al., 2003.

The beta for the interaction of the moderator with the construct provides information regarding the interaction effect. The beta coefficient represents the standardized regression coefficient. The beta values indicate the importance of the impact of the moderator. In the following tables the beta value of interest is the interaction between the moderator and the construct. For example, in Table 13, the interaction of the presence of a technology plan on attitude is labeled as ATT x Tech. The values should not be less than 0.1 and if they go beyond 1 there is the sign of multicollinearity. According to Cohen (1977) the following beta values indicate the effect size of the interaction according to the following scale if the beta value is between 0.10 and 0.30 there is a small effect, if the value is between 0.30 and 0.50 there is a medium effect,

and if the beta value is above 0.50 there is a large effect. A small beta value denotes a lower influence of the moderator on the construct.

***The moderating effects of a technology plan that includes technology use***

Average variance extracted (AVE) was proposed by Fornell and Larcker (1981) as a measure of the shared variance in a latent variable. AVE is a measure of the error-free variance of a set of items, and AVE is used as measure of convergent validity. The AVE (and shared variance) decreases for Effort Expectancy, Attitude, Anxiety, and Performance Expectancy with the inclusion of technology plan. The inclusion of a technology plan improves the AVE (and shared variance) for Social Influences. Internal consistency was assessed by means of the Cronbach alpha coefficient, and each of the product factors had an acceptable Cronbach alpha (Table 13).

According to the beta values, technology plan had a negligible effect on Attitude ( $\beta = -.001$ ), Anxiety ( $\beta = .011$ ), and a weak effect on Effort Expectancy ( $\beta = -.037$ ) Performance Expectancy ( $\beta = .057$ ), and Social Influences ( $\beta = -.029$ ).

Scores on all used scales can be considered as reliable, with Cronbach's alphas (0.80 and above) and composite reliabilities (0.88 and above) higher than the advocated value of 0.7 (Fornell & Larcker, 1981). All scales load high on convergent validity, with average variance extracted (AVE) scores of 0.68 and above which are higher than the acceptable level of 0.50. All t-values indicated statistically non-significant interactions between the moderator defined as the inclusion of a technology plan and the independent variables.

Table 13

*The Moderating Effects of a Technology Plan*

	AVE	Composite Reliability	Cronbach's Alpha	Communality	Beta	Sig
<b>ATT</b>	.617	.89	.84	.617	.510	.00**
<b>ATT x Tech Plan</b>	.113	.02	.83	.113	-.001	.98
<b>ANX</b>	.676	.89	.84	.676	-.096	.07
<b>ANX x Tech Plan</b>	.646	.87	.83	.646	.011	.85
<b>EE</b>	.593	.69	.39	.593	.106	.14
<b>EE x Tech Plan</b>	.525	.65	.34	.525	-.037	.67
<b>PE</b>	.537	.87	.81	.537	.121	.11
<b>PE x Tech Plan</b>	.496	.84	.81	.496	.057	.45
<b>SI</b>	.652	.90	.87	.652	.150	.00**
<b>SI x Tech Plan</b>	.662	.91	.87	.662	-.029	.59

Note: PE = Performance expectancy, ATT= Attitude, SE=Self-efficacy, ANX= Anxiety, BI = Behavioral Intention, EE=Effort Expectancy, SI= Social Influences, CG = Curriculum Guide

\* p < .05 \*\* p < .01

### *The moderating effects of a curriculum guide that includes technology use*

It can be seen in Table 14 that the inclusion of a curriculum guide that includes technology skills a decrease in the AVE (and shared variance) for Attitude, Anxiety, Effort Expectancy, Performance Expectancy and Social Influences. Scores on each of the product factors had acceptable composite reliability. According to the beta values, curriculum guide had a negligible effect on Anxiety ( $\beta = .001$ ), a weak effect on Attitude ( $\beta = .038$ ), Effort Expectancy ( $\beta = .020$ ) Performance Expectancy ( $\beta = .070$ ), Social Influences ( $\beta = -.058$ ).

There is one significant interaction between the moderator defined as the inclusion of a curriculum that includes technology use and the independent variables. The inclusion of a curriculum guide that addresses technology use ( $p = .034$ ) has a statistically significant moderating influence of the relations between Social Influences and Behavioral Intention, with a slight decrease in AVE and a negative correlation coefficient ( $\beta = -.058$ ), indicating that a curriculum guide that includes technology activities will reduce the effect of Social Influences on a teacher's Behavioral Intention



to develop curricular activities that require the use of technology by the students (Figure 10).

Table 14

*The Moderating Effects of a Curriculum Guide*

	AVE	Composite Reliability	Cronbach's Alpha	Communality	Beta	Sig
ATT	.617	.889	.845	.617	.478	.00
ATT x CG	.582	.873	.835	.582	.038	.64
ANX	.676	.892	.840	.676	-.111	.08
ANX x CG	.667	.889	.872	.667	.001	.98
EE	.593	.693	.390	.593	.110	.18
EE x CG	.561	.644	.401	.561	.020	.78
PE	.537	.868	.812	.537	.104	.21
PE x CG	.357	.685	.822	.357	.070	.40
SI	.652	.903	.873	.652	.191	.00
SI x CG	.587	.878	.833	.588	-.058	.03*

Note: PE = Performance expectancy, ATT= Attitude, SE=Self-efficacy, ANX= Anxiety, BI = Behavioral Intention, EE=Effort Expectancy, SI= Social Influences, CG = Curriculum Guide. \* p < .05 \*\* p < .01

***The moderating effects of an annual evaluation that includes technology use***

It can be seen in Table 15 that the inclusion of an evaluation that includes technology use improves the AVE for Anxiety, Effort Expectancy, and Performance Expectancy. The AVE decreases for Attitude and Social Influences with the inclusion of annual evaluation. Each of the product factors has an acceptable composite reliability. According to the beta values, an annual evaluation had a negligible effect on Anxiety ( $\beta = -.011$ ), and Performance Expectancy ( $\beta = -.012$ ), and a weak effect on Attitude ( $\beta = .026$ ), Effort Expectancy ( $\beta = -.024$ ) and Social Influences ( $\beta = .082$ ). There were no significant moderator interactions due to the presence of an annual evaluation that includes technology use.

Table 15

*The Moderating Effects of Annual Evaluation*

	AVE	Composite Reliability	Cronbach's Alpha	Communality	Beta	Sig
<b>ATT</b>	.617	.889	.845	.617	.510	.00
<b>ATT x Eval</b>	.616	.888	.851	.616	.026	.66
<b>ANX</b>	.676	.892	.840	.676	-.096	.09
<b>ANX x Eval</b>	.690	.898	.846	.691	-.011	.85
<b>EE</b>	.593	.696	.390	.593	.088	.26
<b>EE x Eval</b>	.599	.672	.386	.599	-.024	.84
<b>PE</b>	.537	.868	.812	.537	.228	.36
<b>PE x Eval</b>	.685	.928	.908	.685	-.012	.73
<b>SI</b>	.652	.903	.873	.652	.114	.01
<b>SI x Eval</b>	.569	.865	.847	.569	.082	.21

Note: PE = Performance Expectancy, ATT= Attitude, SE=Self-efficacy, ANX= Anxiety, BI = Behavioral Intention, EE=Effort Expectancy, SI= Social Influences, CG = Curriculum Guide

\* p < .05 \*\* p < .01

### *The moderating effects of teaching experience*

It can be seen in Table 16 that the inclusion of a teaching experience as a moderator improved the AVE for anxiety. The constructs that have a decrease in the AVE as a result of teaching experience are the constructs of Attitude, Performance Expectancy, Social Influences, and Effort Expectancy. Each of the product factors has an acceptable composite reliability. According to the beta values, teaching experience had a weak effect on Attitude ( $\beta = .132$ ), Anxiety ( $\beta = -.065$ ), Effort Expectancy ( $\beta = -.099$ ), Performance Expectancy ( $\beta = -.040$ ), and Social Influences ( $\beta = .036$ ). There are no significant interactions between the moderator defined as teaching experience and the independent variables.

Table 16

### *The Moderating Effects of Teaching Experience*

	AVE	Composite Reliability	Cronbach's Alpha	Communality	Beta	Sig
<b>ATT</b>	.617	.889	.845	.617	.536	.00
<b>ATT x Exp</b>	.546	.854	.872	.546	.132	.09

<b>ANX</b>	.676	.892	.840	.676	-.087	.11
<b>ANX x Exp</b>	.687	.894	.842	.687	-.065	-.22
<b>EE</b>	.593	.693	.390	.593	.083	.26
<b>EE x Exp</b>	.579	.717	.353	.571	-.099	.26
<b>PE</b>	.537	.868	.812	.537	.136	.04*
<b>PE x Exp</b>	.481	.845	.797	.481	-.040	.50
<b>SI</b>	.652	.903	.873	.652	.149	.00*
<b>SI x Exp</b>	.590	.872	.846	.590	.036	.49

Note: PE = Performance expectancy, ATT= Attitude, SE=Self-efficacy, ANX= Anxiety, BI = Behavioral Intention, EE=Effort Expectancy, SI= Social Influences, CG = Curriculum Guide

\*  $p < .05$  \*\*  $p < .01$

### *The moderating effects of gender*

It can be seen in Table 17 that the inclusion of gender as a moderator decreases the AVE for Attitude, Effort Expectancy, Anxiety, Performance Expectancy, and Social Influences. Scores on each of the product factors had an acceptable composite reliability. According to the beta values, gender had a negligible effect on Attitude ( $\beta = -.008$ ) and Social Influences ( $\beta = -.008$ ); and a weak effect on Anxiety ( $\beta = -.085$ ), Effort Expectancy ( $\beta = -.022$ ), and Performance Expectancy ( $\beta = -.034$ ). There are no statistically significant interactions between the moderator defined as gender and the independent variables.

Table 17

### *The Moderating Effects of Gender*

	AVE	Composite Reliability	Cronbach's Alpha	Communality	Beta	Sig
<b>ATT</b>	.617	.889	.845	.617	.163	.00
<b>ATT x Gender</b>	.346	.665	.835	.346	-.008	-.69
<b>ANX</b>	.676	.892	.840	.676	-.083	.12
<b>ANX x Gender</b>	.645	.870	.820	.645	-.085	.17
<b>EE</b>	.593	.693	.390	.593	.110	.14
<b>EE x Gender</b>	.344	.128	.385	.344	-.022	.77
<b>PE</b>	.537	.868	.812	.537	.118	.11
<b>PE x Gender</b>	.529	.857	.813	.529	-.034	.71

<b>SI</b>	.652	.903	.873	.652	.163	.00
<b>SI x Gender</b>	.623	.891	.865	.623	-.008	.9

Note: PE = Performance expectancy, ATT= Attitude, SE=Self-efficacy, ANX= Anxiety, BI = Behavioral Intention, EE=Effort Expectancy, SI= Social Influences, CG = Curriculum Guide

\*  $p < .05$  \*\*  $p < .01$

### *The moderating effects of technology experience*

It can be seen in Table 18 that the inclusion of technology experience as a moderator improves the AVE (and shared variance) for Anxiety, Performance Expectancy, and Effort Expectancy. The AVE (and shared variance) decreased slightly for Attitude and Social Influences with the inclusion of technology experience. Each of the product factors has an acceptable composite reliability. According to the beta values, technology experience had a weak effect on Attitude ( $\beta = -.068$ ), Anxiety ( $\beta = -.116$ ), Effort Expectancy ( $\beta = .035$ ), Performance Expectancy ( $\beta = .039$ ), and Social Influences ( $\beta = .058$ ). There are no significant interactions between the moderator defined as technology experience and the independent variables.

Table 18

### *The Moderating Effects of Technology Experience*

	AVE	Composite Reliability	Cronbach's Alpha	Communality	Beta	Sig
<b>ATT</b>	.617	.889	.845	.617	.494	.00**
<b>ATT x T Exp</b>	.597	.879	.845	.597	-.068	.44
<b>ANX</b>	.676	.892	.840	.676	-.083	.09
<b>ANX x T Exp</b>	.720	.908	.872	.720	-.116	.08
<b>EE</b>	.593	.692	.390	.593	.091	.23
<b>EE x T Exp</b>	.610	.750	.395	.610	.035	.69
<b>PE</b>	.537	.867	.812	.537	.140	.07
<b>PE x T Exp</b>	.552	.865	.840	.552	.039	.65
<b>SI</b>	.652	.903	.873	.652	.162	.00**
<b>SI x T Exp</b>	0.636	0.895	0.8647	0.636	.058	.52

Note: PE = Performance expectancy, ATT= Attitude, SE=Self-efficacy, ANX= Anxiety, BI = Behavioral Intention, EE=Effort Expectancy, SI= Social Influences, CG = Curriculum Guide

\*  $p < .05$  \*\*  $p < .01$

In the present study moderators did not have a major influence on the relationships between the independent variables and the dependent variable of behavioral intention. Several of the moderators did increase the shared variance of the independent variable on behavioral intention. In addition, several of the moderators did result in a weak effect on the relationship between the independent variables and behavioral intention. The literature review by Chin et al. suggested researchers often reported moderators with a small effect size, beta averaging 0.10, suggesting that the moderating terms play only a small part in understanding information systems issues. The only moderator that had a statistically significant effect was the presence of a curriculum guide on the relationship between social influence and behavioral intention. In their study human capital management policies, Bontis and Serenko (2007) found no interaction effects of management policies and other constructs in terms of a moderator analysis. They concluded that measurement error may have occurred because the survey instrument, that used a Likert scales, may not be suitable for every sub-group of the sample. Others (Thong, Venkatesh, Xu, Hong, & Tan, 2011; Venkatesh et al., 2003) measured the items using a seven-point Likert scale. Further investigation in to the effect of moderators is required.

### *Summary*

Chapter Four has presented the results of the analysis of the data. The first CFA yielded nine factors that could be identified. The results indicated that three items needed to be removed. A second CFA II was run after some items were removed. Six factors were identified, and an additional two items did not load on any factor. A factor analysis was run a third time (CFA III), selecting six factors to arrive at the strongest model.

Social Influences, Effort Expectancy, and Anxiety had the strongest structural coefficients also in this model. Anxiety proved to be a very strong factor in the CFA III, and three of the items that measured Anxiety had factor structure coefficients above 0.8. Effort Expectancy (EE) proved to be a strong factor in the CFA III. All six of the items intended to measure EE are salient with factor 4, and all were above 0.5. Social Influences (SI) was a very strong factor in the final CFA III. There were five items that measured SI, and all five factors are salient with a single factor with structure coefficients above 0.6. The factors that have a more moderate strength are Performance Expectancy, Attitude, and Facilitating Conditions. Performance Expectancy (PE) proved to be a moderate to strong factor. All four PE items are salient with Factor 3, and all four factors were above 0.5 and two of the items were above 0.70. Attitude (ATT) proved to be a moderate to strong factor. All of the items that measured ATT were salient with the same factor. All four correlations were above 0.4, but two of those four were correlated above 0.7. Facilitating Conditions proved to be a moderate to strong factor in the CFA III. All four of the FC items measuring Facilitating Conditions are salient with the same factor. All four factors were above 0.5, and two of the items were above 0.70. Self-efficacy (SE) did not prove to be an interpretable construct in the final confirmatory analysis and was removed from the model.

The path analysis was accomplished with PLS analysis producing a measurement model and a structural model. The measurement model included path loadings analogous to factor structure coefficients in the CFA III. The path loadings support the conclusions found with the factor analysis. All constructs that emerged in the path measurement model had a composite reliability above .60, except for Facilitating Conditions.

