ABSTRACT

JONES, SHARON TORRENCE. Technology Integration in the Teaching and Learning Process in Career and Technical Education Programs in North Carolina. (Under the direction Dr. James Bartlett.)

Career and technical education (CTE), historically known as vocational education, is a collective term used to identify high school curricula designed to teach students job skills and prepare them for employment (Lynch, 2000). Transformations in the workforce have created a demand for teachers to be technologically literate and adept at using technology as a part of their teaching methods (Gaytan, 2006).

The purpose of the study was to examine North Carolina CTE instructor's level of technology integration and related factors that could be used to predict technology integration including: perceived technology anxieties, barriers, and perceived teaching effectiveness. The research methodology included a survey design utilizing the frameworks of the Technology Acceptance Model (TAM) and the Kotrlik/Redmann Technology Integration Scale (KRIS). The sample was drawn from CTE teachers who attended the 2009 Summer Conference in North Carolina.

The study was expected to show that CTE teachers were not fully integrating technology into their pedagogy due to barriers such as lack of time and training. The findings will be significant because they will help determine why CTE teachers are or are not integrating technology in the classroom. Additionally, findings from this study can be used to train administrators and other CTE teachers to better utilize technology.

Technology Integration in the Teaching and Learning Process in Career and Technical Education Programs in North Carolina

by
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DEDICATION

I dedicate this dissertation to my family- my Mom, Dad and brother David, and my in-laws- who have given me unconditional love and have been my cheerleaders as I have progressed through this journey. This paper is also dedicated to my fellow cohort colleagues, Lisa Martin and Patrice Mitchell for their consistent support and encouragement. We made it through the marathon together! And finally to my husband Ricky, who has been my rock through this process. As I complete this passage, I look to the new chapter in our life as our family grows.

BIOGRAPHY

I am a Career and Education teacher in Charlotte Mecklenburg Schools and have been teaching for 5 years. My first teaching position was in Apex, NC teaching computer programming and web development. Currently my position at Phillip O. Berry Academy of Technology includes teaching SAS programming, web development, and computer programming.

My husband Ricky and I have been married for two and a half years and have a cockapoo named Cooper, who brings joy to us everyday. Some of my hobbies include reading, swimming, cooking, traveling, and planning family/friend events. My passion for education, teaching, and Career and Technical Education lead me to this dissertation.

TABLE OF CONTENTS

Table of Contents (Continued) Page

LIST OF TABLES

List of Tables (Continued)

List of Tables (Continued)

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

Technology is becoming an integral part of many jobs within the workforce (Atkinson, 2000; Plomp, Anderson, & Law, 2009). Bailey and Stefaniak (2002) stated that "computer systems have permeated virtually every facet of organizations" (p. 5), and the field of education is not immune to rapid changes regarding the use of technology. In a study of career and technical education teachers, Redmann and Kotrlik (2004) stated, "The rapid changes occurring in society and in technology have had tremendous impact on the educational community as it prepares individuals for the workplace" (p. 76). CTE teachers face a unique challenge regarding technology because they are both professionals in the workforce and participants in a profession that prepares people to enter the workforce. Career and technical education is a discipline that has been created to better prepare students to use technology in the workforce, employers are challenging their employees not only to understand and use technology, but to find innovative ways to enhance the uses of technology (Jacobsen, 2001; Redmann & Kotrlik, 2004). Despite the support and investment schools have placed in acquiring technology, concern exists that technology still remains underutilized (Fabry & Higgs, 1997).

Over 15 years ago, the integration of technology into school curricula received public and professional attention (Office of Technology Assessment, 1995). Although technology standards that call for the use of technology in education have existed for many years (NBEA, 2001, ISTE, 2008), it is still challenging for teachers to infuse technology into their teaching practices (Jacobsen, 2001; Kotrlik and Redmann, 2005;

ISTE, 2008). Providing valuable life skills to American students is the goal of CTE, and the belief that technology can increase learning remains strong. However, the successful integration of computers in the classroom depends largely on how teachers embrace and use technology practices (Fabry & Higgs, 1997).

Since the creation of CTE, economic developments have had major influences on the content and direction of curriculum in the secondary schools (Rojewski, 2002). CTE was enacted to prepare students for jobs resulting from the industrial revolution. The beginning of federal legislation shaping vocational education was the Smith-Hughes Act (Lynch, 2000), which emphasized a call for a curriculum that would meet the needs of the working class (Lynch, 2000). Developments to accommodate the "working class" in school curricula have remained relatively gradual until recently, when economists declared a "new economy" (Rojewski, 2002, p.32). A new economy is one that includes manufacturing, globalization of business, information handling, business management practices, and fierce competition (Rojewski, 2002). The change in society from sole manufacturing environments to a multi-tasking, information-technology-based environment has created diverse problems in our educational system (Rojewski, 2002). The adoption of new technology in business and industry is placing additional emphasis on the need for training and education (Rucker & Reynolds, 2002).

CTE is a collective term used to identify high school curricula designed to teach students job skills and prepare them for enter employment (Lynch, 2000). CTE programs typically include the following disciplines: business, technology, agriculture, family and consumer sciences, health occupations, career development, marketing, and other trade and industrial professions. Teachers are a subset of all educators and are unique because they often have the predominant responsibility of teaching workforce development programs (Brand, 2008). CTE teachers assist in preparing students to pursue academic and technical studies in the workforce, post-secondary education, and beyond (Belland, 2009).

Changes in the workforce due to the technological revolution have created a demand for CTE educators to be computer and technologically literate (Redmann & Kotrlik, 2004; Kotrlik & Redmann, 2005). Additionally, these changes are challenging CTE professionals to adapt to using technology in their teaching methods to prepare students for the workforce. Specifically, the National Educational Technology Standards by the International Society of Technology Education (ISTE) (2008) states that teachers should "develop technology-enriched learning environments that enable all students to pursue their individual curiosities." Pursuing their thoughts and ideas allows students to become active participants in their own educational goals, learning processes, and progress assessments (ISTE, 2008). As a result, CTE teachers need to master technological skills to be prepared to teach their students for these changing environments (ISTE, 2008; Brand, 2008). Because many jobs in the future, especially those within the CTE fields, will involve technology, it is critical for students to have the education and skills to perform in the 21st century workplace (McCoy, 2001; ISTE 2008; Brand, 2008).

Teachers are viewed as important agents of change in the reform effort of education, and they are expected to play a key role in these changing schools and classrooms (Prawat, 1992; Jacobsen, 2001; Baylor & Ritchie, 2001; Bitner & Bitner, 2002). While administrators can support the use of technology, the adoption of technology and its integration into the classroom lies in the hands of teachers (Jacobsen, 2001; Bitner & Bitner, 2002). Teachers who ensure these constant technological changes are included in the classroom are critical factors for CTE to produce highly qualified students to enter the workforce.

Researchers have cited CTE teachers as the most active in exploring the potential of using technology in the teaching/learning process and in adopting technology for regular use in instruction (Redmann, Kotrlik, & Douglas, 2003; Bower, 1998; Hutt, 2003; Redmann & Kotrlik, 2004). However, they are not very active in experimenting with technology or with advanced technology integration (Kotrlik, Redmann, & Harrison, 2000; Huitt, 2003; Redmann & Kotrlik, 2004; Kotrlik & Redmann, 2005). For information technology to be truly effective in education a re-engineering of structure or paradigm shift needs to emerge, one of learning and continued investment in CTE teachers to be confident in the integration of technology in the teaching and learning process (Ensminger, 2008).

Statement of the Problem

Technology is being used extensively across society and in business and industry (Machnaik, 2002). A report by the Information Technology Association of America (ITAA) warns that one out of every 10 jobs requiring information technology skills is going unfilled due to a shortage of qualified workers (Atkinson, 2000). Notions of routine face-to-face interactions are becoming obsolete, while the digital networks are creating a new economy of business and increasing rapidly (Atkinson, 2000).