The second step in the path analysis was to develop a structural model. The structural model identified the strength of the relationships between the independent constructs and Behavioral Intention. The constructs having the strongest relationship with Behavioral Intention, and hence, having a stronger effect were Attitude ( $\beta=.775$ ,  $p < .001$ ), Performance Expectancy ( $\beta=.698$ ,  $p < .001$ ), and Effort Expectancy ( $\beta=.667$ ,  $p < .001$ ). The structural model also supports that Behavioral Intention is strongly related to actual Use ( $\beta=.561$ ,  $p < .001$ ). The construct of Facilitating Conditions had a weak and negative relationship with Use ( $\beta=-.131$ ,  $p = .16$ ). In terms of a moderator analysis, few interaction effects of the moderators and the independent constructs were discovered. The only interaction that was found to be statistically significant was the interaction between Social Influences and the use of a curriculum plan that includes technology skills ( $p < .05$ ). The absence of statistically significant effects of the moderators on the relationships between the independent latent variables and behavioral intention would suggest further research is needed. Chapter Five presents a discussion of the results that have been presented in Chapter Four.

## CHAPTER FIVE: SUMMARY, DISCUSSION AND RECOMMENDATIONS

Chapter Five includes the summary and discussion of the results presented in Chapter Four. Each of the research questions, and the findings relative to each question, are presented. The relationships confirmed in the present study are presented in a diagram of the final model. The chapter concludes with recommendations for practice and future research in the area.

The three major changes in technology (i.e., computer applications, computer-based curriculum materials, and the Internet) have developed during the career of many practicing teachers. Unfortunately, many teachers have not maintained their skills along with the technological changes and do not integrate modern technology. School administrators often supported technology integration but only emphasized invention and innovation of new tools, neglecting the diffusion of the current technology. As a result of these trends, there has been limited acceptance of technology use by public school teachers in their classrooms, especially when it comes to developing activities that require students to use technology. Teachers reported that their students used computers in the school often (29%), or sometimes (43%), or not at all (28%; Gray et al., 2010). Private school students are more likely than public school students to use computers at home (76% compared to 66%), but public school students are more likely to use computers and the Internet at school (85% compared to 71%; Debell & Chapman, 2006). There is research that supports the level of technology use, but there is limited research



that has applied a unified approach towards factors that may affect a teacher's perceptions towards technology integration.

The present study was focused on the behavioral intention of teachers to develop curriculum projects that require students to use technology. Behavior intention has been determined to be an important indicator of the final use of technology (Alshare et al., 2009; Venkatesh et al., 2003). The present study adapted the UTAUT model (Venkatesh et al., 2003) along with components of the TPB model (Ajzen, 1991) for use in a secondary educational setting. An important purpose of the present study was to investigate the factors that influence teacher behavioral intention to integrate technology, specifically the relationships among the factors that may affect a teacher's decision to develop curriculum activities in which students integrate technology. The analysis included factor analysis to ascertain the latent variables and partial least squares analysis to confirm the measurement model and to develop a path model.

Several researchers have investigated the factors that affect the behavioral intention to use technology by members of an organization (Davis et al., 1992; Venkatesh & Davis, 2000). Because the present research investigated the behavioral intention of teachers to use technology with their students, the work of Venkatesh et al. (2003) was applicable. Venkatesh et al. (2003) combined several models into the Unified Theory of Acceptance and Use of Technology (UTAUT) that incorporated factors found in earlier models. In the present study, an adapted variation of the UTAUT model was applied in an education setting in order to test the ability of the model to predict teacher behavioral intention to have students use technology. The adapted UTAUT model measured the influence of seven latent variables on the Behavioral intention of a teacher to use

technology in the classroom. The model consists of the following constructs: Social Influence, Facilitating Conditions, Performance Expectancy, and Effort Expectancy from the UTAUT model, and Attitude, Anxiety, and Self-efficacy from the TPB model. The relationship between behavior intention of the teacher and technology use was also tested. The data also determined within the given sample whether the correlations among key constructs are moderated by gender, teaching experience, technology experience, or the voluntariness of technology use. Because behavioral intention has been reported to be a good predictor of use, the relationship between behavioral intention and actual use was also investigated in this study to confirm the relationship in an educational setting. *Use* was defined as the implementation of activities into the curriculum by the teachers that require student use of technology. The study was designed to be a quantitative research study. The design included data collection via a survey instrument, determination of constructs through factor analysis, and determination of the path model using partial least squares.

### **Summary of the Findings**

Of the teachers who completed the survey, the majority were female (64.4%), taught in high school (78.5%), and had less than 20 years of experience (74.3%). Even though technology has been available in schools for decades, 37.5% of the teachers sampled had been implementing activities that require students to use technology only one to four years, and 6% of the respondents had not integrated technology activities (Table 1), confirming a minimal use of technology in those classrooms. The majority of teachers implemented projects that require student use of technology with a frequency of only once a quarter, for a duration of 2-3 class periods, and was of such intensity that the

majority of teachers relied on the technology skills the students already have developed. This may indicate that the teachers only implement projects that require basic skills that the students already have developed, and therefore have minimum impact on increasing student competencies with technology.

The factor analysis was completed using confirmatory factor analysis in three trials. The model was refined with each progressive trial by removing items and reducing factors. In the final CFA III, the six factors retained represented 71% of variance in Behavioral Intention. In the final factor analysis (CFA III), three factors proved to be very strong factors (Social Influences, Effort Expectancy, and Anxiety). The factors are discussed in relation to the research questions below. The last step in the present analysis was the development of a measurement model and a structural model using PLS.

Four questions were addressed in the present study, and the results for each question are addressed in this section.

*1. Can interpretable constructs be obtained when responses from a sample of private school secondary teachers on the school-based version of the UTAUT are inter-correlated and factor analyzed using R-technique confirmatory factor analysis?*

Confirmatory factor analysis was used to analyze the data and to determine whether there were identifiable constructs. The analysis was completed in three attempts to determine the strongest model. The confirmatory factor analysis supported the research model by clustering the survey items into six latent variables. The success of the model to identify the factors suggests that the present research model is adaptable to educational settings and has identified several factors related to the Behavioral Intention of teachers to integrate technology. Each factor has been discussed individually below.

*a. Is the construct of Social Influence significantly related to the Behavioral intention of the teacher to implement curriculum activities that require students to use technology?*

Social Influences ( $\alpha=.85$ ) proved to be a very strong factor in the CFA III. In the present research survey, five items were intended to measure Social Influences, and all five of the items are salient with a single factor and all the factor structure coefficients were above 0.6. In the path analysis, the relationship between Social Influence and Behavioral Intentions was moderate and statistically significant ( $\beta=.378$ ,  $p<.001$ ).

*b. Is the construct of Facilitating Conditions significantly related the Behavioral Intention of the teacher to implement curriculum activities that require students to use technology, or will it be significantly related to use?*

Facilitating Conditions ( $\alpha=.72$ ) proved to be a moderate to strong factor in the final factor analysis. There were four items on the survey intended to measure Facilitating Conditions and all four are salient with the same factor. The strength of the factor is moderate because while two of the factors had factor structure coefficients above .70, two of the remaining structure coefficients were between .5 and .6, making this an interpretable construct (Stevens, 2002). In the path analysis, Facilitating Conditions was negatively associated with a weak effect on *use*, and the relationship between Facilitating Conditions and Behavioral Intention was not statistically significant ( $\beta = -0.131$ ,  $p = 0.14$ ).

*c. Is the construct of Effort Expectancy significantly related to the Behavioral Intention of the teacher to implement curriculum activities that require students to use technology?*

Six items from the survey were intended to measure Effort Expectancy and all six are salient with the same factor. Effort Expectancy ( $\alpha=.83$ ) was considered a strong factor, as all six had factor structure coefficients above 0.5 (Stevens, 2002). In the path analysis, the relationship between Effort Expectancy and Behavioral Intention was statistically significant and positively associated with a strong effect on Behavioral Intention ( $\beta = 0.667, p<.001$ ).

*d. Is the construct of Performance Expectancy significantly related to the Behavioral Intention of the teacher to implement curriculum activities that require students to use technology?*

Performance Expectancy ( $\alpha=.77$ ) turned out to be a moderately strong factor. Four of the items intended to measure Performance Expectancy are salient with the same factor. Two of the items loaded with a value of .7 while two were between .5 and .6. According to Stevens (2002), four factor structure coefficients above .6 (the average) yielded an interpretable factor regardless of sample size. In the path analysis, Performance Expectancy was statistically significant and positively associated with a moderated effect on Behavioral Intention ( $\beta = 0.698, p<.001$ ).

*e. Is the construct of Attitude of the teacher toward teacher implementation of curriculum activities that require students to use technology significantly related to Behavioral Intention of the teacher to implement curriculum activities that require students to use technology?*

Attitude ( $\alpha=.85$ ) is a moderate factor because all four items are salient with the appropriate factor. While two strong items loaded above .7, two of the items had factor

structure coefficients above .4, which are weaker factor structure coefficients. In the path analysis, the relationship between Attitude and Behavioral Intention was statistically significant and positively associated with a strong effect on Behavioral Intention ( $\beta = 0.775, p < .001$ ).

*f. Is the construct of Self-efficacy of the teacher, concerning teacher implementation of curriculum activities that require students to use technology, significantly related to Behavioral Intention of the teacher to implement curriculum activities that require students to use technology?*

Self-efficacy ( $\alpha = .29$ ) as a construct was not retained in the final factor analysis. In CFA I there were 4 items intended to investigate Self-efficacy, and the 4 items were salient with two separate factors. In CFA II, of 4 items intended to measure Self-efficacy 2 items were salient with one factor and 2 items were not salient with any factor and removed in the final CFA. The items intended to measure Self-efficacy did not cluster on a single factor, and the Self-efficacy construct did not emerge as a construct in this analysis. In the path analysis, the relationship between Self-efficacy and Behavioral Intention was statistically significant and positively associated with a moderated effect on Behavioral Intention ( $\beta = 0.475, p < .001$ ). However, the construct is composed of only two items rendering the construct not acceptable.

*g. Is the construct of Anxiety toward teacher implementation of curriculum activities that require students to use technology significantly related to Behavioral Intention toward teacher implementation of curriculum activities that require students to use technology?*

Anxiety ( $\alpha=.80$ ) proved to be a very strong factor as identified in CFA III. The three items intended to measure Anxiety are salient with a single factor and all three had factor structure coefficients above .80, making a reliable construct (Stevens, 2002). In the path analysis, the relationship between Anxiety and Behavioral Intention was statistically significant and negatively associated with a strong effect on Behavioral Intention ( $\beta = -0.549, p<.001$ ).

*2. To what extent does the research model specifying path relationships among a series of predictor variables, Behavioral Intention, and technology use behavior fit actual perception data gathered from a sample of private school secondary teachers on the school-based version of the UTAUT?*

The data collected supports the premise behind the second research question. This research question was tested using partial least squares analysis employing Smartpls© software. The path relationships are determined by first establishing the measurement model that confirms the findings in the confirmatory factor analysis. In the development of the path model the three scales from the UTAUT model had reliabilities as measured by Cronbach's alpha above .7; however, Facilitating Conditions, Self-efficacy, and Effort Expectancy had Cronbach's alpha reliabilities below .70. The composite reliabilities of each of the constructs were acceptable ( $\alpha \geq .60$ ; Fornell & Larcker, 1981).

The average variance extracted (AVE) is a statistic that indicates discriminant validity indicating the constructs are different from each other. Of the eight constructs measured with the PLS, five were above .6, the acceptable reliability as recommended by Fornell and Larcker (1981). The other three constructs were only slightly below .6, but above

.56. The above results indicated that the PLS measurement model produced a measurement model that contained eight constructs that are different from each other. The  $R^2$  statistic indicates the amount of variance of the dependent variable explained by the independent variables, and a value of .2 is required. Attitude ( $R^2 = .60$ ), performance expectancy ( $R^2 = .48$ ) and Effort Expectancy ( $R^2 = .45$ ) were the measures that presented the greatest proportion of variability of the data set, and the model provided a measure of how well the research model may explain future outcomes.

The path coefficients of the structural model are the standardized regression correlations (beta weights) between the defined construct (independent variables) and Behavioral Intention (dependent variable). The beta weights above .50 represent a strong effect of the dependent variable on the independent variable (Behavioral Intention). The constructs that had a strong effect on the Behavioral Intention of a teacher to develop activities that require students to use technology were Attitude toward technology ( $\beta = 0.775$ ), Performance Expectancy ( $\beta = .698$ ), Effort Expectancy ( $\beta = 0.667$ ), and Anxiety toward technology use ( $\beta = -.549$ ). Anxiety was negatively related to Behavioral Intention. Two constructs had only a moderate effect on Behavioral Intention of teachers: Self-efficacy ( $\beta = .475$ ) and Social Influences ( $\beta = 0.348$ ). There were only two items retained for Self-efficacy in the measurement model and, therefore, the construct was not acceptable. Venkatesh et al. (2003) found that the construct of Facilitating Conditions did not have an effect on Behavioral Intention but did have a positive effect of the actual use of technology. In the present path analysis Facilitating Conditions was negatively associated with Use ( $\beta = -.131$ ), and the relationship was not statistically significant ( $p = .16$ ).



*3. Within the larger context of the research path model, to what extent does each predictor variable contribute to the Behavioral Intention to implement technology after the moderating effects of gender, teaching experience, technology experience, and policy are taken into consideration?*

Moderators are characteristics of the context of the data set. The moderators of interest in the present study are gender, teaching experience, technology experience, and policy. The policy moderators include the presence of a technology plan that includes technology use, a curriculum guide that includes technology use, and an annual teacher evaluation that includes technology use. Each of the listed possible moderators were tested against each of the latent variables. The statistics that describe moderators are average variance extracted (AVE), beta weights ( $\beta$ ), variance ( $R^2$ ), and Cronbach's alpha ( $\alpha$ ). Each of the moderators is discussed below.

There were six moderators tested in the present study; three that were found to be a statistically significant influence in the original UTAUT model and three characteristics were added whose moderating influences were tested. Although several statistics indicated an influence of the moderators, only one effect was statistically significant. The presence of curriculum guide that includes technology use had a statistically significant influence on the relationship between Social Influences and Behavioral Intention ( $p=.034$ ). Although the relationship is statistically significant, it accounts for only 2.9% of the variance.

Each of the six moderators was tested against each of the constructs in the model. AVE is a measure of the error-free variance of a set of items and needs to be above .6 to establish discriminant validity (Fornell & Larcker, 1981). In many cases the

AVE increased with the moderators included. The presence of a technology plan in a school increased the average variance extracted in the construct of Social Influences. The presence of an annual teacher evaluation that includes technology use in a school increased the average variance extracted in the constructs of Anxiety, Effort Expectancy, and Performance Expectancy. The presence of teaching experience increased only for Anxiety with the inclusion of teaching experience as a moderator. The inclusion of technology experience as a moderator improved the average variance extracted for Anxiety, Performance Expectancy, and Effort Expectancy.

Beta weights were used to compare two variables that are measured in different units. If the beta weight is positive, then there is a positive relationship between the independent constructs and the dependent variable of Behavioral Intention; and if the value is negative, then there is a negative relationship. The presence of a technology plan had a negative relationship with Attitude ( $\beta = -.001$ ) and Effort Expectancy ( $\beta = -.037$ ) but a positive relationship with Anxiety ( $\beta = .011$ ) and Performance Expectancy ( $\beta = .057$ ). The presence of a curriculum guide that included technology use had a negative relationship with Social Influence ( $\beta = -.058$ ), and Anxiety ( $\beta = -.111$ ). The curriculum guide had a positive relationship with Attitude ( $\beta = .038$ ), Performance Expectancy ( $\beta = .070$ ), and Effort Expectancy ( $\beta = .020$ ).

The inclusion of an annual evaluation that include technology use as a moderator had a positive relationship with Attitude ( $\beta = .026$ ) and Social Influence ( $\beta = .082$ ); however, there was a negative relationship with Anxiety ( $\beta = -.011$ ), Effort Expectancy ( $\beta = -.024$ ), and Performance Expectancy ( $\beta = -.012$ ).

The presence of a teaching experience that included technology use had a positive relationship with Social Influence ( $\beta = .036$ ) and Attitude ( $\beta = .132$ ), and a negative relationship with Anxiety ( $\beta = -.065$ ), Effort Expectancy ( $\beta = -.099$ ), and Performance Expectancy ( $\beta = -.04$ ).