Today's educators have wider access to computer technology and are beginning to recognize it as a powerful tool in the teaching and learning process (Machnaik, 2002). While this impacts all education, CTE is especially impacted due to the technical nature of the discipline. CTE has evolved from practical education to prepare professionals for the workplace to a field that is highly technologically driven (Lynch, 2000). Technology impacts CTE teachers as they educate students for the workforce. CTE teachers do not only teach technology applied to students' future roles in the workforce; they are being encouraged to use this technology in their instruction. If teachers are not using and teaching current technology, it places students at a disadvantage when trying to enter the workforce or further their educations (Lynch, 2000).

Little research has been conducted about why teachers do not use technology (Zhao & Cziko, 2001); most research about educational technology has focused on the impact of technology on learners (Zhao & Cziko, 2001). Studies conducted about teachers using technology have centered on the successful/accomplished technology users (Hadley & Sheingold, 1993) rather than the majority. Within their own study Hadley and Sheingold (1993) found that motivated teachers who were accomplished in using computers were more likely to report impressive changes in their teaching when using technology. Researchers have examined barriers to technology use (Kotrlik & Redmann, 2005), levels of usage, and even levels of integration (Kotrlik & Redmann, 2005). However, the literature has not provided a clear understanding of why or why not

CTE teachers are integrating technology. In other studies of technology adoption (Mellon 1999; Huitt, 2003), there have been links between technology usage and anxieties, attitudes, beliefs, and experiences. Without understanding what impacts CTE teachers' technology integration, it is hard to provide effective in-service training, professional development opportunities, and teacher education program preparation. Because the topic of technology for teaching and learning is emerging as one of the forces leveraging educational reform (Jacobsen, 2001), it is critical for those providing professional development opportunities to understand the perspectives of CTE teachers. Districts face difficulties providing students with the best education to prepare them for the workplace; therefore, research to increase student preparation is imperative to offer students the knowledge they need to succeed.

Statement of Purpose

The purpose of this study was to examine North Carolina CTE instructors' levels of technology integration and related factors that can be used to predict technology integration, including perceived technology anxieties, barriers, and perceived teaching effectiveness. To assess both the levels of integration and the factors that predict integration, the Kotrlik and Redmann Technology Integration Scale (KRIS) was used. The Technology Acceptance Model (TAM) was used to assess the levels of technology acceptance. This study examined CTE teachers' integration of technology in the classroom. The researcher described the levels of technology integration and perceptions of such factors as technology anxieties, barriers, and teaching effectiveness. The study then examined the relationship between the levels of integration and the factors. Finally, the researcher determined if the factors sought to explain technology integration explain a significant proportion of the variance in the level of integration within the CTE instructors' classrooms.

Research Objectives

This study utilized a quantitative survey design to examine technology integration by CTE teachers. In addition to describing the sample on basic demographic characteristics (gender, age, years of experience, education experience), the following research objectives guided the study:

- *Research Objective 1* – Describe the level of career and technical educators' technology integration with the four constructs of integration (exploration, experimentation, adoption, and advanced integration) as measured by the Kotrlik and Redmann Technology Integration Scale (KRIS).
- *Research Objective 2* – Describe career and technical educators' perceptions of technology usefulness and ease of use in the teaching and learning process, as measured using the Technology Acceptance Model (TAM) developed by Davis (1989).
- *Research Objective 3* – Explore the relationships between career and technical educators' technology acceptance factors (perceptions of technology usefulness and ease of use) and levels of technology integration with each of the four levels of integration (exploration, experimentation, adoption, and advanced integration).

- *Research Objective 4* – Explore which aspects of demographic variables; technology integration factors; and perceptions of such factors as technology anxieties, barriers, and teaching effectiveness explain a significant proportion of the variance in technology integration within each of the four levels of technology integration.

Significance of the Study

It is imperative for CTE professionals to stay abreast of current technologies and business practices to prepare students for the workforce. CTE empowers students by providing a range of learning opportunities that serve different learning styles (Plank, Deuce, & Estacion, 2005). Using technology within instruction often creates a learning environment that integrates a variety of learning styles and is similar to the workplace (Plank et al., 2005; Brand, 2008). Since CTE often relies on a powerful mode of teaching and learning that cognitive scientists call “contextual” or “situated” learning, both in classrooms and in workplaces (Plank et al., 2005; Anderson, Reder, & Simon, 1996), it is important for instructors to integrate this type of instruction in the classroom in order to create a contextual environment. “Contextual/situated learning emphasizes the idea that much of what is learned is specific to the situation in which it is learned” (Anderson et al., 1996, p. 5). Applying academic and technical skills to real-world activities, using computers and other tools, and being able to see how their learning is related to the world of work make CTE classes more interesting, motivating, and educationally powerful than standard academic classes (Plank, et al., 2005). “Greater emphasis should be given to the relationship between what is learned in the classroom and what is needed outside of the classroom, and this has been a valuable contribution of the situated learning movement" (Anderson et al., 1996, p. 5). The career focus integrated with technology to prepare them for the workforce often gives students a sense of direction.

Today, information is readily available from numerous sources (ACOT2, 2008). These technology innovations democratize information, giving students direct access to their future knowledge in an organized, indexed, and affordable way, with resources and instruction available around the clock (Lynch, 2000). These changes affect the role of educators even more dramatically (ACOT2, 2008). "Educators must become more than information experts; they must also be collaborators in learning, leveraging the power of students, seeking new knowledge alongside students, and modeling positive habits of mind and new ways of thinking and learning" (ACOT2, 2008). To make these transitions, teachers must be well versed in knowing and using technology. It is important to understand the current status of the CTE field in terms of integrating technology. Additionally, it is important to understand why CTE teachers are integrating the technology.

Identifying the extent that CTE teachers are integrating technology into their classrooms will contribute to the creation of a CTE teacher profile and development strategies to increase technology integration. Economists are widely pointing out that it is no longer a post-agricultural or post-industrial world (Lynch, 2000). Instead, the discipline has shifted from a more job-specific approach to a more generic, academic-based approach (Rojewski, 2002). Grubb (1997) called this notion "new vocationalism", where there is still a focus on career education, but the lessons are more general in nature than they are job specific (as cited in Rojewski, 2002, p. 34). Employers are increasingly looking for employees to be able to work effectively, demonstrate competence in general education (reading, writing, calculating, and computing), solve problems, effectively use technology, use interpersonal skills, and work with others (Jacobsen, 2001). This ultimately leads back to education and the importance of CTE and its role in the new economy.

"In the educational community, the level of technology integration can deeply affect what teachers do and what their student's experience" (Redmann et al., 2003, p. 30). There has been a plethora of research on the teacher in general and on the use and integration of technology into the classroom (Kotrlik & Redmann, 2004); however, there has been very little research on the CTE teacher. CTE provides students with hands-on, business-related experience that assist in their preparation for the workforce (Jacobsen, 2001). The technologies from CTE afford students the tools to explore, experiment, construct, converse, and reflect on what they are doing, so they can learn from they are doing (Machnaik, 2002). Therefore, it is critical that CTE teachers integrate technology into instruction and the curriculum because it is part of the new economy.

Definition of Terms

The terms defined below are used throughout this study.

- *Career and Technical Education* – Vocational Education and Training (VET), also called Career and Technical Education (CTE), prepares learners for jobs that are based in manual or practical activities. These jobs are traditionally non-academic and are wholly related to a specific trade, occupation, or vocation. It is sometimes referred to as technical education, as the learner directly develops expertise in a particular group of techniques or technology (Public Schools of North Carolina, 2003).

- *Career and Technical Teacher Education (Vocational Teacher Education)* – "Programs that prepare individuals to teach occupational skills in high schools, trade schools, community colleges, agricultural and technical colleges, adult continuing education programs, armed forces training, and industry" (Collins & O'Brien, 2003, p. 376).

- *Teaching/Learning Process* – "The implementation of instructional activities that result in student learning" (Redmann & Kotrlik, 2004, p. 78).

- *Technology* – "Instructional high-tech media such as computers (e-mail, Internet, listervs, CD-ROMs, computer-based software, laser disc players, interactive CDs, 35d) and digital imaging (digital cameras, scanners, digital video, digital camcorders, etc.)" (Redmann & Kotrlik, 2004, p. 78).

- *Technology Integration* – "Employing the Internet, computers, software, CD-ROMs, interactive media, satellites, teleconferencing, and other technological means in instruction to support, enhance, inspire, and create learning" (Redmann & Kotrlik, 2004, p. 78).

- *Agricultural Education* – "Agricultural education in North Carolina employs the phrase 'food, fiber and environmental systems' to describe a very broad field, best defined by the National Research Council as, 'A field that encompasses the production of agricultural commodities, including food, fiber, wood products, horticulture crops, and other plant and animal products'" (Public Schools of North Carolina, 2003).

- *Business and Technology Education* – "Provides students with meaningful instruction for and about business. Instruction in Business and Information Technology Education encompasses business skills and techniques, an understanding of basic economics, and business attitudes essential to participate in the multinational marketplace as productive workers and consumers" (Public Schools of North Carolina, 2003).

- *Career Development Education* – "Process that involves students, parents, teachers, counselors, and the community. The goal is to help students make good decisions about themselves and their future" (Public Schools of North Carolina, 2003).

- *Family and Consumer Sciences Education* – “Prepares students for careers working with individuals and families, as well as for competence in the work of their own families. The concept of work, whether in a family or career, is central to the program area” (Public Schools of North Carolina, 2003).

- *Health Occupations Education* – “Seeks to meet present and predicted needs for health care workers within a health care delivery system that is characterized by diversity and changing technologies” (Public Schools of North Carolina, 2003).

- *Marketing Education* – “Prepare students for advancement in marketing and management careers and future studies in community and technical colleges or four-year colleges or universities. It encompasses activities within production, as well as aspects of consumption. It is as specific as procedures for inventory control and, at the same time, as general as the creativity needed in effective promotion.” (Public Schools of North Carolina, 2003).

- *Technology Education* – “Helps students develop an appreciation and fundamental understanding of technology through the study and application of materials, tools, processes, inventions, structures and artifacts of the past and present. Technology may be defined as ‘How people modify their natural world to suit their purposes’ (from Technology for All Americans)” (Public Schools of North Carolina, 2003).

- *Trade and Industrial Education* – “Secondary program to prepare students for careers in six of the ten North Carolina Career Pathways. While completing course sequences in these pathways, students participate in instructional units that educate them in standardized industry processes related to: concepts, layout, design, materials, production, assembly, quality control, maintenance, troubleshooting, construction, repair and service of industrial, commercial and residential goods and products” (Public Schools of North Carolina, 2003).

- *Technology Acceptance Model* – “An information theory that models how users come to accept and use a technology” (Davis, 1989, p. 319).

- *Perceived Usefulness* – “The degree to which a person believes that using a particular system would enhance his or her job performance” (Davis, 1989, p. 320).

- *Perceived Ease of Use* – “The degree to which a person believes that using a particular system would be free of effort. This follows from the definition of "ease": freedom from difficulty or great effort” (Davis, 1989, p.320).

Theoretical Framework

Davis' (1989) Technology Acceptance Model (TAM), shown Figure 1.1, provided the theoretical framework for this research. This research examined the level of technology integration by CTE teachers based on attitudes, beliefs, and experience. Adapted from the Theory of Reasoned Action (TRA) (Fishbein & Ajzen 1975; Ajzen & Fishbein, 1980), the TAM draws on the theoretical basis of the TRA to specify linkages among beliefs, user attitudes, intentions, and actual behavior. The theory of reasoned action derived from previous research started out as the theory of attitude, which led to the study of attitude and behavior. Hale, Householder, & Greene (2003) state that the theory was "born largely out of frustration with traditional attitude-behavior research, much of which found weak correlations between attitude measures and performance of volitional behaviors" (p. 259).

Derived from the social psychology setting, the Theory of Reasoned Action (TRA) was proposed by Ajzen and Fishbein (1975 & 1980) (Venkatesh & Morris, 2000). "Three general components outline the TRA: behavioral intention (BI), attitude (A), and subjective norm (SN). TRA suggests that a person's behavioral intention depends on the person's attitude about the behavior and subjective norms" (Hale et al., 2003, p. 260). Therefore, if a person intends to do a behavior, then it is probable that the person will do that behavior (Hale et al., 2003). In breaking down the theory to a more simple form, Miller (2005) states, "a person's volitional (voluntary) behavior is predicted by his/her attitude toward that behavior and how he/she thinks other people would view them if they performed the behavior" (p. 127). Miller continues to explain that "a person's attitude, combined with subjective norms, forms his/her behavioral intention" (p. 127).

People accept or reject information technology for a variety of reasons and tend to use or not use a technology application to the extent they believe it will help them perform their job better, which is referred to as perceived usefulness (PU) (Davis, 1989; Hale et al., 2003). However, even if users believe that a given application is useful, they may at the same time believe that the system or technology is too hard to use and therefore do not actively learn how to use the system or technology (Davis, 1989). Davis, Bagozzi, and Warshaw (1992) say "because new technologies such as personal computers are complex and an element of uncertainty exists in the minds of decision makers with respect to the successful adoption of them, people form attitudes and intentions toward trying to learn to use the new technology prior to initiating efforts directed at using" (p. 670). Attitudes and intentions formed that influence the performance benefits of usage can out weigh the effort of using the application, this is called perceived ease of use (PEOU) (Davis, 1989). PU and PEOU are the constructs that create the basis of the TAM framework.

In the original TAM, actual system use is determined by behavioral intention to use, which is, in turn, jointly determined by attitude towards using and perceived usefulness (Davis et al., 1989). "The original components were PU, PEOU, attitude towards using (AT), behavioral intention to use (BI), and actual use (AU). However as studies were conducted, AT and BI were not included and therefore were eventually dropped from the model" (Legirs, Ingham, & Collerette, 2003, p. 193). PEOU is a direct determinant of PU and is a direct and indirect determinant of attitude (Venkatesh & Morris, 2000). The context of this model explains PU as users' perceptions of the degree to which using the system will improve their job performance and PEOU as the belief that the system will be free of effort (Davis, 1989). Davis et al. (1989) also proposed that these constructs mediate the effects of external variables.

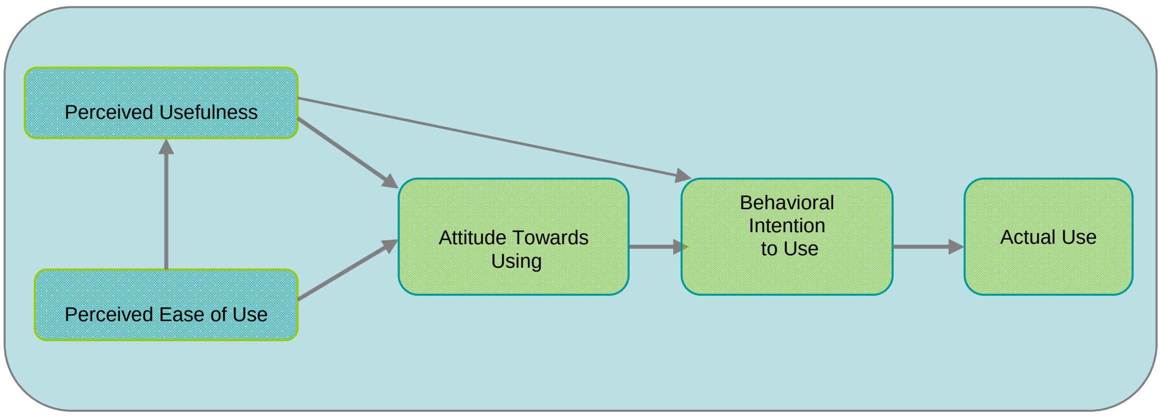

Figure 1.1

Original Technology Acceptance Model (Davis, et al., 1989, p. 985)

Although the TAM has a similar theoretical structure to the TRA, the theories differ in two key areas:

> The subjective norm from the TRA is omitted from the TAM model due to "…its uncertain theoretical and psychometric status." Second, perceived usefulness, in addition to attitude has a direct effect on behavior intention in the TAM. Finally, the two belief variables, perceived usefulness and perceived ease of use are treated as priorities in the TAM and are two distinct variables influencing attitude towards using (Davis et al., 1989, p. 986).