According to the beta values, gender had a weak effect on Attitude ( $\beta = -.008$ ), Anxiety ( $\beta = -.085$ ), Effort Expectancy ( $\beta = -.022$ ), Performance Expectancy ( $\beta = -.034$ ), and Social Influences ( $\beta = -.008$ ).

*4. Within the larger context of the research path model, to what extent is Behavioral Intention to implement technology related to technology use behavior as specified by frequency, duration, and intensity of use behavior.*

Use is defined by Venkatesh et al. (2003) as the use of a particular technology by an individual. In the present study, use has been defined as *the development of curricular activities by teachers that require the student use of technology to access, manipulate, or present information*. According to the results of PLS measurement model, duration of use is negatively, and strongly, related to use indicating that as the duration of use increases the actual use will decrease ( $\beta = -.688$ ). The frequency of use is strongly related to actual use ( $\beta = .799$ ) indicating that increases in the frequency of use increases the actual use. Intensity of use is moderately related to actual use ( $\beta = .449$ ) indicating that as the complexity of the technology use increases the actual use also increases.

According to the PLS structure model, Behavioral Intention is positively associated with Use ( $\beta = .551$ ). This indicates that as Behavioral Intention increases then Use will increase as well. Behavioral Intention of the teacher represents 30.4% ( $R^2 = 0.30$ ) of the

variance in Use. Facilitating Conditions is negatively and weakly associated with Use ( $\beta=-.131$ ), indicating Facilitating Conditions have improved to such a degree to make the lack of access to technology less of a concern for teachers. Facilitating Conditions represents only 1.7% ( $R^2=0.017$ ) of the variance in Use.

In the present study the frequency of implementation of projects that require students to use technology are once a quarter (35.2%), once per week (22.3%), once per chapter (20.6%), once per semester (17.0%), or once per year (4.9%). When teachers implement technology projects the duration of the projects are: 2-3 class periods (46.6%), 1 class period (31.2%), 4-5 class periods (12.1%), or more than 5 periods (10.1%). The intensity of the projects in which students are required to use technology refers to the complexity of the project and 38.2% of the responses indicated that the project requires teaching of some technology skills, and 61.8% of the teachers rely on existing technology skills when implementing projects that require student to use technology. The model has shown that Behavioral Intention to implement technology is related to technology use behavior and frequency, duration, and intensity of use behavior are related to actual use.

To summarize, I have identified a robust model that identified 5 factors that have a relationship to the Behavioral Intention of a teacher to develop activities that require students to use technology. The survey instrument employed in this study successfully identified four constructs from the UTAUT model: social influences, effort expectancy, performance expectancy, and facilitating conditions. The survey instrument employed in this study successfully identified two constructs from the TPB model: attitude of the teacher toward technology, and anxiety of a teacher about technology. Self-efficacy

(TPB) was a construct that did not emerge as a latent variable represented by the survey items. From the path model, social influences, effort expectancy, performance expectancy, attitude, and anxiety have a statistically significant effect on the behavioral intention of a teacher to develop lessons that require students to use technology, and the construct of facilitating conditions did not have a statistically significant effect on the final use of technology. Figure 11 displays the relationships that emerged in the present study and includes the strength of the relationships, as measured by the beta statistic, between the constructs that emerged and behavioral intention of the a teacher to use technology with their students. Figure 11 also includes that amount of variance (R<sup>2</sup>) that the construct represents, as well as the composite reliability of the construct. In addition, the figure includes the only moderator that was statistically significant and that is the effect of a curriculum guide on the relationship between social influence and behavioral intention.

Most of the moderating effects of several characteristics of the teachers' influences on the relationships were not statistically significant; however, the method used identified the amount of variance extracted, the beta values, and the reliability of the measures. While the relationships were not statistically significant, that does not prove the null hypothesis. It may not be statistically significant because there was no interaction effect, or it may be because the model did not have enough statistical power (Henseler & Chin, 2010).

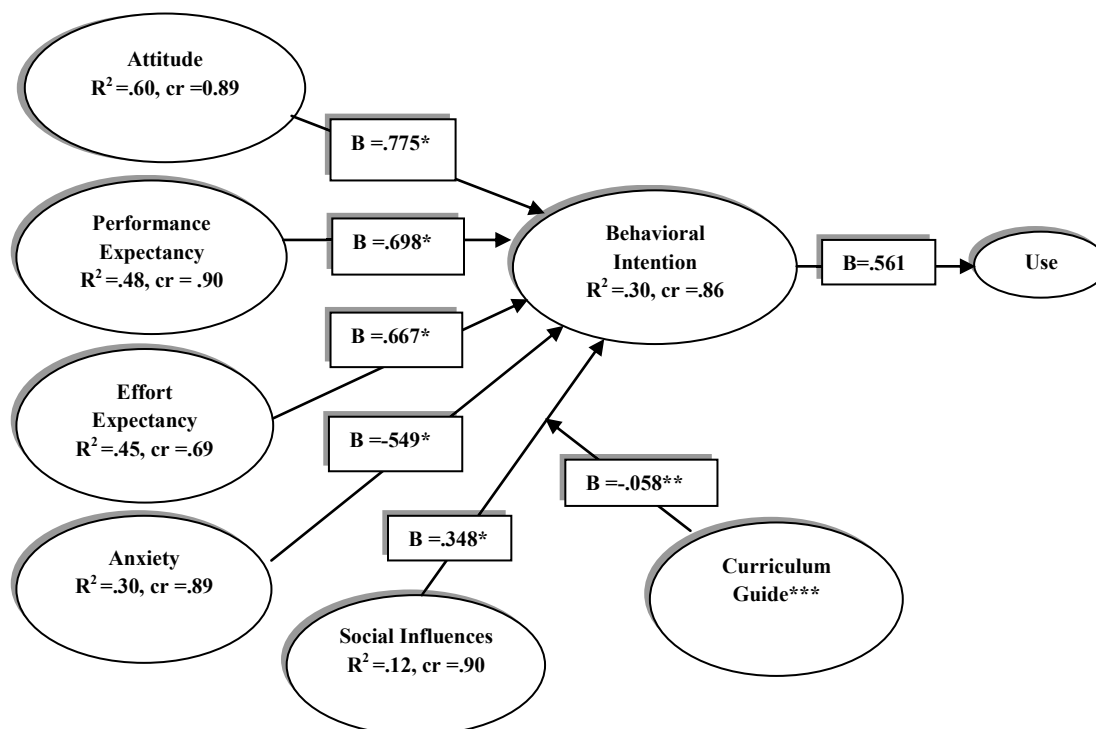


Figure 11: The model of the educational adaptation of the UTAUT  
 Note: cr = composite reliability, \*  $p < .001$ , \*\*  $p < .01$ , \*\*\*moderator

### The Importance of the Factors

The present study has provided information that can be useful for individuals interested in promoting the use of technology by students within the context of the curriculum. The knowledge offered by this study provides a better understanding of what factors influence a teacher to develop a project that requires students to collect, manipulate, or produce a product with the use of computer technology. In the following section each of the factors that emerged in the study has been discussed. There are three useful statistics that indicate the importance of the factor: the strength of the effect of the independent factor on the dependent factor of Behavioral Intention, the amount of variance that the factor accounts for, and the strength of the factor itself. The factors

have been discussed in order of the strength of their effect on the Behavioral Intention of the teacher.

### *Attitude toward Technology Use*

Attitude toward technology is defined as the individual's overall reaction to the use of a particular technology and has been tested in an educational setting in this research. Attitude was not included in the UTAUT model but was added to the present research because attitude was found to be a significant predictor of Behavioral Intention by others (Alshare et al., 2009; Christensen, 2002; Davis, 1989; Yang et al., 1999). In the path analysis of the present study, Attitude ( $\beta=0.775$ ) proved to have the strongest effect on Behavioral Intention and accounted for the greatest amount of variance in Behavioral Intention ( $R^2=.60$ ). Yet in the factor analysis Attitude proved to be only a moderate factor ( $\alpha=.85$ ). The results support the results of other researchers that have reported a relationship between teachers' attitude toward technology and the amount of technology they will use in the classroom (Chan Lin, 2007; Moore & Benbasat, 1991; Sugar et al., 2005). Attitudes are difficult to change (Rokeach, 1968) but are changeable if there is persuasion from an authority figure. These attitudes are reinforced by the culture (Pajares, 1992) and can have a major impact on behaviors (Nespor, 1987). Teacher's attitudes toward technology use can be influenced by the school culture and the school leaders. Interventions should be targeted to improve negative attitudes teachers may have towards technology (Sugar et al., 2005). When teachers have the willingness to learn the required skills, they are more likely to integrate technology into their classrooms (Kiridis et al., 2006; Zhao, 1998). School leaders need to take responsibility for the school

culture and develop a culture that is not only supportive of technology use but also makes student use of technology a priority.

### *Effort Expectancy*

Effort expectancy is defined as the degree of ease associated with the use of a particular technology. In the present study, effort expectancy referred to the amount of effort a teacher must expend for the integration of student technology projects. In the path analysis of the present study, Effort Expectancy ( $\beta=0.667$ ) proved to have the second strongest effect on Behavioral Intention, accounting for 45% of the variance in Behavioral Intention ( $R^2=.45$ ), and in the factor analysis Effort Expectancy ( $\alpha=.83$ ) was considered a strong factor as all six items had factor structure coefficients above 0.5 (Stevens, 2002). The relationship between Effort Expectancy and Behavioral Intention was a positive value. The survey items that measured effort expectancy referred to the ease of using technology. This means that the more the teacher felt it easy to integrate technology the more likely they would have the intention to integrate technology. The perceived ease of use has been found to be the individual perception of the effort required to learn the new technology (Davis, 1989) and has a major impact on the decision of teachers to integrate technology. The availability of professional development for technology use might increase technology use by teachers in their classrooms by reducing the individual concerns over the effort required to develop a project.



### *Anxiety*

Anxiety is defined as evoking anxious or emotional reactions with negative thoughts and attitudes about the use of computers. Venkatesh and Davis (2000) stated that anxiety would not have a direct effect on behavioral intention, and it was not included in the UTAUT model. Other researchers have posited that computer anxiety plays an important role in technology acceptance among instructors (Christensen, 2002; Korukonda, 2006; Venkatesh & Speier, 1999). Anxiety was therefore measured in the present study, and it emerged as strong factor. Anxiety towards technology use had a strong effect on the Behavioral Intention of a teacher to develop activities that require students to use technology ( $\beta = -.549$ ), but it was negatively related. This negative relationship indicates that as anxiety toward technology increases, the intention to use the technology decreases. Anxiety can have a noteworthy impact on the overall attitude toward technology use, and anxiety can be a barrier to teachers implementing new technology. Computer anxiety is not only a barrier for teachers in using new technology in programs but also may be the main reason for limited implementation of technology by teachers (Ball & Levy, 2008; Yang et al., 1999).

### *Performance Expectancy*

Performance expectancy is defined as the degree to which the teachers believe that using a particular technology will help them complete a task. In the present study, the task is defined as integrating student technology projects with the expectancy to improve the instruction in their classes. In the factor analysis, Performance Expectancy ( $\alpha = .77$ ) turned out to be a moderately strong factor, and Performance Expectancy explained the second greatest amount of variance in Behavioral Intention ( $R^2 = .48$ ).

Performance Expectancy had a strong effect on Behavioral Intention of teachers ( $\beta = .698$ ). This result has been reinforced by others researching technology use models (Agarwal & Prasad, 1998; Compeau & Higgins, 1995; Taylor & Todd, 1995; Venkatesh et al., 2003). Performance expectancy had the second strongest path coefficients of the items from the UTAUT, indicating that the technology implemented must support the teacher's instructional goals. It is the role of the technology leaders to provide these links between the technology and instructional goals and leaders most familiar with these goals, such as department leaders, could have the greatest influence.

### ***Social Influences***

Social influence is the construct that refers to the degree to which teachers perceive that important others (both formal and informal leaders) believe they should complete a particular task, in this case, integrate student technology projects. Social Influences had only a moderate effect on Behavioral Intention of teachers ( $\beta = 0.348$ ) although the construct of Social Influences ( $\alpha = .85$ ) proved to be a very strong factor in the CFA III. The  $R^2$  statistic indicates the amount of variance of the dependent variable explained by the independent variables, and Social Influences only explained 12% of the variance of the Behavioral Intention of teachers ( $R^2 = .12$ ), falling below an acceptable level. This construct, which was a strong factor, did not have much influence on the intention of the teachers to implement technology activities. Social influence has been found to only be significant in mandatory settings, and social influence appears to be important only in the first stages of the adoption (Agarwal & Prasad 1998; Barki & Hartwick, 1994, Venkatesh & Davis, 2000). The individual may change behavioral intentions in order to align with social influence. Individuals may change when others

have the ability to reward the desired behavior or punish the non-compliance (French & Raven, 1959; Warshaw, 1980). It would be fair to conclude that the opinion of others about technology use is less important than other constructs. The opinion of others could possibly influence the attitude a teacher has towards technology use or the anxiety they feel. This relationship should be investigated further.

### ***Self-efficacy***

Self-efficacy is defined as the self-judgment of one's ability to use a technology to complete a particular job or task. In the social cognitive theory (SCT), self-efficacy and anxiety were found to be determinants of intention (Bandura, 1977; Compeau & Higgins, 1995). Venkatesh and Davis (2000) hypothesized that self-efficacy would not have a direct effect on behavioral intention. For the present study, Self-efficacy ( $\alpha = .29$ ) as a construct was not retained in the final factor analysis. In CFA I, there were 4 items intended to investigate Self-efficacy, and the items are salient with two separate factors. Although Self-efficacy also had a moderate effect on Behavioral Intention ( $\beta = .475$ ), because it included only two items in the measurement model, the construct was not deemed acceptable. Other researchers have found a positive relationship between computer Self-efficacy and Behavioral Intention to use technology (Ajzen, 1991; Ball & Levy, 2008; Compeau & Higgins, 1995). Self-efficacy should be investigated further in educational settings.

### ***Facilitating Conditions***

Facilitating conditions are defined as the teachers' perceptions about the organizational support and technical infrastructure available to support integration of student technology projects. Venkatesh et al. (2003) found that the construct of

Facilitating Conditions did not have an effect on Behavioral Intention but did have a positive effect of the actual use of technology. In the present path analysis, the construct of Facilitating Conditions was negatively associated with use ( $\beta = -.131$ ) but was not statistically significant ( $p = .16$ ). The  $R^2$  statistic indicates the amount of variance of the dependent variable explained by the independent variables. A value of .2 is required, and all the constructs are above this value except for Facilitating Conditions ( $R^2 = .017$ ). Facilitating conditions ( $\alpha = .72$ ) proved to be a moderate to strong factor in the final factor analysis. It has been noted that a lack of facilitating conditions can be a barrier to the intention of use; however, the presence of favorable Facilitating Conditions may not lead to intention of use on its own (Taylor & Todd, 1995). This concept is supported by the weak and negative beta weight formed in the present study.

### **Moderators**

Moderators are characteristics of the participant, or the organization, which have been found to influence the construct's effect on the dependent variable (Behavioral Intention). The present research tested gender, teaching experience, technology experience, and the use of policy instruments as possible moderators.

The presence of a technology plan in a school decreases the average variance extracted (AVE) for Self-efficacy, Attitude, Anxiety, and Performance Expectancy, but increases the AVE for Social Influences. According to the beta values, technology plan had a weak effect on the relationships of Performance Expectancy ( $\beta = .057$ ), Effort Expectancy ( $\beta = -.037$ ), Social Influences ( $\beta = -.029$ ), Anxiety ( $\beta = .011$ ), and Attitude ( $\beta = -.001$ ). The t-values indicated that there were not significant interactions between the moderator defined as the inclusion of a technology plan and the independent variables.

Based upon the beta values, several moderators did have an effect upon the relationship between the constructs and Behavioral Intention but lack of statistical significance indicates these relationships are not likely to be found in the population.