From multiple disciplinary vantage points, PU and PEOU are indicated as fundamental and distinct constructs that are influential in decisions to use information technology (Davis, 1989). TAM assumes that beliefs about PU and PEOU are always the primary determinants of use decisions (Mathieson, 1991). This was a conscious choice on the part of Davis et al. (1989), because they wanted to use "a belief set that . . . readily generalizes to different computer systems and user populations" (p. 988, as cited in Mathieson, 1991, p. 179).

Across the literature, researchers have acknowledged the parsimony robustness of the TAM, and the ease with which it can be applied in different situations (Venkatesh, 2000; Chua, 1996; Davis et al., 1989). Researchers have conducted several studies to examine the relationship between PEOU, PU, AT and the usage of other information technologies in recent years (Lederer, Maupin, Sena, & Zhuang, 2000; Venkatesh & Morris, 2000; Szanja, 1994; Adams, Nelson, & Todd, 1992; Davis et al., 1989). Their research has supported the TAM in that PEOU and PU can predict AT; that can predict the usage of that technology. “The research then validates TAM using several different applications including primarily e-mail, voice mail, word processing, and spreadsheets” (Lederer et al., 2000, p. 6). Gaining an understanding of the antecedents of PEOU and PU will enable the development of more meaningful design and training interventions to improve user acceptance and use of information technologies (Venkatesh, 2000).

Davis’s TAM model will be used in this research to study and determine the influence PU and PEOU have on technology integration among CTE teachers. Conclusions will assist teachers and administrators in the development of strategies for technology integration implementation.

Conceptual Framework

The conceptual framework emerged from the overall framework, the TAM. The TAM examines behavioral intentions that jointly determine individuals' attitudes towards perceived usefulness. PEOU is a direct determinant of PU and a direct and indirect determinant of attitude (Davis et al., 1989). In the conceptual framework of this study, PU refers to users' perceptions of the degree to which using the system will improve their teaching and learning processes, and their PEOU that the technology will be effortless (Davis, 1989).

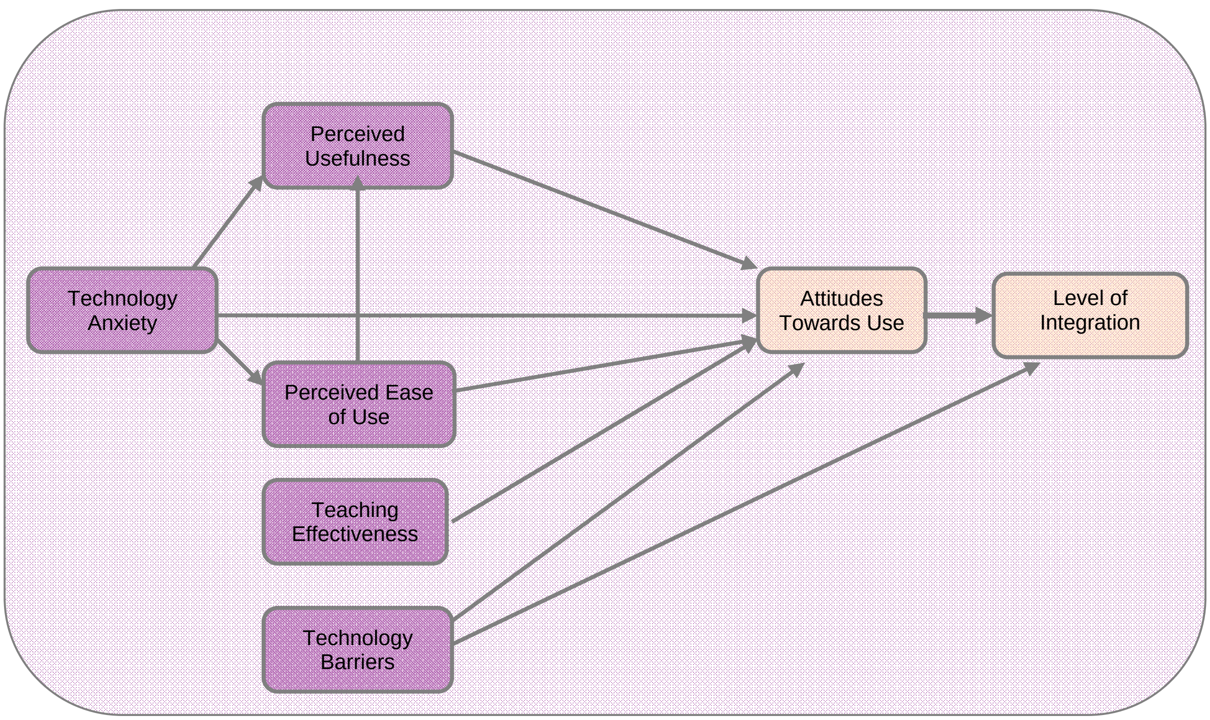

Figure 1.2

Conceptual Framework for the Study

The conceptual framework shown in Figure 1.2 offers the foundation for the thought process of this study, and shows how the dependent variables (PU, PEOU, technology anxiety, teaching effectiveness, and technology barriers) ultimately affect how teachers integrate technology into their classrooms.

Limitations and Delimitations

Limitations

The study is limited by the sample of secondary CTE teachers. It is also limited by the self-reported perceptions and responses from the CTE teachers. In addition, there is a limitation in the narrow literature regarding CTE teachers and technology integration: such narrow literature often results similar perspectives from the same authors in different studies.

Delimitations

The study is delimited to the scope of the study and bound to CTE teachers.

CHAPTER TWO

LITERATURE REVIEW

The body of literature on the use and integration of technology in the classroom provided the basis for this study. This study was designed to determine the extent to which CTE teachers are integrating technology into their classrooms. The researcher also sought to determine the variables and factors that influenced integration of technology. CTE teachers' experiences were examined in relation to the Technology Acceptance Model (TAM) (Davis, 1989) and the Kotrlik and Redmann Technology Integration Scale (KRIS) (Redmann & Kotrlik, 2003).

The review begins with an overview of technology integration versus technology adoption. This section will review the similarities and differences among the two ideas that are often interchanged. The second section introduces Fred Davis' TAM, which provides the theoretical framework for this study. The TAM theory is derived from the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1975), to specify casual linkages among beliefs, user attitudes, intentions, and actual behavior. The third section discusses the development of the Kotrlik and Redmann Technology Integration Scale and its impact on the research of technology. The fourth section examines technological history and education. The last section examines constructs influencing technology integration, which include gender, years of experience, perceived teaching effectiveness, technology anxiety, and barriers to integrating technology.

Technology Adoption Versus Technology Integration

Society has embraced computer technology and allowed it to reinvent the ways we create, find, exchange, and even think about information (Pierson, 2001). The teacher of the future must not only be accomplished in instructional techniques and technology, but also in the integration of technology into the curriculum (Pierson, 2001). The following questions arise: what is technology adoption vs. technology integration, why should we integrate and not just adopt, and how do we integrate?

What is Technology Adoption?

Since early in 20th century, various "new" educational technologies have been touted as the revolutionary pedagogical wave of the future (Lohr, 1996). Technologies have been adopted and integrated into the curriculum with varying degrees of success; integrations include classroom films, programmed learning devices, language laboratories, educational television, computer-assisted instruction, and, more recently, interactive videodisc (Lohr, 1996). Each technology was widely perceived as meeting a need, and each gained a measure of initial commitment of resources from a high-level administrative or legislative entity (Gumport & Chun, 1999). Gumport & Chun (1999) conclude that the adoption and diffusion process generally followed by administrators is what has been termed the "traditional model", a top-down process in which administrative "mandate" introduced the technology, and administrative perceptions, decisions, and strategies drove adoption and diffusion (p. 4). Successful adoption was highly dependent on the degree, stability, and wisdom of administrative sponsorship.

Use of technology in education has been growing in the United States steadily with recent governmental pushes (Thacker, 2007). Computers have traditionally been used by educators to organize and store huge amounts of data, perform research on the internet, supplement classroom instruction, and transmit educational courses via the Internet to students (Thacker, 2007). Budin (1999) reported that teachers did not see computers as part of the normal classroom process and often used them for ancillary activities (as cited in Kotrlik & Redmann, 2005).

There are a number of adoption models, two of the most notable are Rogers' Diffusion of Innovations and Hall and Louck's Concerns-Based Adoption Model. These two theories explain technology adoption through stages. Rogers Innovation Decision Process Theory proposes that there are five distinct stages to the process of diffusion. The stages are:

1. Knowledge - when the person or group begins to learn and know about a new innovation
2. Persuasion - the person begins to form attitudes through interactions with others
3. Decision - there is a drive to seek additional information and a decision is made
4. Implementation - as regular use is attempted more information is sought
5. Confirmation - Continued use is justified or rejected based on the evidence of benefits or drawbacks

(Rogers, 1995, p. 36)

Rogers (1995) defines adoption as “the relative speed with which members of a social system adopt an innovation” (p. 37). In general, individuals who first adopt an innovation require a shorter adoption period than late adopters (Redmann & Kotrlik, 2004).

Hall and Loucks' (1979) Concerns-Based Adoption Model evaluated the lack of teacher investment in innovations. Their model describes the seven levels of concern that teachers experience as they adopt a new practice:

1. Awareness - Teachers have little concern or involvement with the innovation.
2. Informational- Teachers have a general interest in the innovation and would like to know more about it.
3. Personal- Teachers want to learn about the personal ramifications of the innovation. They question how the innovation will affect them.
4. Management- Teachers learn the processes and tasks of the innovation. They focus on information and resources.
5. Consequence- Teachers focus on the innovation's impact on students.
6. Collaboration- Teachers cooperate with other teachers in implementing the innovation.
7. Refocusing- Teachers consider the benefits of the innovation and think of additional alternatives that might work even better

(Hall and Louck, 1979, p. 40)

While the above models explain the adoption and diffusion of innovations in general, they are not specific models describing technological innovations. These two models do not engage in the concept of teachers and technology. However, there is research that looks at the implementation of technology in the classroom.

In the early 1990’s, Apple Computer created a research team to investigate computer usage in the classroom. The team created the Apple Classroom of Tomorrow (ACOT) project (Dwyer, Ringstaff, & Sandholtz, 1991). The research from the project evaluated computer usage in the classroom and a five-stage model of technology implementation was created based on the results (Dwyer et al., 1991). The five-stage model was to be implemented when computers were placed in school classrooms following the steps:

1. Entry - teachers struggle to cope with and establish order in the transformed classroom.
2. Adoption - the beginning of adoption into the traditional classroom
3. Adaptation - while traditional teaching methods still predominate, but now supported with technology
4. Appropriation - with increasing confidence teachers become confident and pedagogically innovative
5. Invention - creativity including active experimentation by teaches and students (Dwyer et al., 1991, p. 48)

This study offered first insights into the technology being used in the classroom; however, the study was limited because Apple sponsored the study. Participants involved were given technology to use and, therefore, were at an advantage to adopt the technology (Dwyer et al., 1991). This research laid the groundwork for researchers to begin to understand the levels of adoption/integration in classrooms, and Apple has continued research with the ACOT^2, Apples' research from the 2000's, project.

Over the past 35 years, computers have moved into U.S. schools at an unprecedented rate, with the majority of secondary schools owning at least one computer by the year 1985 (Fabry & Higgs, 1997) and 100 percent of schools having computers by 2009 (Plomp et al. , 2009). With a great push for technology in schools, the perception is that schools have adopted technology into classrooms and the curriculum. A decade ago, Fabry and Higgs (1997) asked why schools rumble along virtually unchanged by the presence of computers, and Plomp, Anderson, and Law reiterated the question in 2009. Although 100 percent of schools implemented computers, the integration of technology varies greatly across school systems (Plomp et al., 2009). Their studies also found that the ways technology is implemented depends on school leadership.

America has long been a bastion of controlling educational approaches (Skinner, 1968). While constructivist models of education have been proposed and propagated in the U. S., educational institutions in this country have been resistant to the significant change that they advocate (Skinner, 1968). The implementation of computers is widely seen as adoption of technology; however, teachers are prone to return to their original pedagogical models and disregard technology.

What is Technology Integration?

Proof exists that computers have been implemented in classrooms since the early 1980’s (Pownell & Bailey, 2002). According to Fabry and Higgs (1997), the Report on the Effectiveness of Technology in Schools reported fifteen years ago; “more that 18.1 million computers were installed in the nations 109,000 public and private K-12 schools” (p. 388). Plomp et al. (2009) found that 100 percent of schools have computers and Internet connections. During the school year of 2004-2005, there were four students for every one computer (Belland, 2009). Even though investments in instructional technology have increased over the past decade, it does not mean that teachers know how to use the technology (Gaytan, 2006). Therefore, an inference can be made that computers are in schools, but are not being utilized**.**

To understand what technology integration encompasses, a definition of what it is not must be evaluated. Technology integration is not putting computers in the classroom without teacher training. Integration can not happen without training teachers to integrate technology into both their classrooms and their curricula (Jacobsen, 2001; Gaytan, 2006).

Over a decade ago, Dockstader (1999) explained that technology integration is not simply integrating 30 minutes of computer skill time or using application software without a purpose; it is actively implementing the software with a purpose. Dockstader (1999) continued with the idea that defining what technology integration “is and is not is the first step in deciding how to integrate it into the classroom” (p. 73).

Redmann & Kotrlik (2004) define technology integration as “employing the Internet, computers, CD-ROMS, interactive media, satellites, software, teleconferencing, and other technological means in instruction to support, enhance, inspire, and create learning” (p. 4). Barron, Kemker, Harmes, and Kalaydjian (2003) define technology integration as “a tool for research, communication, productivity, and problem solving, with the goal of cross-curriculum attainability” (p. 504). Each of these definitions showcase the complete use if technology to enhance and encourage learning. Computer skills take on new meaning when they are integrated within the curriculum (Jacobsen, 2001).

Global analysts around the world acknowledge the rapid evolution of a knowledge-oriented, information technology society (Plomp et al., 2009). Technology should be implemented in the classroom through use of software supported by the business world. Using real-world applications in the classroom enables students to learn to use computers flexibly, purposefully, and creatively, which gives students an edge when competing in a global economy (Plomp et al., 2009). Researchers defining technology integration encourage educators to let the curriculum drive the technology usage so it can become a part of everyday learning and teaching. The teaching process must reach a new paradigm of efficiently incorporating technology in every facet of the curriculum to enhance both learning and teaching (Thacker, 2008). Technology integration should focus organizing the goals of the curriculum and technology into a coordinated and harmonious whole (Redmann & Kotrlik, 2005).

When promoting alternative approaches to learning and teaching, technology can open new channels of innovation to help students meet higher standards and perform at increased levels (George, 2000). Thirteen years ago, the Office of Technology Assessment (1998) on teachers indicated that schools have made significant progress in implementing technology, but teachers still struggle with integrating technology into the curriculum (Redmann et al., 2003). This trend has continued. The National Center for Education Statistics (2000) reported the following examples of how teachers had integrated technology in their classrooms: 44 percent reported using technology for classroom instruction, 42 percent reported using computer applications, 41 percent reported requiring Internet research (p. 3). The research further indicated that 27 percent of teachers had students conduct research using CD-ROMs, 27 percent assigned students to produce multimedia reports/projects, 23 percent assigned graphical presentations of materials, and only 21 percent of teachers assigned demonstrations/simulations using technology (p. 3). In another study, conducted by Barron et al. (2003), the researchers found that fewer than 50 percent of teachers in the Florida district surveyed integrate technology into their classrooms. The study found that 31 percent use the Internet for research, 27 percent for problem solving, and 49 percent use technology as a communication tool (Barron et al., 2003, p. 504). Overall the studies found low usage of technology in the classroom.