The inclusion of a curriculum guide that includes technology skills decreased the AVE for Attitude, Anxiety, Effort Expectancy, Performance Expectancy, and Social Influences. According to the beta values, a curriculum guide had a weak effect on Attitude ( $\beta = .038$ ,  $\alpha = .83$ ), Anxiety ( $\beta = .001$ ,  $\alpha = .88$ ), Effort Expectancy ( $\beta = .020$ ,  $\alpha = .64$ ), Performance Expectancy ( $\beta = .070$ ,  $\alpha = .68$ ), and Social Influences ( $\beta = -.058$ ,  $\alpha = .83$ ). The inclusion of a curriculum guide that includes technology use had a significant moderating influence of the relations between Social Influences and Behavioral Intention ( $p = .034$ ).

The presence of an annual teacher evaluation that includes technology use improved the AVE for the constructs of Anxiety, Effort Expectancy, Performance Expectancy, but decreased the AVE for Social Influences, and Attitude. An annual evaluation had a weak effect on Attitude ( $\beta = .026$ ,  $\alpha = .85$ ), Anxiety ( $\beta = -.011$ ,  $\alpha = .84$ ), Effort Expectancy ( $\beta = -.024$ ,  $\alpha = .38$ ), Performance Expectancy ( $\beta = -.0123$ ,  $\alpha = .90$ ), and Social Influences ( $\beta = .082$ ,  $\alpha = .01$ ). The moderator defined as an evaluation process that includes technology use did not have a statistically significant effect on the relationship between the constructs and Behavioral Intention to use technology.

Teaching experience is the number of years a teacher has been working in the classroom. The AVE decreased for Attitude, Effort Expectancy, Performance Expectancy and Social Influences with the increase of teaching experience, but increased for Anxiety. According to the beta values, teaching experience had a weak effect on

Attitude ( $\beta = .132$ ,  $\alpha=.87$ ), Anxiety ( $\beta = -.065$ ,  $\alpha=.84$ ), Effort Expectancy ( $\beta = -.099$ ,  $\alpha=.35$ ) Performance Expectancy ( $\beta = -.040$ ,  $\alpha=.80$ ), and Social Influences ( $\beta = .036$ ,  $\alpha=.84$ ). There were no significant interactions between the moderator defined as teaching experience and the independent variables. The strongest moderator effect teaching experience had on Behavioral Intention was Attitude, having 13% of the variance of Behavioral Intention. In the present research years of teaching experience represented age, as years of working in the field of education may be more useful than age itself. Other researchers have concluded that younger users (newer teachers) find it easier to learn new technology, and this has an impact on the Effort Expectancy of the individual (Plude & Hoyer, 1985). In order to increase use of technology by teachers, newer teachers may be motivated by external rewards while experienced teachers are motivated by internal rewards (Fields & Shallenberger, 1987; Morris & Venkatesh, 2000).

When gender is considered as a moderator, it decreases the AVE for Attitude, Effort Expectancy, Anxiety, Performance Expectancy, and Social Influences. According to the beta values, gender had a weak effect on Attitude ( $\beta = -.008$ ,  $\alpha=.83$ ), Anxiety ( $\beta = -.085$ ,  $\alpha = .81$ ), Effort Expectancy ( $\beta = -.022$ ,  $\alpha=.38$ ), Performance Expectancy ( $\beta = -.034$ ,  $\alpha=.81$ ), and Social Influences ( $\beta = -.008$ ,  $\alpha = .86$ ). There were no significant interactions between the gender as a moderator and the independent variables. Others have found that gender has an effect on Performance Expectancy (Kirchmeyer, 2002; Minton & Schnieder, 1980).

The inclusion of technology experience as a moderator improved the AVE for Anxiety, Performance Expectancy, and Effort Expectancy. The AVE decreased for Attitude, and Social Influences with the inclusion of technology experience. Each of the

product factors had an acceptable Cronbach alpha. According to the beta values, technology experience had a weak effect on Attitude ( $\beta = -.068$ ,  $\alpha = .85$ ), Anxiety ( $\beta = -.116$ ,  $\alpha = .87$ ), Effort Expectancy ( $\beta = .035$ ,  $\alpha = .39$ ), Performance Expectancy ( $\beta = .039$ ,  $\alpha = .84$ ), and Social Influences ( $\beta = .058$ ,  $\alpha = .86$ ). There were no significant interactions between the moderator defined as technology experience and the independent variables. Higher level of technology experience appears to increase the behavioral intention of the teacher to use technology because with technology experience teachers have better technology skills. Others have found that experience plays an influential role in technology acceptance (Taylor & Todd, 1995; Thompson et al., 2006; Venkatesh et al., 2003). The experienced technology user would have a better understanding of the performance expectancy and effort expectancy of the task to integrate technology. Additionally, the experienced technology user would have less anxiety toward the task and as a result would also be less influenced by social influences. Training, along with the voluntary decision to adopt the technology, can moderate perceptions that negatively influence behavioral intention to use a technology.

The UTAUT model has been used in several studies and has been adapted to new situations, and most have modified the UTAUT by dropping the testing of the moderator effect (Venkatesh, 2010). The original UTAUT moderators were maintained in this study and three more added. Unfortunately, while the moderators did change the average variance extracted, the relationship between the moderators and independent variables (constructs) were not significant.

### Discussion of the Findings

The survey presented to the teachers in March of 2010 allowed teachers to respond to several items that were intended to measure particular constructs. In both the factor analysis and the measurement model of the PLS, the items clustered into several latent variables. Scores on the latent variables that emerged in the present study proved to be reliable, valid, and statistically significant in both analyses. The path analysis determined the relationships between those identified constructs and the dependent variable of Behavioral Intention. Behavioral Intention has been identified as a predictor of actual use, and Behavioral Intention is positively related to Use ( $\beta = .561$ ). The decision to have students use technology in a class is most often determined by the teachers who are the gatekeepers of the activities that take place in a classroom. It would benefit teachers to understand the forces guiding their decision to create activities that require students to use technology. There are four strong factors that affect teachers' Behavioral Intention: Attitude ( $\beta = .775$ ), Performance Expectancy ( $\beta = .698$ ), Effort Expectancy ( $\beta = .667$ ), and Anxiety ( $\beta = -.549$ ).

The greatest influence on teachers' Behavioral Intention to use technology is their Attitude toward technology ( $\beta = .775$ ). A teacher who has a negative feeling toward technology has been less likely to have the Behavioral Intention to use technology. Why the teacher has a negative attitude could be based on past experience, lack of physical support, or lack of institutional support.

The importance of two factors from the original UTAUT model was confirmed in the present research: Performance Expectancy ( $\beta = .698$ ), and Effort Expectancy ( $\beta = .667$ ). Performance Expectancy refers to the teacher's perception of the technology



succeeding in completion of a goal. If the use of a technology activity increases the students' understanding of the content, then a teacher will find it acceptable. Decisions teachers make about the use of technology may relate more to pedagogical issues than technological issues because teachers often do not see a relationship between technology and pedagogy. Teachers will also have an Effort Expectancy ( $\beta = .667$ ) when it comes to a particular task and this is a strong factor in their decision. If the teacher does not believe the infrastructure will support their goal, they may not make the effort. A task may require extra effort if there are problems with scheduling, reliability of the technology, or the teachers' own technology skills.

The fourth strongest relationship was not included in the UTAUT model but was found to have a significant, and negative, relationship with Behavioral Intention in the present results. If teachers have a high level of Anxiety ( $\beta = -.549$ ) towards technology, then they are less likely to develop activities that require students to use technology. To mitigate the anxious feelings teachers need a series of positive experiences with technology.

Social Influences ( $\beta = .348$ ), from the UTAUT model, had the smallest influence on a teacher's Behavioral Intention to use technology in the classroom. Teachers are influenced by others, especially formal leaders, but not to the level of the other factors. However, because teachers can be influenced by others in the school, it is important that the leaders present a positive opinion of technology use by students, and indeed encourage it. Teachers should understand the factors that could influence their intention to develop and implement activities that require student use of technology and, therefore, improve technology use by students.

### **Recommendations for Research**

The present study's findings share several implications for research within education. The educational version of the UTAUT used in the present research was a robust model that includes several constructs that can be used to predict a teacher's behavioral intention to use educational technologies. The present study contributes to behavioral intention research by confirmation of the model and providing a new context for the adapted UTAUT (Venkatesh et al., 2003) that was developed for a teacher acceptance and use of technology in an educational setting.

The UTAUT has served as a theoretical model and applied to the study of a variety of technologies in organizational settings since its publication in 2003. There have been many versions of the model in organizational settings that have supported it as an adaptable model. The model has been tested in new contexts with different technologies and populations. The successive versions of the technology use models have refined the relationships as well as increased the number of predictors in the models. The goal has been to improve understanding of the adoption of technology use and to refine the underlying theoretical framework.

Many of the models have applied the UTAUT model by removing the moderators. The UTAUT model adapted to this research included the testing of the effects of moderators. Although the relationships between the moderators, the latent constructs, and the dependent variable did not prove to be statistically significant in this study, the moderators did have an influence on the relationships. These and other possible moderators should be tested as in future studies.

The present study expanded the UTAUT model to include three affective measurements (Attitude, Anxiety, and Self-efficacy), and Attitude and Anxiety proved to be not only strong factors with strong relationships with Behavioral Intention but also explained much of the variance in Behavioral Intention. The results are meaningful in the sense that they support an organizational approach to technology use. Future research should include measurements of the affective components of an individual as they proved to be important constructs in this research. Because Self-efficacy could not be retained in the model, future researchers should revisit the items and attempt to revise the questions in an attempt to more effectively measure Self-efficacy as a possible predictor of Behavioral Intention.

The research model should be retested with a broader and larger sample of teachers. Of particular interest should be the influence of the moderators in a broader setting. Conversely, the instrument and theoretical model should be tested in a large school as a school sponsored initiative to ensure an adequate sample size. There are several limitations to the present research that could be addressed in future research. The sample was self-selected at two levels. First, the permission of the school director was required for participation, and schools where directors chose not to participate may have conditions different from the participating schools. Also, teachers were self-selected as well. Participation of the teachers was voluntary, possibly excluding teachers who did not support technology use in schools. It would be useful to test the research model in a single school, where the entire teacher population would be required to participate, in order to get a clear picture of the particular school. Lastly, the data were all self-reported information, possibly skewing the data to either those who were adopters of technology

or, conversely, were technology avoiders. In a future adaptation of the research model, some data that are not self-reported, such as actual observed technology use, may be available in the school records.

An important area for future research into technology adoption is the examination of the role of other predictors of behavioral intention, such as leadership (Neufeld et al., 2007). An understanding of the determinants for behavioral intention would allow leaders to understand why some teachers may use a technology while others do not. This understanding could lead to determining which interventions could be designed to impact teachers' behavioral intention. The objective of technology adoption research is to support the adoption of a new technology use and improve the diffusion of the use of the technology. Additionally, Venkatesh (2006) included the area of individual adoption of technology, as well as the addition of new factors that affect behavioral intention to use a technology, as new areas of research in user adoption.

### **Recommendations for Practice**

The findings of the present study have several implications for practice within education. Understanding the relationships between the factors and the Behavioral Intention of a teacher has important ramifications for practice. This knowledge allows stakeholders to target their efforts in areas that will increase the use of technology by teachers. The approach to technology adoption requires an understanding of how leaders of an organization, as well as individual teachers, approach technology use. The following constructs relate to individual teachers, yet these factors are not the defining factors when leaders in an organization make a decision concerning technology. Successful adoption of technology happens when cognitive (Performance and Effort

Expectancy), affective (Attitude and Anxiety), and contextual factors (Social Influences and Facilitating Conditions) are aligned. It should be noted that the individual level focus, such as decision making issues related to the individual employee (e.g., adoption decision) and consequences of organizational actions on individual employees (e.g., job satisfaction implications of process change), have been almost completely overlooked” (Venkatesh, 2006 p. 500).

Attitude towards technology use had the strongest effect on Behavioral Intention ( $\beta = .775$ ). Teachers can develop their attitudes toward technology through their experiences with technology. If a school continually mandates the use of technology for administrative purposes, teachers may be less willing to develop projects that encourage student use of technology. School leaders also need to understand the difference between attitudes about informal technologies (Smart phones) and formal technologies (school computers), and attempt to leverage positive attitudes towards one to the other.

Performance Expectancy ( $\beta = .698$ ) was found to be a significant factor in the present research as in other research (Alshare et al., 2009). With the second strongest effect on Behavioral Intention, Performance Expectancy can be problematic if teachers are rigid in their pedagogy and the need to have particular results. If a teacher is test-oriented then a problem-based learning approach found in a technology projects may lead to frustration for that teacher. Proper expectations are needed if teachers are going to be justified in allocating time to projects that require students to use technology. If those responsible to promote technology use fail to demonstrate performance gains, there will be less support for the initiative. Specifically, teachers may need to be convinced that the

time spent enriching a topic with a technology-based project is as valuable as traditional methods. This level of convincing often must come from leaders in the content area.

Effort Expectancy ( $\beta = .667$ ) was found to be a significant factor in the present research as in other research (Alshare et al., 2009). Learning new technology tasks can be challenging for many teachers. Effort Expectancy was found to be moderated by experience by Venkatesh et al. (2003), but the results were not significant in the present study. Based on this finding it would be important to make the use of technology in a school as easy as possible for teachers. This could include strategies that improve access to professional development, technical assistance, and reliable facilities. To understand the amount of effort a particular teacher needs to expend, it is necessary to have some knowledge of their skill set. A new technique may require less effort of the experienced user compared to the inexperienced user.

Anxiety towards technology had a strong, yet negative, effect on Behavioral Intention ( $\beta = .599$ ). The development of projects that require students to use technology may cause high levels of anxiety within some teachers. Teachers may have anxiety about the difficulty of the new task and the possibility of failure with the task, while some teachers will be anxious about looking incompetent in front of their peers. Fear can be a powerful emotion that needs to be addressed carefully. If a school is large enough, it would be useful to introduce new initiatives to homogenous groupings of teachers such as beginner or intermediate level. The professional development needs to be in steps so as not to instill early negative attitudes toward the technology.

Social Influence ( $\beta = .34$ ) has the least predictive power of Behavioral Intention ( $\beta = .348$ ). Social Influence is a well-known factor in commercial marketing, but it also

may have an impact in education. Social Influences has been found to be not significant in voluntary situations but is significant when use is mandated. In the present research, Social Influences had a significant effect on behavioral influence and was moderated by the existence of a curriculum guide that includes the use of technology. Teachers can be influenced by those who have the authority to reward or punish behaviors. If the leaders of a school support the expected performance of technology use, they need to convey this message to the teachers. Conversely, if leaders appear to have a negative regard for technology use, that message will be heard as well.

Facilitating Conditions ( $\beta = .17$ ,  $p = .13$ ) was not a significant factor in the path analysis. Facilitating Conditions include the infrastructure that supports technology use at a school such as access to computers, reliability of the network, and technical support. At the time of the present research, a high percentage of schools have adequate Facilitating Conditions; however, the instrument is a self-reporting survey and therefore reports the perceptions of the teachers. It has been recommended that a technology plan be available that includes professional development. Teachers must be made aware of the infrastructure, including support, through timely communications.

The relationship between Behavioral Intention and actual Use ( $\beta = .561$ ,  $p < .001$ ) in an educational setting has been confirmed in this study. Because Behavioral Intention is a predictor of actual Use, it is reasonable to suggest that Behavioral Intention should be an area of concern. The present research suggests that the increase of Behavioral Intention will increase actual Use.

Moderators have not been studied as much as is needed (Venkatesh, 2010). Researchers (Anderson, Schwager, & Kerns, 20027; Venkatesh et al., 2003) have found

that voluntariness (as opposed to a mandatory task) is a predictor of adoption. A Technology use decision cannot be an entirely independent choice in a school, but allowing teachers to have some flexibility will improve sustainable adoption. Venkatesh et al. (2003) found that gender, age, and experience were moderators of the four UTAUT constructs; however, this was not found to be the case in the present research. The present research did discover that the use of a curriculum guide that includes technology integration will moderate the relationship between Social Influences and Behavioral Intention to use technology. This finding encourages the inclusion of technology integration into curriculum guides in order to increase Behavioral Intention and ultimately to increase use.

Leaders in an organization have an influence on the use of technology by students and that influence lies beyond the simple purchase of hardware for their schools. The important factors that affect the use of technology by teachers in secondary schools are their own attitudes towards technology, their expectation concerning the performance of the technology use by the students, and the amount of effort they expect to expend to complete the task. The attitudes of teachers can be affected by leaders in authority roles who can reward positive behavior. School leaders must also recognize that the minimal use of technology in secondary schools is related more to curriculum, and not hardware or infrastructure. The integration of technology-based projects into content curriculum should be encouraged in an attempt to define the performance of technology as projects that work. As a teacher begins to have success with technology-based projects, the effort required by the teacher and associated anxiety about the process, will be reduced.



Technology leaders at a school include all the individuals who have an influence on the school culture. Although technology directors usually have authority over the network and hardware and the technology coordinator may have the responsibility of professional development, it is the principals that have the responsibility for curriculum issues and school directors that have the responsibility for the institutional climate. There is an influential connection between administrators' and teachers' use of technology (Sugar et al., 2005). Teacher attitudes towards technology may be influenced more by pressure from the school district or availability of resources than by student needs or practices (Lim, 2007). Many teachers understand that technology could be an important tool for students and have remained current with the technologies (Barr & Tagg 1995; Holmes, 1999, cited in Owen & Demb, 2004). At the same time, the goals of technology use may have not been made clear to educators, and this responsibility falls to the school leaders.

It is important that school leaders accept their role in the use of technology by teachers. Understanding this relationship between administrators and teachers will enable leaders to plan strategic support to facilitate technology integration. ISTE (2009) provided guidance for administrators in the form of a set of standards that include components addressing visionary leadership, digital age learning culture, excellence in professional practice, and systemic improvement. Educational administrators should support an environment that encourages educators to enhance student learning through the use of technologies.

## Conclusion

The present study has contributed to practice in an educational setting as the provided information can be used to improve the behavioral intention of teachers to use technology in their classes. Teachers themselves should be made aware of the influence of their own beliefs and behaviors concerning their technology use. Also, administrations need to understand their own influence on the behavioral intentions of teachers concerning technology. The organizational goal would be to develop initiatives that increase the use of technology, and to develop appropriate training to address those initiatives. In an organizational setting, technology leaders need to understand that for teachers to use technology with their classes they need to have their effort expectancy reduced, the performance expectancy increased, and the facilitating conditions conducive to the technology use. Teachers themselves, and leaders, also need to understand the effect of their attitudes on their behavioral intention. Negative attitudes toward technology need to be addressed through carefully planned initiatives that result in positive experiences. Positive experiences through professional development can also reduce anxiety that a teacher may feel toward technology and in the process improve their self-efficacy.

Much of the literature review herein has focused on the complex nature of technology use by individuals in an organization. Over time, access to technology has focused the discussion upon the individuals who bring attitudes and skills to their decisions concerning technology. However, the school culture presents expectations through policies developed to enhance technology goals in that school. The NCES survey has confirmed that infrastructure for technology integration has been in place but

high-level student use of technology continues to be relatively low (Gray et al., 2010). This indicates that there are barriers related to teachers' pedagogical beliefs that are responsible for their technology use. These beliefs were represented in this present study by the constructs of attitude and anxiety towards technology. Schools continue to acquire new technology use in the form of 1:1 computing and new software availability, but the student benefit will rest on the ability of teachers to use those tools with their students. It is clear that teachers have expectations of the effort required in the use of technology and the performance of that technology use. Teachers are unlikely to use technology unless the technology use supports their expectations. These concerns may influence teachers' overall attitude toward technology use and therefore influence their behavioral intention to develop curriculum activities that include the use of technology by their students.

The current study showed that in the context of educational use, prediction of the behavioral intention of a teacher to develop activities that require students to use technology is complex. Personal attributes of attitude toward technology and anxiety towards technology use had the greatest effect on behavioral intention of the teacher. Teachers were also concerned about the effort required to develop activities that require students to use technology as well as the performance of the technology. Although the relationships were moderated with the inclusion of contextual elements, only the presence of a curriculum guide as a moderator had an effect on social influences in an organization. This would indicate that teachers would look to the curriculum guide for guidance instead of, or in addition to, school leaders. If a school community wants to increase student use of technology, they must understand the views that teachers have toward their uses of technology. If teachers are influenced by their personal beliefs,

effort expectancy and performance expectancy, the challenge for school leaders is to find ways to remove these barriers. Although attitude and anxiety towards technology, as well as effort and performance expectancy, proved to have some influence on teachers' behavioral intention, continued research is needed to verify the relative impact of these variables.

The particular research questions were developed as result of the lack of technology use in the classrooms as suggested by the literature review. The underlying assumption is that technology use by students is important. While schools are funding technology purchases, few teachers are maximizing the potential of technology use. The present study highlighted the factors, or concerns, important to teachers. With this knowledge, school technology leaders and administrators can develop interventions to improve the frequency, duration, and intensity of technology use by the students in their schools.

Technology projects are unlikely to be developed by teachers unless the technology activity fits with teachers' existing beliefs and perceptions towards technology. It is critical that educators increase their ability to address teachers' perceptions as part of the efforts to increase teachers' technology skills and uses. Overall, the study confirmed the important roles of attitude, performance expectancy, effort expectancy, and anxiety in influencing behavioral intention of teachers in private school settings to develop curricular activities that require students to use technology. It is imperative that teacher perceptions be understood in order to increase the chance that students will use technology in high-level, meaningful ways.

## APPENDICES

**Appendix A: The Items used to estimate the UTAUT****Performance Expectancy**

I would find the system useful in my job.  
 Using the system enables me to accomplish tasks more quickly.  
 Using the system increases my productivity.  
 If I use the system, I will increase my chances of getting a raise.

**Effort Expectancy**

My interaction with the system would be clear and understandable.  
 It would be easy for me to become skillful at using the system.  
 I would find the system easy to use.  
 Learning to operate the system is easy for me.

**Attitude toward using technology**

Using the system is a bad/good idea.  
 The system makes work more interesting.  
 Working with the system is fun.  
 I like working with the system.

**Social Influence**

People who influence my behavior think that I should use the system.  
 People who are important to me think that I should use the system.  
 The senior management of this business has been helpful in the use of the system  
 In general, the organization has supported the use of the system.

**Facilitating Conditions**

I have the resources necessary to use the system.  
 I have the knowledge necessary to use the system.  
 The system is not compatible with other systems I use.  
 A specific person (or group) is available for assistance with system difficulties.

**Self-efficacy**

I could complete a job or task using the system...  
     If there was no one around to tell me what to do as I go.  
     If I could call someone for help if I got stuck.  
     If I had a lot of time to complete the job for which the software was provided.  
     If I had just the built-in help facility for assistance.

**Anxiety**

I feel apprehensive about using the system.  
 It scares me to think that I could lose a lot of information using the system by hitting the wrong key.  
 I hesitate to use the system for fear of making mistakes I cannot correct.  
 The system is somewhat intimidating to me.

**Behavioral Intention to use the system**

I intend to use the system in the next <n> months.

I predict I would use the system in the next <n> months.  
I plan to use the system in the next <n> months.

## Appendix B: The Hypotheses

H<sub>0</sub>1. The Research Model does not significantly identify the constructs, or relationships between constructs, that influence *Behavioral Intention* of the teacher to implement curriculum activities that require students to use technology.

H<sub>0</sub>1a. The construct of *Social Influence* is not significantly related to the *Behavioral Intention* of the teacher to implement curriculum activities that require students to use technology.

H<sub>0</sub>1b. The construct of *Facilitating Conditions* is not significantly related to the *Behavioral Intention* of the teacher to implement curriculum activities that require students to use technology.

H<sub>0</sub>1c. The construct of *Effort Expectancy* is not significantly related to the *Behavioral Intention* of the teacher to implement curriculum activities that require students to use technology.

H<sub>0</sub>1d. The construct of *Performance Expectancy* is not significantly related to the *Behavioral Intention* of the teacher to implement curriculum activities that require students to use technology.

H<sub>0</sub>1e. The construct of *Behavioral Intention* is not significantly related to teacher implementation of curriculum activities that require students to use technology.

H<sub>0</sub>2. The individual characteristics of the teacher are not significantly related to the *Behavioral Intention* of the teacher to implement curriculum activities that require students to use technology.

H<sub>0</sub>2a. The construct of *Attitude toward technology* is not significantly related to the *Behavioral Intention* of the teacher to implement curriculum activities that require students to use technology.

H<sub>0</sub>2b. The construct of *Self-efficacy toward technology* is not significantly related to the *Behavioral Intention* of the teacher to implement curriculum activities that require students to use technology.

H<sub>0</sub>2c. The construct of *Anxiety toward technology* is not significantly related to the *Behavioral Intention* of the teacher to implement curriculum activities that require students to use technology.

H<sub>0</sub>3. The seven relationships listed in research question number one are not moderated by gender, age, or experience.

H<sub>0</sub>3a. The seven relationships listed in research question number one do not vary in environments depending on the gender of the teacher.

H<sub>0</sub>3b. The seven relationships listed in research question number one do not vary in environments depending on the age of the teacher.

H<sub>0</sub>3c. The seven relationships listed in research question number one do not vary in environments depending on the experience of the teacher.

H<sub>0</sub>4. The seven relationships listed in research question number one vary depending on the institutional policies influence voluntariness that concern technology use.

H<sub>0</sub>4a. The above seven relationships do not vary in environments depending on the existing of a technology plan that requires technology use by students.

H<sub>0</sub>4b. The above seven relationships do not vary in environments depending on the existence of a curriculum guide that includes the use of technology by students.

H<sub>0</sub>4c. The above seven relationships do not vary in environments depending on the inclusion of technology use by students in the annual teachers evaluation.



### Appendix C: Request for participation letters

Dear School Head,

My name is John McCombs and I am a doctoral candidate in Educational Leadership at the University of North Florida. I am conducting a study that involves the analysis of the factors that have an influence on the intention of teachers to integrate technology into their curriculum, and I would like your assistance. Technology integration, in this case, is defined as the creation of lessons in which students use technology in the development of student authored products. This particular study is being limited to private secondary schools within the State of Florida. Because your school is a private secondary school in Florida, I am asking for your support in conducting my study. The study involves the completion of a 15-20 minute survey by teachers who volunteer to participate. The project has been reviewed, and approved by the UNF Institutional Review Board (IRB # 09-167).

I would like your permission to contact the teachers in your school and request your participation in the study. To participate, the teachers will only be requested to complete a 50-item survey that has been available on-line. Please be confident that the participants' email addresses have been kept confidential, and the participants email addresses will not be associated with their responses. Their responses have been completely anonymous. The name of the school also will not be identifiable from the responses. If you agree to participate, I request access to a list of the teachers' email addresses. You can either forward a list of the email addresses of the teachers in your school, or direct me to a directory that may be located on-line. Upon receipt of the email addresses, I will send an email request to the individual teachers requesting their participation in the survey. The email will contain a link to the survey that has been hosted by the University of North Florida Information Technology Services. The survey itself has been available in the early 2010. The particular survey is an instrument that has a published history, and it is attached for your review. I would request however, that you not distribute the survey to others prior to the commencement of the study.

Again, the survey participants have been entirely anonymous as I am interested in the aggregate results, not the results for individual participants or schools.

I hope you will support this educational research and join me in attempting to determine some of the factors that affect whether a teacher will develop student technology projects. If you participate in this study, a summary of the results has been forwarded to you at the conclusion of the study. These results may assist you in the development of your technology program. If you are willing to participate, I would appreciate it if you could respond to this email so that I can include your school in the study.

I look forward to hearing from you, and I thank you in advance for your support.

John McCombs  
Doctoral Candidate  
University of North Florida  
Email: [mccj0041@unf.edu](mailto:mccj0041@unf.edu)

Supervising Faculty:  
Dr. Katherine Kasten  
Doctoral Program Director  
College of Education and Human Service  
University of North Florida  
email: [kkasten@unf.edu](mailto:kkasten@unf.edu)

Dear Secondary Teacher,

My name is John McCombs, and I am a doctoral candidate in Educational Leadership at the University of North Florida. I am conducting a study that involves the analysis of the factors that have an influence on the intention of teachers to integrate technology into their curriculum, and I would like your assistance. I have recently received permission from your school director to email the teachers in the school to request your participation in this research into technology integration, Technology integration, in this case, is defined as the creation of lessons in which students use technology in the development of student authored products. This particular study is being limited to private secondary schools within the State of Florida. Because you are a teacher at a private secondary school in Florida, I would like to ask for your participation in my study. The study involves the completion of a 15-20 minute survey by teachers who volunteer to participate. The project has been reviewed, and approved by the UNF Institutional Review Board (IRB # 09-167).

Please be confident that your email addresses, and our email correspondence, has been keep confidential and your email address will not be associated with your answers, nor will it be forwarded to any other individuals or organizations. The survey itself has been hosted on a secure server by the University of North Florida Information Technology Services. If you prefer to complete a paper copy of the survey, feel free to reply to this email and I will mail a paper copy and a stamped return envelope to you. The return envelope will not reveal your identity. I would like to request that you do not submit a paper copy of the survey in addition to the on-line version of the survey.

Again, the survey participants have been entirely anonymous as I am interested in the aggregated results, not the results for individual participants or schools.

I hope you will support this educational research and join me in attempting to determine some of the factors that affect whether a teacher will develop student technology projects. If you participate in this study, a summary of the results has been forwarded to you at the conclusion of the study. These results may assist you in the development of your technology program.

If you are willing to participate, please visit the following link, read the short introduction, and then complete the questions as best you can.

Place Link Here

I thank you in advance for your support.

John McCombs  
Doctoral Candidate  
University of North Florida  
Email: [mccj0041@unf.edu](mailto:mccj0041@unf.edu)

Supervising Faculty:  
Dr. Katherine Kasten  
Doctoral Program Director  
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## Appendix D: Research Survey

### Informed Consent Statement

*The survey you are being asked to complete is dissertation research that is a component of a doctoral degree in the department of Educational Leadership at the University of North Florida. You are being asked to participate in the research by answering the questions in the survey. The survey is being stored at the UNF Technology Services Department. Your identity has been anonymous, and your responses has been coded in a manner that will not identify you, or connect the answers to you. Individuals that decide to participate will not be compensated in any way and will decide to participate with the understanding that there is no monetary benefit for doing so. A refusal to participate will incur no penalty to you, or loss of any benefits that you are entitled. A participant can contact the researcher for any questions or concerns. The researcher is John McCombs and the email is [mcco0041@unf.edu](mailto:mcco0041@unf.edu). The supervising faculty member is Dr. K. Kasten at [kkasten@unf.edu](mailto:kkasten@unf.edu). For information concerning the rights of research subjects you can also contact Kareem Jordan, UNF Institutional Review Board Vice Chairman at (904) 620-1723.*

*The following survey is intended to measure several factors that may have an influence on the integration of technology in secondary schools. The integration of technology is defined as the implementation of curricular activities that specifically require the use of technology by students. The curricular activities may include using technology to access information, manipulate information, or present information. Technology is defined as computer use including the wide range of available software as well as the Internet. Student use of technology is defined as activities in which students have a ‘hands-on’ experience with computer technology.*

*The survey is an adaptation of the Unified Theory of Acceptance and Use of Technology (UTUAT) model (Venkatesh, Morris, Davis, & Davis, 2003). The survey includes 43 questions about factors that may have an influence on the use of technology by teacher, 3 questions that measure the frequency, duration and intensity of technology use, and 8 questions related to general demographics of the participants. Please complete the survey so that your answers reflect your own beliefs, Attitudes, and present teaching practice. The survey responses are a seven point Likert scale as follows:*

*1 = completely disagree,      2 = moderately disagree,      3 = somewhat disagree,  
4 = neutral    5 = somewhat agree,      6 = moderately agree,      7 = completely agree.*

*By participating there is no foreseeable risk to you in completing this survey. For the completion of the survey the participant should have 15 to 20 minutes available to complete the survey. There has been no direct benefit for you other than the knowledge they you will contribute to the knowledge base concerning secondary education. You may contact me at [mcco0041@unf.edu](mailto:mcco0041@unf.edu) for a summary of the results.*

*Your participation in this survey requires that you be a secondary private school teacher in Florida and at least 18 years of age.*

*Clicking below indicates that I have read the description of the study and I agree to participate.*

### **Social Influence Questions (UTAUT Model)**

1. The school administrators think that I should include in my lessons curriculum activities that require students to use technology
2. Colleagues that I believe are social leaders in the school, think that I should include in my lessons curriculum activities that require students to use technology
3. Administrators in this school have been helpful to me in the implementation of curriculum activities that require students to use technology.
4. The school principal is very supportive of the implementation of curriculum activities that require student to use technology in my classes.
5. In general, the school organization has supported curriculum activities that require students to use technology
6. The implementation of curriculum activities that require students to use technology is a status symbol at my school.