Technology does not exclusively include computer usage; it also includes other devices. Most related research describes technology simply as the use of a computer, but technology reaches far beyond the computer. Therefore, this study looks at both computer usage and other technological devices that can be integrated into the curriculum.

Compare/Contrast

Both technology adoption and technology integration are methods to increase the use of technology in both the classroom and the workplace. However, technology adoption refers to “the decision to use specific technology for an intended outcome or purpose” (Ensminger, 2008, p. 333), and technology integration refers to “the specific practices and amount of use that occurs once a technology has been implemented” (Ensminger, 2008, p. 334). Studies of diffusion and adoption assist in explaining the reasons that technology is accepted or rejected in education (Davis, 1989). Properly achieving integration occurs when technology tools support curricular goals, and help students to effectively reach higher expectations. Seamless technology integration creates more actively engaged students. (Redmann & Kotrlik, 2004).

Uses of technology are often grounded in the eighteenth century models of learning, which include a teacher at the head of the class and students simply copying and regurgitating knowledge, with nineteenth century notions of organizational management (Privateer, 1999). In academia, there is a tacit assumption that instructional technologies can spearhead serious institutional reform because they create real change (Privateer, 1999). The debate continues today as those in education battle over the importance of implanting technology into the classroom (Deubel, 2007).

Real change can not occur unless there is a paradigm shift from the eighteenth century model of only teaching to the twentieth century model of learning. Society must move from the notion of schooling, which is instilling the basics using lecture and memorization (Deubel, 2007) to a focus on education that incorporates “21st century skills, such as critical thinking and problem-solving skills, computer and technology skills, and communication” (Deubel, 2007). Privateer (1999) stated over a decade ago, “Innovational uses of technology, grounded in traditional notions of teaching, will not bring about important reforms to education and create first rate learning environments” (p. 62).

Technology is continuously changing. It is an ongoing process. It demands continual learning and change is not always easy. The initial human reaction to change is resistance and resistance makes for slow change, but change is inevitable (Davis, 1989).

Technology Acceptance Model

Studies of the technology adoption model assist in explaining reasons that technology is accepted or rejected in education. The TAM is a theory that helps in understanding why individuals integrate or reject technology. The TAM model includes two elements: perceived ease of use (PEOU) and perceived usefulness (PU) (Davis, 1989). Davis' TAM model relates specifically to the study and will be the theoretical framework to assess CTE teachers' integration of technology.

Individuals are constantly making decisions about accepting, adopting, and using computer and information technologies (Venkatesh & Davis, 1996). Research has explored the determinants of these decisions, and has revealed PEOU and PU as key determinants of intention to use (Venkatesh & Davis, 1996). TAM uses two specific beliefs: (a) PEOU, the user's perception of the amount of effort required to use the system and (b) PU), the user's perception of the degree to which using the system will improve his or her performance in the workplace (Venkatesh & Davis, 1996). User intentions have proved to be better predictors of system usage than competing predictors, such as realism of expectations, motivational force, value, and user involvement and satisfaction (Venkatesh & Davis, 1996).

Versions of TAM

In the original version of TAM, the components included PU, perceived ease of PEOU, attitude towards using (AT), behavioral intention (BI), and actual use (AI) (Davis, 1989). From these five components there was a possibility of 10 different relationships that could be examined: (1) PEOU–PU; (2) PU–AT; (3) PEOU–AT; (4) PU–BI; (5) PEOU–BI; (6) AT–BI; (7) AT–U; (8) BI–U; (9) PEOU–U; and (10) PU–U (Legris et al., 2003, p. 193). In research conducted by Legris et al., no one study used all of these components instead the studies only evaluated a portion of the variables. In the original TAM, AT and BI were used, but in the studies researched by Legris et al., these variables were only used in seven of the studies and only measured PU and PEOU. These two belief variables, PU and PEOU, are central to the original TAM referenced in the theoretical framework (Figure 1.1). In the initial testing by Davis et al. (1989), the AT was omitted due to the casual link between belief and intention. PU and PEOU show a strong link towards behavioral intention to use, even though attitudes towards technology may not be positive (Davis et al., 1989, p. 990).

Venkatesh and Davis (1996) recommended improving the model by incorporating "external variables" as underlying determinants of the belief variables that fully mediate the influence of external variables on the attitude and use variables, as shown in Figure 2.1 below.

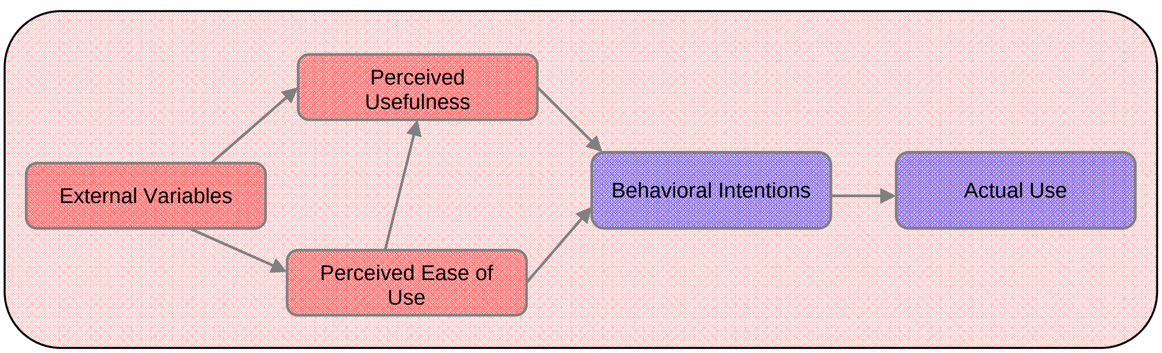

Figure 2.1

Final Technology Acceptance Model (Venkatesh & Davis, 1996, p. 453)

External variables examined in research include computer self-efficacy, information, quality, importance of the system, computer anxiety, social influence, perceived accessibility, training and support, trust, and social presence. Indirectly, external variable can influence attitude, subjective norms, PEOU, or PU (Legris et al., 2003). The research performed by Legris et al. research noted that there is no clear pattern with respect to the choice of which external variables are considered in a given study.

Analysis of TAM

In a critical review of the TAM (Venkatesh & Davis, 1996; Chau, 1997; Venkatesh, 2000; Legris et al., 2003) conclude that the TAM is a useful model. However, it has to be integrated on a broader scale to include variables related to human and social change processes and to the adoption of the innovation model (p. 191). These researchers underline three limits of TAM research: involving students, type of application, and self-reported use (Legris et al., 2003). Legris et al. (2003) reviewed over 30 studies involving the TAM and only nine involved students. And the applications examined were limited to office software or systems development applications, and TAM only actually measures the variance of self-reported use (Legris et al., 2003).

A key purpose of the TAM is to provide a basis for tracing the impact of external variables on internal beliefs, attitudes, and intentions (Venkatesh, 2000). The TAM is a theoretical model that helps in understanding why individuals integrate or reject technology. Research has explored the determinants of such decisions and has revealed PEOU and PU are both determinants of intention to use (Davis, 1993; Szanja, 1994; Venkatesh & Davis, 1996). Although the TAM has changed over time, its two specific constructs PEOU, and PU, continue to be the framework of the TAM throughout its evolution (Venkatesh & Davis, 1996).

Review of literature on TAM describes the robustness of the framework and the ease with which it can be applied in different situations (Venkatesh, 2000). In validation of the robustness, several studies have been conducted to confirm its reliability and validity. Through the test-retest method, results showed that correlations between PEOU and PU were high (Hendrikson, Massey, & Cronan, 1993). Szanja (1994) found that the instrument had predictive validity for intent to use and self-reported use. The sum of this research confirms the validity of the instrument and to support its use with different populations of users (Venkatesh, 2000). Chau's (1997) research supported that PU and PEOU are hypothesized and empirically supported as fundamental determinants of user acceptance.