### **Facilitating Conditions Questions. (UTAUT Model)**

7. Teachers at my school have the resources necessary to implement curriculum activities that require students to use technology.
8. Teachers at my school have the knowledge necessary to include in the curriculum activities that require students to use technology
9. Curriculum activities that require students to use technology are not compatible with the computers available at my school.
10. Technology support for me is available for assistance with difficulties that arise when implementing curriculum activities that requires student use of technology
11. Integrating activities that require students to use technology activities fits into my preferred teaching style.

### **Performance Expectancy Questions (UTAUT Model)**

12. Implementing activities that require students to use technology enables teachers to cover curriculum more quickly.
13. Implementing activities that require students to use technology increases teacher effectiveness.

14. Implementing activities that require students to use technology makes it easier for students to learn the curricular material.
15. Implementing activities that require students to use technology causes colleagues to perceive other teachers as competent.
16. Implementing activities that require students to use technology increases my administrators' respect for me.
17. Implementing activities that require students to use technology is useful to me.

**Effort Expectancy Questions (UTAUT Model)**

18. Learning to develop activities that require students to use technology is easy for me.
19. I find it easy to get students to understand the requirements of activities that require students to use technology.
20. The requirements for success in implementing activities that require students to use technology are clear and understandable.
21. I find that the activities that require students to use technology allow me flexibility in meeting my curriculum objective.
22. It is easy for me to become skillful at creating a variety of activities that require students to use technology.
23. I find the technology needed to implement activities that require students to use technology easy to use.
24. Creating activities that require students to use technology takes too much time from my normal duties.
25. Working with activities that require students to use technology is complicated and the activity can be difficult to complete.

**Attitude toward using technology questions (TAM-Technology Assessment Model)**

26. Creating activities that require students to use technology is a good idea.
27. Developing activities that require students to use of technology is a pleasant process for the teacher.
28. The activities that require students to use technology make schoolwork more interesting for the student.
29. Implementing activities that require students to use technology is fun for the student.
30. I like implementing activities that require students to use technology.

### **Behavioral Intention Questions (TAM-Technology Assessment Model)**

31. Whenever possible, I intend to implement activities that require students to use technology in my classes.
32. I perceive implementing activities that require students to use technology as a mandatory practice to be a good teacher.
33. I plan to implement an activity that requires students to use technology into my classes within in the next three months.
34. I would implement activities that require students to use technology if they were completed outside of class time.
35. To the extent possible, I would implement activities that require students to use technology in my classes weekly.

### **Self-efficacy (TAM, Technology Assessment Model)**

36. I could complete a task implementing a project that requires students to use technology even without instruction from someone else.
37. I could complete a task implementing an activity that requires students to use technology only if I had seen someone else demonstrate how it could be used.
38. I could complete a task implementing an activity that requires students to use technology if I could call someone for help if I got stuck.
39. I could complete a task implementing an activity that requires students to use technology if I had a sufficient time to complete the job.

### **Anxiety Questions (TAM-Technology Assessment Model)**

40. I feel apprehensive about implementing activities that require students to use technology.
41. It concerns me that I could lose a lot of teaching time by implementing activities that require student use of technology.
42. I hesitate in implementing activities that require student use of technology for fear of lack of knowledge about the technology when students ask me questions.
43. Implementing activities that require students to use technology is somewhat intimidating to me.
44. On average, what is the duration (how many class periods) do students use technology when you implement a project that requires students to use technology?

1 class period    2-3 class periods    3-4 class periods    5 periods or more





### Appendix E: Frequency Report

Item*	1	2	3	4	5	6	7	Mean	Standard Deviation	Valid Responses
1	3.0	3.0	1.5	6.0	18.8	20.3	46.2	5.7	1.5	266
2	3.8	1.5	4.5	16.5	20.3	25.9	27.4	5.3	1.5	266
3	6.0	4.9	8.3	7.5	17.3	18.4	37.6	5.3	1.8	266
4	4.9	3.0	1.5	5.6	10.9	16.9	57.1	5.9	1.6	266
5	3.8	3.0	1.9	3.0	17.4	22.3	48.5	5.8	1.5	264
6	8.4	7.2	8.7	18.6	23.2	15.6	18.3	4.6	1.8	263
7	3.8	8.0	8.0	2.3	20.9	20.9	36.1	5.3	1.7	263
8	1.9	8.7	15.2	4.9	35.0	25.1	9.1	4.7	1.5	263
9	32.8	22.9	11.1	9.9	14.1	6.9	2.3	2.7	1.7	262
10	3.4	3.8	8.4	3.1	20.2	23.3	37.8	5.5	1.6	262
11	1.9	3.8	8.8	8.8	24.6	24.2	27.7	5.3	1.5	263
12	5.7	5.4	17.2	17.6	21.5	20.7	11.9	4.5	1.6	261
13	4.2	3.1	6.2	11.2	23.8	32.3	19.2	5.2	1.5	260
14	1.9	3.1	5.8	12.7	25.0	34.2	17.3	5.2	1.3	260
15	4.3	4.3	6.6	18.7	26.1	26.8	13.2	4.9	1.5	257
16	3.9	1.2	4.3	17.1	32.3	21.0	20.2	5.1	1.4	257
17	3.9	1.2	3.5	17.3	33.5	18.9	21.7	5.1	1.4	254
18	4.7	10.7	15.4	6.7	19.4	24.1	19.0	4.7	1.8	253
19	1.6	5.5	10.6	11.4	26.3	29.4	15.3	5.0	1.4	255
20	2.0	7.1	12.2	16.5	27.6	19.7	15.0	4.7	1.5	254
21	2.0	2.4	8.7	16.5	31.1	21.7	17.7	5.0	1.4	254
22	4.7	7.1	20.1	9.8	23.2	17.7	17.3	4.6	1.7	254
23	2.0	6.8	12.7	9.6	28.3	25.9	14.7	4.9	1.5	251
24	10.4	12.0	11.2	7.6	37.8	13.9	7.2	4.2	1.7	251
25	13.2	17.6	20.0	13.2	22.4	11.2	2.4	3.5	1.6	250
26	.8	.8	2.0	4.4	21.9	23.9	46.2	6.0	1.1	251
27	4.0	8.4	20.0	23.6	22.8	16.0	5.2	4.2	1.4	250
28	.4	.8	1.2	7.6	26.0	30.0	34.0	5.8	1.1	250
29	0.0	0.8	2.0	7.6	27.1	36.3	26.3	5.7	1.0	251
30	1.2	2.8	4.4	14.3	25.1	26.3	25.9	5.4	1.3	251
31	1.6	3.6	8.0	12.8	30.4	21.2	22.4	5.2	1.4	250
32	10.4	5.2	12.0	13.5	26.7	20.3	12.0	4.4	1.7	251
33	6.0	1.6	5.6	10.4	10.4	13.1	53.0	5.6	1.7	251
34	6.4	4.4	10.0	20.7	21.1	17.5	19.9	4.7	1.7	251
35	4.4	5.6	11.6	12.0	17.5	20.7	28.3	5.0	1.7	251
36	3.2	4.0	11.2	9.2	17.5	19.1	35.9	5.3	1.7	251
37	24.0	14.8	13.2	7.2	20.4	9.6	10.8	3.5	2.0	250
38	6.0	3.6	4.8	17.1	22.7	12.4	33.5	5.1	1.7	251
39	0.4	0.4	1.6	7.6	17.5	22.3	50.2	6.0	1.1	251
40	37.5	16.3	12.4	3.6	18.7	7.6	4.0	2.8	1.9	251
41	21.5	16.3	11.6	12.7	19.9	9.6	8.4	3.5	1.9	251
42	39.0	18.3	11.6	5.6	15.5	3.2	6.8	2.7	1.9	251
43	41.0	16.7	9.2	6.0	15.9	5.2	6.0	2.7	1.9	251

Note: Note: Values are presented as percentage of respondents selecting each response. Response choices were 1) *completely disagree*, (2) *moderately disagree*, (3) *somewhat disagree*, (4) *neutral*, (6) *moderately agree*, (7) *completely agree*.

\* The survey questions.

1. The school administrators think that I should include in my lessons curriculum activities that require students to use technology.
2. Colleagues that I believe are social leaders in the school, think that I should include in my lessons curriculum activities that require students to use technology.
3. Administrators in this school have been helpful to me in the implementation of curriculum activities that require students to use technology.
4. The school principal is very supportive of the implementation of curriculum activities that require students to use technology in my classes.
5. In general, the school organization has supported curriculum activities that require students to use technology.
6. The implementation of curriculum activities that require students to use technology is a status symbol at my school.
7. Teachers at my school have the resources necessary to implement curriculum activities that require students to use technology.
8. Teachers at my school have the knowledge necessary to include in the curriculum activities that require students to use technology.
9. Curriculum activities that require students to use technology are not compatible with the computers available at my school.
10. Technology support for me is available for assistance with difficulties that arise when implementing curriculum activities that requires student use of technology.
11. Integrating activities that require students to use technology activities fits into my preferred teaching style.
12. Implementing activities that require students to use technology enables teachers to cover curriculum more quickly.
13. Implementing activities that require students to use technology increases teacher effectiveness.
14. Implementing activities that require students to use technology makes it easier for students to learn the curricular material.
15. Implementing activities that require students to use technology causes colleagues to perceive other teachers as competent.
16. Implementing activities that require students to use technology increases my administrators' respect for me.
17. Implementing activities that require students to use technology increases my administrators' respect for me.
18. Learning to develop activities that require students to use technology is easy for me.
19. I find it easy to get students to understand the requirements of activities that require students to use technology.

20. The requirements for success in implementing activities that require students to use technology are clear and understandable.
21. I find that the activities that require students to use technology allow me flexibility in meeting my curriculum objective.
22. It is easy for me to become skillful at creating a variety of activities that require students to use technology.
24. Creating activities that require students to use technology takes too much time from my normal duties.
25. Working with activities that require students to use technology is complicated and the activity can be difficult to complete.
26. Creating activities that require students to use technology is a good idea.
27. Developing the activities that require students to use of technology, is a pleasant process for the teacher.
28. The activities that require students to use technology make schoolwork more interesting for the student.
29. Implementing activities that require students to use technology is fun for the student.
30. I like implementing activities that require students to use technology.
31. Whenever possible, I intend to implement activities that require students to use technology in my classes.
32. I perceive implementing activities that require students to use technology as a mandatory practice to be a good teacher.
33. I plan to implement an activity that requires students to use technology into my classes within in the next three months.
34. I would implement activities that require students to use technology if they were completed outside of class time.
35. To the extent possible, I would implement activities that require students to use technology in my classes weekly.
36. I could complete a task implementing a project that requires students to use technology even without instruction from someone else.
37. I could complete a task implementing an activity that requires students to use technology only if I had seen someone else demonstrate how it could be used.
38. I could complete a task implementing an activity that requires students to use technology if I could call someone for help if I got stuck.
39. I could complete a task implementing an activity that requires students to use technology if I had a sufficient time to complete the job.
40. I feel apprehensive about implementing activities that require students to use technology.
41. It concerns me that I could lose a lot of teaching time by implementing activities that require student use of technology.

- 42.** I hesitate in implementing activities that require student use of technology for fear of lack of knowledge about the technology when students ask me questions.
- 43.** Implementing activities that require students to use technology is somewhat intimidating to me.

### Appendix F: Confirmatory Rotated Factor Matrix I (CFA I)

Survey Item		Factor Structural Coefficients									Item
No.	Construct	1	2	3	4	5	6	7	8	9	Strength
1	SI 1			.694							Strong
2	SI 2			.574							Moderate
3	SI 3			.732		.411					Strong
4	SI 4			.829							Strong
5	SI 5			.700		.452					Strong
6	SI 6										Weak
7	FC 1					.862					Strong
8	FC 2					.679					Moderate
9	FC 3					-.532					Moderate
10	FC 4					.505					Moderate
11	PE 1	.561	.414								Moderate
12	PE 2	.602									Moderate
13	PE 3	.866									Strong
14	PE 4	.897									Strong
15	PE 5						.545				Moderate
16	PE 6						.917				Very Strong
17	PE 7						.937				Very Strong
18	EE 1		.576					.433			Moderate
19	EE 2	.418						.506			Moderate
20	EE 3	.409						.590			Moderate
21	EE 4	.519									Moderate
22	EE 5		.535					.507			Moderate
23	EE 6		.572					.453			Moderate
24	EE 7				-.464						Weak
25	EE 8	-.402	-.445								Weak
26	ATT 1	.586									Moderate
27	ATT 2	.486									Weak
28	ATT 3	.635									Moderate
29	ATT 4	.582								.441	Moderate
30	ATT 5	.639									Moderate
31	BI 1	.525			.474						Weak
32	BI 2	.459									Weak
33	BI 3				.560						Moderate
34	BI 4										Remove
35	BI 5	.493			.547						Moderate

36	SE 1	.602			Moderate
37	SE 2	-.460			Weak
38	SE 3			.536	Moderate
39	SE 4			.409	Weak
40	ANX 1	-.760			Strong
41	ANX 2	-.457		-.402	Weak
42	ANX 3	-.803			Strong
43	ANX 4	-.896			Strong

Note: Values < |.40| are omitted.

### Appendix G: Confirmatory Rotated Factor Matrix II (CFA II)

Survey Item		Factor Structural Coefficients						Item Strength
No.	Construct	1	2	3	4	5	6	
1	SI 1						.736	Strong
2	SI 2						.641	Strong
3	SI 3		.619				.567	Moderate
4	SI 4		.536				.628	Moderate
5	SI 5		.660				.487	Moderate
7	FC 1		.810					Strong
8	FC 2		.750					Strong
9	FC 3		-.585					Moderate
10	FC 4		.610					Moderate
11	PE 1	.480			.432			Moderate
12	PE 2			.480	.538			Moderate
13	PE 3				.743			Strong
14	PE 4				.800			Strong
15	PE 5							Remove
17	PE 6							Remove
18	EE 1	.581		.555				Moderate
19	EE 2			.609				Moderate
20	EE 3			.673				Moderate
21	EE 4			.522				Moderate
22	EE 5	.554		.615				Moderate
23	EE 6	.553		.521				Moderate
26	ATT 1					.433		Weak
27	ATT 2			.525				Moderate
28	ATT 3					.803		Strong
29	ATT 4					.704		Strong
30	ATT 5	.410			.423	.455		Weak
36	SE 1	.608						Strong
38	SE 3							Remove
40	ANX 1	-.794						Strong
42	ANX 2	-.814						Strong
43	ANX 3	-.909						Strong

Note: Values < |.40| are omitted.

### Appendix H: Confirmatory Rotated Factor Matrix III (CFA III)

Survey Item		Factor structure coefficients						Item
No.	Construct	1	2	3	4	5	6	Strength
1	SI 1					.729		Strong
2	SI 2					.624		Moderate
3	SI 3		.527			.664		Moderate
4	SI 4		.429			.722		Strong
5	SI 5		.577			.586		Moderate
7	FC 1		.812					Strong
8	FC 2		.749					Strong
9	FC 3		-.574					Moderate
10	FC 4		.580					Moderate
11	PE 1	.498		.456				Weak
12	PE 2			.569	.441			Moderate
13	PE 3			.772				Strong
14	PE 4			.810				Strong
18	EE 1	.610			.515			Moderate
19	EE 2				.576			Moderate
20	EE 3				.641			Moderate
21	EE 4				.485			Weak
22	EE 5	.586			.571			Moderate
23	EE 6	.576			.486			Weak
26	ATT 1			.403			.437	Weak
27	ATT 2				.492			Weak
28	ATT 3						.790	Strong
29	ATT 4						.721	Strong
30	ATT 5	.423		.444			.459	Weak
36	SE 1	.619						Strong
40	ANX 1	-.804						Strong
42	ANX 2	-.820						Strong
43	ANX 3	-.914						Strong

Note: Values < |.40| are omitted.



## REFERENCES

- Adamy, P., & Heinecke, W. (2005). The influence of organizational culture on technology integration in teacher education. *Journal of Technology and Teacher Education*, 13(2), 233-256.
- Agarwal, R., & Prasad, J. (1998). A conceptual and operational definition of personal innovativeness in the domain of information technology. *Information Systems Research*, 9(2), 204–215.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211.
- Ajzen, I. (2001). Nature and operation of attitudes. *Annual Review of Psychology*, 52(2), 27-58.
- Ajzen, I., & Fishbein, M. (1975) *Belief, attitude, intention, and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.
- Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall.
- Alfred, R. L., & Carter, P. (Eds.). (1998). The transformation imperative: New designs for community colleges. *Community College Journal of Research and Practice*. (Special Issue). Philadelphia, PA: Taylor and Francis Publishers.
- Alshare, K. A., Freeze, R., & Kwun, O. (2009). Student intention to use expert systems: An exploratory study. *The Journal of Computer Information Systems*, 49(4), 105-113.
- Anderson, J. E., Schwager, P. H. & Kerns, R. L. (2007). The drivers for acceptance of table PCs by faculty in a college of business. *Journal of Information Systems Education*, 17, 429-440.
- Anderson, R. E., & Dexter, S. (2000). *School technology leadership: Incidence and impact*. Irvine, CA: University of California, Center for Research on Information Technology and Organizations. Retrieved from <http://repositories.cdlib.org/crito/education/98>
- Anderson, R. E., & Dexter, S. (2005). School technology leadership: An empirical investigation of prevalence and effect. *Educational Administration Quarterly*, 41(1), 49-82.
- Apple Computer, Inc. (1995). *Changing the conversation about teaching, learning and technology: A report on 10 years of ACOT research*. Cupertino, CA: Apple Computer, Inc. Retrieved from [www.apple.com/education/k12/leadership/acot/library.html](http://www.apple.com/education/k12/leadership/acot/library.html)

- Baker, E. L., Gearhart, M., & Herman, J. L. (1994). *Evaluating the Apple Classrooms of Tomorrow. Technology assessment in education and training*. Hillsdale, NJ: Lawrence Erlbaum.
- Ball, D. M., & Levy, Y. (2008). Emerging educational technology: Assessing the factors that influence instructors' acceptance in information systems and other classrooms. *Journal of Information Systems Education, 19*(4), 431-444.
- Ball, S. J. (2003). The teacher's soul and the terrors of performativity. *Journal of Education Policy, 18*(2), 215-228.
- Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice Hall.
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.
- Barki, H., & Hartwick, J. (1994). Measuring user participation, user involvement, and user attitude. *MIS Quarterly, 18*(1), 59-82.
- Barr, R. B., & Tagg, J. (1995). From teaching to learning: A new paradigm for undergraduate education. *Change Magazine, 27*(6), 12-25.
- Barron, A. E., Kemker, K., Harmes, C., & Kalaydjian, K. (2003). Large-scale research study on technology in K-12 schools: Technology integration as it relates to the national technology standards. *Journal of Research on Technology in Education, 35*(4), 489-507.
- Bartlett, J. E., Kotrlik, J. W., & Higgins, C. C. (2001). Organizational research: Determining appropriate sample size in survey research. *Information Technology, Learning, and Performance Journal, 19*(1), 43-50.
- Beane, J. A. (1995). Introduction: What is a coherent curriculum? In J. A. Beane (Ed.). *Toward a coherent curriculum*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Becker, H. J. (1994). *Analysis and trends of school use of new information technologies*. Irvine, CA: University of California, Irvine, Department of Education.
- Becker, H. J. (2000). Access to classroom computers. *Communications of the ACM, 43*(6), 24-25.
- Bellamy, J., (2005). Exploring the influence of new technology planning and implementation on the perceptions of new technology effectiveness. *The Journal of Technology Studies, 33*(1), 32-40.

- Berg, S., Benz, C. R., Lesley, T. J. & Raisch, C. D. (1998). Exemplary technology use in elementary classrooms. *Journal of Research on Computing in Education*, 31(5), 111-122.
- Boden, M. A. (1973). The structure of intentions. *Journal for the Theory of Social Behavior*, 3(1), 23-46.
- Bolster, A. (1983). Toward a more effective model of research on teaching. *Harvard Educational Review*, 53(3), 294-308.
- Bontis, N., & Serenko, A., (2007). The moderating role of human capital management practices on employee capabilities. *Journal of Knowledge Management*, 11(3), 31-51.
- Brooks-Young, S. (2006). *Critical technology issues for school leaders*. Thousand Oaks, CA: Corwin Press.
- Bruin, J., (2006). *Newtest: Command to compute new test*. Los Angeles, CA: Academic Technology Services. Retrieved from: <http://www.ats.ucla.edu/stat/stata/ado/analysis/>
- Burgelman, R. A., & Sayles, L. R. (1986). *Inside corporate innovation*. New York, NY: The Free Press.
- Carpenter, S. R. (1977). Philosophical issues in technology assessment. *Philosophy of Science*, 44(4), 574-593.
- Cattell, D. R. B. (1996). The scree test for the number of factors. *Multivariate Behavioral Research* 1(5), 245-76.
- Chan Lin, L. J. (2007). Perceived importance and manageability of teachers toward the factors of integrating computer technology into classrooms. *Innovations in Education and Teaching International*, 44(1), 45-56.
- Chen, C., Wu, J., & Yang, S. C., (2008). Accelerating the use of weblogs as an alternative method to deliver case-based learning. *International Journal on ELearning*, 7(2), 331-349.
- Chin, W. W. (1998). Issues and opinion on structural equation modeling. *MIS Quarterly*, 22(1), 7-16.
- Chin, W. W., & Gopal, A. (1995). Adoption intention in GSS: Relative importance of beliefs. *The Data Base for Advances in Information Systems*, 26(2), 42-64.
- Chin, W. W., Marcolin, B. L., & Newsted, P. R. (2003). A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion/adoption study. *Information Systems Research*, 1(2), 189-217.

- Christensen, R. (2002). Effects of technology integration education on the attitudes of teachers and students. *Journal of Research in Technology in Education*, 34(4), 411-434.
- Cicchelli, T., & Baecher, R. (1990, March). *Theory and practice: Implementing computer technology in a secondary school*. Paper presented at the seventh International Conference on Technology and Education, Brussels, Belgium.
- Cohen, J. (1977). *Statistical power analysis for the behavioral sciences* (revised ed.). New York, NY: Academic Press.
- Coley, R., Cradler, J., & Engel, K. (1997). *The status of technology in U.S. schools*. Policy Information Report. Princeton, NJ: Educational Testing Service.
- Compeau, D., & Higgins, C. (1995). Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly*, 19(2), 189-211.
- Compeau, D., & Higgins, C. (1999). Social cognitive theory and individual reactions to computing technology: A longitudinal study. *MIS Quarterly*, 23(2), 145-158.
- Comrey, A. L. (1978). Common methodological problems in factor analytic studies. *Journal of Counseling and Clinical Psychology*, 46(2), 648-659.
- Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed approaches*. Thousand Oaks, CA: Sage.
- Cuban, L. (1988). *The managerial imperative and the practice of leadership in schools*. Albany, NY: State University of New York Press.
- Cuban, L. (1993). *How teachers taught: Constancy and change in American classrooms 1890-1990* (2<sup>nd</sup> ed.). New York, NY: Teachers College Press.
- Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining an apparent paradox. *American Educational Research Journal*, 38(4), 813-834.
- Culp, K. M., Honey, M., & Mandinach, E. (2003). *A retrospective on twenty years of education technology policy*. Washington, DC: Education Development Center for Children and Technology. Retrieved from: [http://www.nationaledeotechplan.org/docs\\_and\\_pdf/20yearsdotherevised](http://www.nationaledeotechplan.org/docs_and_pdf/20yearsdotherevised)
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-339.
- Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology*, 22(14), 1111-1132.

- Debell, M., & Chapman, C. (2006). *Computer and Internet use by students in 2003* (NCES 2006-065). Washington, DC: National Center for Education Statistics.
- Dede, C. (1998). Evaluating the effectiveness of technology initiatives. *The High School Magazine*, 6(1), 16-20.
- Dexter, S. L., Anderson, R. E., & Becker, H. J. (1999). Teachers' views of computers as catalyst for changed in their teaching practice. *Journal of Research on Computing in Education*, 31, 221-238.
- Dickard, N. (Ed.), (2003). *The sustainability challenge: Taking ed-tech to the next level*. Washington, DC: The Benton Foundation Communications Policy Program & EDC Center for Children and Technology. Retrieved from: [http://www.benton.org/publibrary/sustainability/sus\\_challenge.html](http://www.benton.org/publibrary/sustainability/sus_challenge.html)
- Dillman, D. A. (2007). *Mail and Internet surveys: The tailored design method*. Hoboken, NJ: Wiley.
- Dwyer, D. (1995). Technology locks, creative destruction, and on-convergence in productivity levels. *Center for Economic Studies Working Paper*, 95-6. Washington DC: U.S. Census Bureau, Center for Economic Studies.
- Eckhardt, A., Laumer, S., & Weitzel, T. (2009). Who influences whom? Analyzing workplace referents' social influence on IT adoption and non-adoption. *Journal of Information Technology*, 24(1), 11-24.
- Ertmer, P. A. (1999). Addressing first and second order barriers to change: Strategies for technology integration. *Educational Technology, Research and Development*, 47(4), 47-62.
- Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration. *Educational Technology, Research and Development*, 53(4), 25-40.
- Field, A. (2005). *Discovering statistics using SPSS* (2<sup>nd</sup> ed.). London, England: Sage.
- Fields, M. W., & Shallenberger, W. R. (1987). The influence of age and education on perceptions of occupational attractiveness. *Journal of Occupational Psychology*, 6(4), 339-242.
- Ford, M. E. (1992). *Motivating humans: Goals, emotions, and personal agency beliefs*. Newbury Park, CA: Sage.
- Ford, K. J., MacCallum, R.C., & Tait, M. (1986). The application of exploratory factor analysis in applied psychology: A critical review and analysis. *Personnel Psychology*, (39)1, 291-315.

- Fornell, C., & Larcker, D. (1981). Structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39-50.
- French, J. R. P., & Raven, B. (1959). The bases of social power. In D. Cartwright (Ed.) *Studies in social power* (pp. 150-167). Ann Arbor, MI: University of Michigan Press.
- Freed J. E., & Klugman M. R. (1997). *Quality principles and practices in higher education. Different questions for different times*. Phoenix, AZ: Orxy Press.
- George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference* (4th ed.). Boston, MA: Allyn & Bacon.
- Goodhue, D. L, Lewis, W., & Thompson, R. L. (2007). Statistical power in analyzing interaction effects: Questioning the advantage of PLS with product indicators. *Information Systems Research*. 18(2), 211-227.
- Gorsuch, R. L., (1983). *Factor analysis* (2<sup>nd</sup> ed.). Hillsdale, N.J. Erlbaum.
- Gray, J., & Thomas, S. (2001). Educational effectiveness and improvement: Developing new theories and methods. *British Educational Research Journal*, 27(4), 387-402.
- Gray, L., Thomas, N., & Lewis, L. (2010). *Teachers' use of educational technology in U.S. public schools: 2009* (NCES 2010-040). Washington, DC. U.S. Department of Education. National Center for Education Statistics, Institute of Education Sciences.
- Green, S. B., & Salkind, N. J. (2005). *Using SPSS for Windows and Macintosh: Analyzing and understanding data*. Upper Saddle River, NJ: Prentice Hall.
- Grossman, P. L., & Stodolsky, S. S. (1995). Content as context: The role of school subjects in secondary school teaching. *Educational Researcher*, 24(8), 5-11.
- Hall, G, E., (1974). *The concerns-based adoption model: A developmental conceptualization of the adoption process within educational institutions*. Austin, TX: University of Texas Research and Development Center for Teacher Education.
- Hallinger, P., & Heck, R. (1996). Reassessing the principal's role in school effectiveness: A review of empirical research, 1980-1995. *Educational Administration Quarterly*, 32(1), 5-44.
- Harrison, D. A. (1995). Volunteer motivation and attendance decisions: Competitive theory testing in multiple samples from a homeless shelter. *Journal of Applied Psychology*, 80(3), 371-385.

- Hart, H., Allensworth, E., Lauen, D. & Gladden, M. (2002). *Educational technology in Chicago public schools: A baseline report*. Chicago, IL: Consortium on Chicago Schools Research.
- Havelka, D. (2003). Student's beliefs and Attitudes toward information technology. *Information Systems Education Journal*, 1 (40), 3-4.
- Heifetz, A. (1993). The Bayesian formulation of incomplete information the non-compact case. *International Journal of Game Theory*, 21, 329-338.
- Henseler, J., & Chin, W. W. (2010). A comparison of approaches for the analysis of interaction effects between latent variables using partial least squares path modeling. *Structural Equation Modeling: A Multidisciplinary Journal*, 17(1) 82-109.
- Hightower, A. M. (2009). Tracking U.S. trends: States earn B average for policies supporting educational technology use. *Education Week*, 28(26), 30-31.
- Iivari, J. (2005). An empirical test of the DeLone-McLean model of information system success. *The Data Base for Advances in Information Systems*, 36(2), 8-27.
- International Society for Technology in Education. (2000). *National educational technology standards for teachers*. Eugene, OR: Author. Available: <http://cnets.iste.org/>.
- International Society for Technology in Education. (2002). *National educational technology standards for students*. Eugene, OR: Author. Available: <http://cnets.iste.org/>.
- International Society for Technology in Education. (2003). *National educational technology standards for teachers*. Eugene, OR: Author. Available: <http://cnets.iste.org/>.
- International Society for Technology in Education. (2009). *National educational technology standards for administrators*. Eugene, OR: Author. Available: <http://cnets.iste.org/>
- Jackson, M. O. (2005). Allocation rules for network games. *Games and Economic Behavior*, 5(11), 128-154.
- Jaspersen, J., Carter, P., & Zmud, R. (2005). A comprehensive conceptualization of post-adoptive behaviors associated with IT enabled work systems. *MIS Quarterly*, 29(3), 525-557.
- Jones, T., & Clarke, V. A. (1995). Diversity as a determinant of attitudes: A possible explanation of the apparent advantage of single sex settings. *Journal of Computing Research*, 12(1), 51-54.
- Jöreskog, K. G., & Wold, H., (1982). *The ML and PLS techniques for modeling with latent variables: Historical and competitive aspects*. Amsterdam, Holland: North-Holland.