As the TAM has grown and developed to include subjective norms, it continues to show the significance of perceived use and perceived usefulness on integrating technology. This instrument can continue to assist in understanding individuals' perceptions of technology and how to proceed to understand those perceptions.

Kotrlik and Redmann Technology Integration Scale

The TAM framework examines the probability of individuals integrating technology, whereas the Kotrlik and Redmann Integration Scale (KRIS) framework addresses the level that instructional technology is integrated in the teaching/learning process (Redmann & Kotrlik, 2004). Evidence of the educational benefits of technology abounds (Thacker, 2007), and investment in hardware and software has dramatically increased; however, relatively few teachers use technology regularly in their teaching

(Zhao & Cziko, 2001). Therefore, the impact of computers on existing curricula is still very limited (Zhao & Cziko, 2001). The TAM and KRIS frameworks can be used together to find common ground and resolution for the resistance to technology in the classroom.

In the educational community, the level of technology integration can deeply affect what teachers do and what their student's experience (Redmann et al., 2003). With technological advances, many traditional methods of teaching are not as effective or efficient for learners, who now need lifelong skills and the ability to cope with changing work environments (Barron et al., 2003). The importance of teachers' influence on technology has often been downplayed. Teacher's enthusiasm toward use of technology can affect students' feelings toward technology. Developing and encouraging teachers' technological pedagogical content knowledge (TPCK) can increase technology perceptions (Mishra & Koeheler, 2005). Teachers have both content knowledge and pedagogical knowledge (West & Graham, 2007). But there is also knowledge about how to use educational technologies effectively to teach a particular content area, and this is the area of TPCK that schools should invest in developing (West & Graham, 2007).

Part of the challenge of educating teachers to use technology effectively lies in overcoming the poor models of technology integration they have previously observed and replacing these with good models (West & Graham, 2007). To create a reliable scale to evaluate technology integration in the teaching-learning process, Redmann and Kotrlik used the work of Ringstaff, Sandholtz, and Dwyer (1991) and Russell (1995). Kotrlik and Redmann developed a definition for technology integration that serves as the basis for their research. Kotrlik and Redmann (2004) define technology integration as "employing the Internet, computers, CD-ROMs, interactive media, satellites, teleconferencing, and other technological means in instruction to support, enhance, inspire and create learning" (p. 77). The researchers also include that the implementation of technology will be influenced by the teaching and learning process. The teaching/learning process is defined as the implementation of instructional activities that result in student learning (Redmann & Kotrlik, 2004).

Kotrlik and Redmann’s first influence in creating the technology integration scale was from the research of Ringstaff et al. (1991), who worked on the Apple Classrooms of Tomorrow (ACOT) project. The project was a research and development collaboration among public schools, universities, research agencies, and Apple Computer, Inc. The study examined the role of both teachers and students as they adapted to teaching and learning in technology-rich classrooms (Ringstaff et al., 1991). The researchers looked at change over time with respect to teaching strategies and student learning. Consistent with research on classroom innovation, teachers in ACOT classrooms continued to rely on traditional teaching strategies during the early years of the project, despite radical physical changes in their classrooms (Ringstaff et al., 1991). By collecting data over an extended period of time, however, research showed gradual shifts in teachers’ beliefs about learning and teaching, and the consequences these changing beliefs had on classroom practice. This progression can be viewed as an evolutionary process similar to other models of educational change (Ringstaff et al., 1991).

While reformers argue about the most efficient way to promote school change, one consistent finding is that, whatever its form, the process of educational change is typically slow and painstaking (Ringstaff et al., 1991). Increasing attention is being paid to the idea that lasting change in the classroom must be accompanied by changes in teachers' beliefs about the purpose and nature of instruction, and that these belief systems are remarkably resistant to change (Redmann & Kotrlik, 2004). To assist with the notion of change in the classroom, the researchers labeled the stages of instructional evolution in the ACOT classrooms as mentioned previously in the review: entry, adoption, adaptation, appropriation, and invention (Ringstaff et al., 1991, p. 5). These stages show the process that teachers and students went through as they progressed through the study and utilized the technology. These stages were also used in the development of a technology integration scale versus a technology adoption scale.

Kotrlik and Redmann also used Russell's stages of technology adoption and email as a basis for their model. Russell (1995) evaluated the six stages adult learners pass through as they become confident in the adoption of technology looking to determine how adult students learn new technologies. The relevance of the computing experience can influence the ways learners apply technology in particular situations. Russell's study focused on the use of email and individuals' resistance to use email. The six stages from Russell's (1995) research include: awareness, learning the process, understanding and application process, familiarity and confidence, adaptation, and creative application. These stages provide a framework for what email users are likely to go through before the technology process becomes second nature (Russell, 1995). The study identified the necessity for students to develop a knowledge base and to assimilate new learning into an existing model. Russell’s six stages offer a formal developmental schema for how naive email learners develop and increase their confidence in using the new technology until the technology becomes background to the relevant task at hand (Russell, 1995, p. 175). From this research, Kotrlik and Redmann were able to develop a model that would be applicable to understanding the integration of a variety of technologies in the teaching and learning process to expand from Russell’s research on the use of email.

Because the base literature revolves mainly on computer implementation/adoption and email use, Kotrlik and Redmann formulated their model to include all areas of technology. Technology has grown to encompass much more than just computers and, therefore, requires a modified model to discuss both adoption and integration of the technology. Through research on the use of technology, Kotrlik and Redmann deducted several factors that can or will influence the integration of technology. These factors include perceived integration barriers, perceived teaching effectiveness, technology anxiety, training sources, and technology availability (Redmann & Kotrlik, 2004). After the researcher’s review of the literature, these factors revealed the most potential for explaining teachers' technology integration. To evaluate these factors, the Kotrlik/Redmann Technology Integration Model was created to evaluate which factors explain the degree of technology integration in the teaching/learning process (Redmann et al., 2003). The four phases of the Kotrlik/Redmann (2003, 2004, 2005) Technology Integration Model are exploration, experimentation, adoption, and advanced integration:

1. Exploration – Thinking About Using Technology. Teachers seek to learn about technology and how to use it.

2. Experimentation – Beginning to Use Technology. Physical changes start to occur in classrooms and laboratories. Instructors focus more on using technology in instruction by presenting information using presentation software and doing a few instructional exercises using spreadsheets, databases, word processors, games, simulations, the Internet, and/or other technology tools.

3. Adoption – Using Technology Regularly. Physical changes are very evident in the classroom and/or laboratory with technology becoming a focal point in the classroom and/or laboratory organization. Instructors employ presentation software and technology-based instructional exercises using games, simulations, spreadsheets, databases, word processors, the Internet or other technology tools as a regular and normal feature of instructional activities. Student-shared responsibility for learning emerges as a major instructional theme.

4. Advanced Integration – Using Technology Innovatively. Instructors pursue innovative ways to use technology to improve learning. Students take on new challenges beyond traditional assignments and activities. Learners use technology to collaborate with others from various disciplines to gather and analyze information for student learning projects. The integration of technology into the teaching/learning process leads to a higher level of learning. (Redmann et al., 2003, p. 34)

Kotrlik and Redman offer an extensive four-phase process of technology integration. Previous models have many steps that individuals work through before reaching complete adoption or integration, but with the Kotrlik and Redmann model, the phases have been synthesized into four distinctive phases, each of which is distinctive and creates clear levels of integration. This technology integration model offers phases dedicated to how educators are implementing technology to increase learning. This doesn’t just including having technology (i.e. computers, LCD projectors, CD-ROMs, etc) in the classroom, it also includes using all aspects of the technology to create new learning paradigms. Educators can place themselves in one of the phases and understand the technological abilities associated with the phase.