- Kay, R. H. (2006). Evaluating strategies used to incorporate technology into pre-service education: A review of the literature. *Journal of Research on Technology in Education*, 38(4), 383-408.
- Kirchmeyer, C. (2002). Change and stability in a manager's gender roles. *Journal of Applied Psychology*, 87(5), 929-939.
- Kiridis, A., Drossos, V., & Tsakiridou, H. (2006). Teachers facing information and communication technology (ICT): The case of Greece. *Journal of Technology and Teacher Education*, 14(1), 75-96.
- Koivimäki, T., Ristola, A., & Kesti, M. (2008). The perceptions towards mobile services: An empirical analysis of the role of use facilitators. *Personal & Ubiquitous Computing*, 1(1), 67-75.
- Korukonda, R. A. (2006). Differences that do matter: A dialectic analysis of individual characteristics and personality dimensions contributing to computer anxiety. *Computers in Human Behavior*, 23(4), 1921-1942.
- Kozma, R. (2003). *Technology, innovation, and educational change: A global perspective*. Eugene, OR: International Society for Technology in Education.
- Kulik, J. A. (1994). Meta-analytic studies of findings on computer-based instruction. In E. L. Baker & H. E. O'Neil, Jr. (Eds.), *Technology assessment in education and training* (pp. 9-33). Hillsdale, NJ: Lawrence Erlbaum.
- Leithwood, K., & Riehl, C. (2003). *What do we already know about successful school leadership?* Philadelphia, PA: Temple University Laboratory for Student Success.
- Lim, C. P. (2007). Effective integration of ICT in Singapore schools: Pedagogical and policy implications. *Educational Technology, Research and Development*, 55(1), 83-116.
- Lleras, C. (2005). Path analysis. In *Encyclopedia of Social Measurement* (Vol. 3). St. Louis, MO, Elsevier Inc.
- Mann, D., Shakeshaft, C., Becker, J., & Kottkamp, R. (1999). *West Virginia's basic skills/computer education program: An analysis of student achievement*. Santa Monica, CA: Milken Family Foundation.
- Marchewka, J. T., & Liu, C. (2007). An application of the UTAUT model for understanding student perceptions using course management software. *Communication of the IIMA*, 7(2), 93-104.
- Marcinkiewicz, H. R. (1996). Computers and teachers: Factors influencing computer use in the classroom. *Journal of Research on Computing in Education*, 26(2), 220-237.



- Mardis, M. A., Hoffman, E. S., & Marshall, T. E. (2008). A new framework for educational digital library use: Re-examining the digital divide in U.S. schools. *International Journal of Digital Libraries*, 9(1), 19-27.
- McLaughlin, M. W., Talbert, J. E., & Bascia, N. (2001). *Professional communities and the work of high school teaching*. Chicago, IL: University of Chicago Press.
- Minton, H. L., & Schnieder, F. W. (1980). *Differential psychology*. Prospect Heights, IL: Waveland Press.
- Moersch, C. (1995). Levels of technology implementation (LoTi): A framework for measuring classroom technology use. *Learning and Leading with Technology*, 23(3), 40-42.
- Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, 2(3), 192-222.
- Moran, M., Walters, J., & Puetz, R., (2009), Longitudinal examination of student attitudes towards enhanced instruction with tablet PC. *MWAIS 2009 Proceedings*. Paper 8. Retrieved from: <http://aisel.aisnet.org/mwais2009/8>
- Morris, M. G., & Venkatesh, V. (2000). Age differences in technology adoption decisions: Implications for a changing workforce. *Personnel Psychology*, 53(2), 375-403.
- National Center for Education Statistics, U.S. Department of Education. (2000). *Teacher use of computers and the Internet in public schools*. Washington, DC: Author. Forum on Education Statistics. Retrieved from <http://nces.ed.gov/pubs2000/2000090.pdf>
- National Center for Education Statistics, U.S. Department of Education, (2003-04). *Schools and Staffing Survey, Private School Data File*. Washington, DC: Author. Forum on Education Statistics.
- Nespor, J. (1987). The role of beliefs in the practice of teaching. *Journal of Curriculum Studies*, 19(4), 317-328.
- Neufeld, D. J., Dong, L., & Higgins, C. A. (2007). Charismatic leadership and user acceptance of information technology. *European Journal of Information Systems*, 16(4), 494-510.
- No Child Left Behind Act of 2001, U.S.C.107, § 1425 (2001).
- Norris, C., Sullivan, T., & Poirot, J., (2003). No access, no use, no impact: Snapshot surveys of educational technology in K-12. *Journal of Research on Technology in Education*, 23(1), 15-27.
- Nunnally, J. C. (1978). *Psychometric theory*. New York, NY: McGraw-Hill.

- Office of Technology Assessment. (1995). *Teachers and technology: Making the connection*. Washington, DC: U.S. Government Printing Office.
- O'Rourke, N., Hatcher, L., & Stepanski, E. J. (2005). *A step-by-step approach to using SAS for univariate and multivariate statistics* (2<sup>nd</sup> ed.). Cary, NC: SAS Institute Inc.
- Owen, P. S., & Demb, A. (2004). Change dynamics and leadership in technology implementation. *The Journal of Higher Education*, 75(6), 636-666.
- Pajares, M. F. (1992). Teachers beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research*, 62(3), 307-332.
- Parsad, B., & Jones, J. (2005). *Internet access in U.S. public schools and classrooms: 1994–2003* (NCES 2005–015). Washington, DC: U.S. Department of Education. National Center for Education Statistics.
- Peneul, W. R. (2006). Implementation and effects of one-to-one computing initiatives: A research synthesis. *Journal of Research on Technology in Education*, 38(3), 329-348.
- Plude, D., & Hoyer, W. (1985). Attention and performance: Identify and localizing age deficits. In N. Charness (Ed). *Aging and human performance*. (pp. 47- 99). New York NY: John Wiley & Sons.
- Prain, V., & Hand, B. (2003). Using new technologies for learning: A case study of a whole school approach. *Journal of Research on Technology in Education*, 35(4), 441-458.
- Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon*, 9(5), 1–2.
- Pruzek, R. (2005). *Factor Analysis: In Encyclopedia of statistics in behavioral science*. Hoboken, NJ: John Wiley & Sons.
- Rai, A., Lang, S. S., & Welker, R. B. (2002). Assessing the validity of IS success models: An empirical test and theoretical analysis. *Information Systems Research*, 13(1), 50-69.
- Ravitz, J., Becker, H., & Wong, Y. (2000). *Report 4: Constructivist-compatible beliefs and practices among U.S. teachers*. Irvine, CA: Center for Research on Information Technology and Organizations. Available at: <http://www.crito.uci.edu/tlc/html/findings>
- Raymond, L., & Bergeron, F. (1997). Global distribution systems: A field study of their use and advantages in travel agencies. *Journal of Global Information Management*, 5(4), 23-32.
- Reeves, D. (2005). Leadership and organization for technology. *School Administrator*, 62(4), 22-24.
- Rivard, S., Poirier, G., Raymond, L., & Bergeron, F. (1994). Development of a measure to assess the quality of user- developed applications. *Communications of the ACM*, 37(5), 102-113.

- Rogers, E. M. (1962). *Diffusions of innovations*. New York, NY: The Free Press.
- Rokeach, M. (1968). *Belief, attitudes, and values: A theory of organization and change*. San Francisco, CA: Jossey-Bass.
- Rummel, R. J. (1970). *Applied factor analysis*. Evanston IL: Northwestern University Press.
- Russell, M., Bebell, D., O'Dwyer, L. M., & O'Connor, K. M. (2003) Examining teacher technology use: Implications for pre-Service and in-Service teacher preparation. *Journal of Teacher Education* 54(4), 297-310.
- Ryan, R. M. (1982). Control and information in the intrapersonal sphere: An extension of cognitive evaluation theory. *Journal of Personality and Social Psychology*, 43(3), 450-461.
- Sanderlands, L. E., & Stablein R. E. (1987). *The concept of organization mind. Research in the sociology of organizations*. Greenwich, CT: JAI Press.
- Sandholtz, J. H., Ringstaff, C., & Dwyer, D. (1997). *Teaching with technology: Creating student-centered classrooms*. New York, NY: Teachers College Press.
- Scardamalia, M., & Bereiter, C. (1996). Engaging students in a knowledge society. *Educational Leadership*, 54(3), 6-10.
- Senge, P. (1990). *The fifth discipline: The art and practice of the learning organization*. New York, NY: Doubleday Currency.
- Schreiber, J. B., Nora, A., Stage, F. K., Barlow, E. A., & King, J. (2006). Reporting structural equation modeling and confirmatory factor analysis results: A review. *The Journal of Educational Research*, 99(6), 323-337.
- Sharma, S., Durand, R. M., & Gur-Arie, O. (1981). Identification and analysis of moderator variables. *Journal of Marketing Research*, 18(3), 291-300.
- Sheppard, B. H., Hartwick, J., & Warshaw, P. R. (1988). The theory of reasoned action: A meta-analysis of past research with recommendations for modifications and future research. *Journal of Consumer Research*, 15(3), 325-343.
- Sivin-Kachala, J. (1998). *Report on the effectiveness of technology in school, 1990–1997*. Washington, DC: Software Publishers Association.
- Smerdon, B., Cronen, S., Lanahan, L., Anderson, J., Iannotti, N., & Angeles, J. (2000). *Teachers' tools for the 21st Century: A report on teacher's use of technology*. (Statistical analysis report No. NCES 2000-102). Washington, DC: U.S. Department of Education, National Center for Education Statistics.

- Smith, S. J., & Robinson, S. (2003). Technology integration through collaborative cohorts: Preparing future teachers to use technology. *Remedial and Special Education, 24*(3), 154–160.
- Spillane, J. P., Reiser, B. J., & Reimer, T. (2002). Policy implementation and cognition: Reframing and refocusing implementation research. *Review of Educational Research, 72*(3), 387-431.
- Stevens, J. (2002). *Applied multivariate statistics for the social sciences*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
- Stoneman, P., & Diederer, P. (1995). Technology diffusion and public policy. *The Economic Journal, 104*(425), 918-930.
- Straub, E. (2009). Understanding technology adoption: Theory and future direction for informal learning. *Review of Educational Research, 70*(2), 625-649.
- Straub, D. M., Limayem, E., & Karahanna-Evaristo, E. (1995). Measuring system usage: Implications for IS theory testing. *Management Science, 41*(8), 1328–1342.
- Sugar, W., Crawley, F., & Fine, B. (2005). Critiquing theory of planned behavior as a method to assess teacher's technology integration attitudes. *British Journal of Educational Technology, 36*(2), 331-334.
- Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (4th ed.). Needham, MA: Allyn & Bacon.
- Taylor, S., & Todd, P. A. (1995). Understanding information technology usage: A test of competing models. *Information Systems Research, 6*(4), 144-176.
- Thompson, R. L., Higgins, C. A., & Howell, J. M. (1991). Personal computing: Toward a conceptual model of utilization. *MIS Quarterly, 15*(1), 124-143.
- Thompson, R., Compeau, R. D., & Higgins, C. (2006). Intentions to use information technologies: An integrative model. *Journal of Organizational and End User Computing, 18*(3), 25-47.
- Thong, J. Y., Venkatesh, V., Xu, X., Hong, S., & Tan, K. Y. (2011). Consumer acceptance of personal information and communication technology services. *IEEE Transactions on Engineering Management, 58*(2), 391-392.
- Thurstone, L. L. (1947). *Multiple-factor analysis: A development and expansion of the vectors of the mind*. Chicago, IL: University of Chicago Press.

- Tienken, C., & Wilson, M. (2007). The impact of computer assisted instruction on seventh-grade students' mathematic achievement. *Planning and Changing*, 38(3/4), 181-190.
- Triandis, H. C. (1977). *Interpersonal behavior*. Monterey, CA: Brooks/Cole.
- U.S. Department of Education. (2000). *Teachers' tools for the 21st century: A report on teachers' use of technology*, Washington, DC: U.S. Government Printing Office.
- U.S. Department of Education. (2003). *Internet access in U.S. public schools and classrooms: 1994-2002*. Washington, DC: U.S. Government Printing Office.
- U. S. National Commission on Excellence in Education. (1983). *A nation at risk: The imperative for educational reform*, Washington, DC: U.S. Government Printing Office.
- Vallerand, R. J. (1997). Toward a hierarchical model of intrinsic and extrinsic motivation, *Advances in Experimental Social Psychology*, 29, 271-360.
- Venkatesh, V. (2006). Where to go from here? Thoughts on future directions for research on individual-level technology adoption with a focus on decision making. *Decision Sciences*, 37(4), 497-519.
- Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies, *Management Science*, 45(2), 186-204.
- Venkatesh, V., Maruping, L. M., Brown, S. A., & Bala H. (2006). Predicting different conceptualizations of system use: The competing roles of behavioral intention, facilitating conditions, and behavioral expectation. *MIS Quarterly*, 32(3), 483-502.
- Venkatesh, V., & Morris, M. G. (2000). Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. *MIS Quarterly*, 24(1), 115-139.
- Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425-478.
- Venkatesh, V., Thong, J.Y.L., and Xin, X. (in press). Consumer acceptance of personal information technology: Extending the unified theory of acceptance and use of technology. *MIS Quarterly*.
- Venkatesh, V., & Speier, C. (1999). Computer technology training in the workplace: A longitudinal investigation of the effect of the mood. *Organizational Behavior and Human Decision Processes*, 79(1), 1-28.
- Verhoeven, J., Heerwegh, D., & De Wit, K. (2010). Information and communication technologies in the life of university freshmen: An analysis of change. *Computers & Education*, 55(1), 53-66.

- Wang, Y., Wang, K., & Wu, M. (2009). Investigating the determinants of age and gender differences in the acceptance of mobile learning. *British Journal of Educational Technology*, 40(1), 92-118.
- Warshaw, P. R. (1980). A new model for predicting behavioral intentions: An alternative to Fishbein. *Journal of Marketing Research*, 1(7), 153-172.
- Warshaw, P. R., & Davis, F. D. (1984). Self-understanding and the accuracy of behavioral expectations. *Personality & Social Psychology Bulletin*, 10(1), 111-118.
- Warshaw, P. R., & Davis, F. D. (1985). The accuracy of behavioral intention versus behavioral expectation for predicting behavioral goals. *Journal of Psychology*, 119(6), 599-602.
- Waxman, H. C., Connell, M. L., & Gray, J. (2002). *A quantitative synthesis of recent research on the effects of teaching and learning with technology on student outcomes*. Naperville, IL: North Central Regional Education Laboratory.
- Wenglinski, H. (1998). *Does it compute? The relationship between educational technology and student achievement in mathematics*. Princeton, NJ: ETS.
- Westland, J. C., & Clark, T. H. (2000). *Global electronic commerce: Theory and case studies*, Cambridge, MA: MIT Press.
- Williams, F. J., & Robinson-Horne, J. P. (2000, November). *Impact of investment in education and training on performance in production, quality and safety*. Paper presented at the Annual Meeting of the Mid-South Educational Research Association. Bowling Green, KY.
- Wiske, M. S., Sick, M., & Wirsig, S. (2001). New technologies to support teaching for understanding. *International Journal of Educational Research*, 35(5), 483-501.
- Wu, A. D., & Zumbo, B. D. (2009). Understanding and using mediators and moderators. *Social Indicators Research*, 87(3), 367-392.
- Yang, H., Mohamed, D., & Beyerbach, B. (1999). An investigation of computer anxiety among vocational-technical teachers. *Journal of Industrial Teacher Education*, 37(1), 64-82.
- Yukl, G. (1989). Managerial leadership: A review of theory and research. *Journal of Management*, 15(2), 251-289.
- Yurov, K. M., & Potter R. E. (2006). Transformational leadership in technology post-adoption period: A motivational factor for acquiring technology enhancement information. *The Proceedings of the 2006 Annual Meeting of Southwest Decision Science Institute*, Oklahoma City, OK. Available at: <http://www.swdsi.org/swdsi06/Proceedings06/Papers/MIS10.pdf>

Zhao, Y. (1998). Design for adoption: The development of an integrated web-based education environment. *Journal of Research on Computing in Education*, 30(3), 307–328.

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"Computer Interfacing Applications in Science" Inter-Kingdom Science Workshop ARAMCO Schools, Dhahran, Saudi Arabia (Oct. 1988).

"The Rock Your Students Dig ", The Science Teacher magazine (March 1990).

Wood County Planning Commission - Bowling Green, Ohio June 1979-June 1982

Assignment: Environmental Land Use Planner.

United States Peace Corps - Swaziland, Africa June 1976 - Jan. 1979

Teaching assignments: Secondary science in rural day school.