The scales and all demographic items for the KRIS were developed by Kotrlik and Redmann. The face and content validity of the instrument were evaluated by an expert panel of educators, university faculty, and teachers enrolled in doctoral programs (Redmann et al., 2003; Redmann & Kotrlik, 2004; Kotrlik & Redmann, 2005). Changes were made by a validation panel and after the pilot test. Robinson, Shaver, and Wrightsman's standards for reliability of Cronbach's Alpha, from their 1991 book *Measure of Personality Social Psychological Attitudes,* were used to evaluate the factor's reliability (Redmann & Kotrlik, 2004). From these scales, the factors showed excellent reliability and were as follows: "Technology Integration Scale - .93; Exploration subscale - .82, Experimentation subscale - .95, Adoption subscale - .97, Advanced Integration subscale - .88, Barriers scale - .87, and Teaching Effectiveness scale - .90" (Redmann & Kotrlik, 2004, p. 37).

Through this scale, researchers can evaluate where teachers are in the technology integration process and use the knowledge to create learning opportunities. Kotrlik and Redmann have created a simple and easily-understood framework that evaluates a variety of technological devices and can be used to change the way technology is integrated into education at the secondary and the university levels. Limitations from the scale include restrictions in study location; however, the limitation opens opportunities for further use of the scale throughout the United States. The limitation also provides additional opportunities to understand more about technology resistance.

Technological History and Education

Fulton (1999) described technology adoption in classrooms as a half-filled glass of water. Optimists look at the glass as half full, but others see the glass half empty. An optimistic view shows that schools have computers with a ration of around six students per computer (Fulton, 1999). According to Becker (1998), nationally, 43 percent of school computers are located in computer labs, compared to 48 percent in classrooms. As of 1998, 90 percent of schools are wired for Internet access and 30 percent of teachers have access to the Internet in their classrooms (Becker, 1998).

On the less optimistic side, a survey by Education Week found that 40 percent of teachers reported that students do not use technology at all during a typical week (Fulton, 1999). Another 30 percent said their students only use technology for approximately one hour each week (Fulton, 1999). Teachers, administrators, and parents are finding that using technology requires more than adding Internet access or placing computers in a classroom. Technology affects the ways teachers teach, students learn, and administrators operate (Norum, 1999). Roles and teaching and learning strategies are changing because technology fosters the use of more student-centered learning strategies (Norum, 1999). The trend and history of technology shows the vast and rapid changes that technology has offered to education.

In 1983, *Time* magazine recognized the personal computer as the man of the year (Campbell-Kelly & Aspray, 2004), and public fascination with the computer has not changed. However, the 1980s was not the beginning of the computer revolution. Thirty-three years prior, the magazine cover featured a picture of a computer wearing a Navy captain's hat to showcase a story about a calculator built for the Navy (Campbell-Kelly & Aspray, 2004). Technology even played a role in 1890 when the punched card tabulating machine was created (Campbell-Kelly & Aspray, 2004; Brown & Presley, 2003). These inventions are markings of the long history of technology.

Molnar (1997) contends the history of computers in education has been variously characterized as an "accidental revolution" (p.63). "The arrival of new technologies for education has often been accompanied with bold predictions for its transformation but this can also conjure up a collective sense of social deja vu" (Gumport and Chun, 1999, p. 6). History has shown the slow acceptance and benefits of technology. Some predicted that the spread of television would eliminate illiteracy and the Ford foundation predicted it as the "the greatest opportunity for the advancement of education since the introduction of printing by moveable type" (Gumport and Chun, 1999). But television did not do all that was predicted because it took decades for education to see the full advancement of television. This same course continues to be followed as new technology emerges. Pownell and Bailey (2002) contend that there are four predominant waves in the revolution of computers in education beginning in the 1960s and progressing until the present, with each decade bringing forth new technologies, but none as quick as our current decade.

The mainframe computer, which was introduced in the 1960s and 1970s, revolutionized how educational facilities conducted administrative business (Pownell & Bailey, 2002). This is what Pownell and Bailey consider the first wave of computers. "This computer technology was used for computer programming mostly in secondary and postsecondary schools. Later, mainframes were used for computer assisted instruction and tutorials" (Pownell & Bailey, 2002, as cited in Chapman, 2003, p. 23). Although there was some infiltration of the mainframe into educational facilities, the majority of computer use was for scientific and military applications (Campbell-Kelly & Aspray, 2004). The personal computer Altair was developed in the 1970s.

Elements that we take for granted today, such as having a computer on our desk that is equipped with a monitor and a mouse, were not conceivable until the 1970s (Campbell-Kelly & Aspray, 2004). In 1970, Marcian Hoff, an engineer at Intel Corporation invented the microprocessor, which was an entire CPU on a single chip. With this, the microcomputer, or personal computer, was born in 1975 (Brown & Presley, 2003). In 1976, Stephen Wozniak and Steven Jobs designed and built the first Apple computer (Brown & Presley, 2003). "The Macintosh Apple computer was the first to use a Graphical User Interface (GUI), which provided a visual output instead of text output commands and made the computer easier to use" (Newby, Stepich, Lehaman, & Russell, 2000, as cited in Chapman, 2003, p. 23). Not far behind the introduction of the Apple computer, IBM designed and produced the IBM-PC (Personal Computer) (Brown & Presley, 2003). This created direct competition and a market for personal computer use. The 1970s introduced the microchip, GUI, and the personal computer, which classifies the decade as the second wave of technology revolution (Pownell & Bailey, 2002).

The progression of the personalized computer unfolded during the 1970s, 1980s and 1990s, creating smaller desktops and the introduction of the laptop computer. The advancement of software and computer capabilities changed the way educational facilities worked. According to Pownell and Bailey (2002), this error created the third wave of the technology revolution. This wave crossed decades including the 1980s and 1990s and involved the Internet and the World Wide Web. Although the Internet had been around since 1969, when the government created it as a better way to move information, it did not become available to the public until the 1990s (Leiner et al., 2003). To facilitate communication between the U.S. Department of Defense and military researchers, the department created a set of networks call ARPAnet (Advanced Research Projects Agency Network) (Brown & Presley, 2003). In the late 1980s, the military portion of ARPAnet became known as MILnet and the National Science Foundation funded a non-military network called NSFnet (Brown & Presley, 2003). Thousands of government, academic, and business computer networks were given remote access to NSFnet and, by the late 1980s, the term Internet was used to describe the information superhighway that was developed (Leiner et al., 2003).

"Just beginning is the fourth wave of the revolution of computers and this includes all the wireless, hand held devices, and other small computer oriented electronics" (Pownell and Bailey, 2002, as cited in Chapman, 2003, p. 26). Smaller, more powerful electronics that can be transported and used in any capacity are the next generation of technology. However, despite the support and the huge investment public education has made in acquiring technology for schools, concern exists that computers remain underutilized (Fabry & Higgs, 1997). It is believed that technology can increase learning and provide valuable life skills to students, and the successful integration of computers depends largely on how teachers embrace and use computers (Fabry & Higgs, 1997).

The past decades have created waves of technology development and, through technology, new teaching methods have emerged. The goal of this study is to examine constructs that influence technology integration and determine where CTE teachers fall within each of the four levels of technology integration.

Constructs Influencing Technology Integration

Bandura (1986) contends that recognition of individuals' beliefs are closely linked with the decisions and choices that they make during the choices inherent in everyday life. Davis (1989) extends this notion with his belief that perceptions of use and ease of use influence how individuals will accept or reject a new technology. A body of research on individual beliefs and educators suggest that the beliefs teachers hold directly affect both their perceptions and judgments of teaching and learning (Clark & Peterson, 1986; Clark & Yinger, 1987; Fulton, 1999; Redmann & Kotrlik, 2004; Ertmer, 2005; Ensminger, 2008). This study will examine the following constructs: gender, years of experience, perceived teaching effectiveness, technology anxiety, and barriers to integrating integration.

Gender and Technology Integration

Gender becomes critical to the understanding of user acceptance because it can play an important role in determining how users make their decisions about adopting and using new technologies (Venkatesh & Morris, 2000). Outside of the information systems research, a significant body of information exists supporting the general viewpoint that social influence and gender do, indeed, play a critical role in influencing behaviors in a wide variety of domains (Venkatesh & Morris, 2000, p.116). Psychology research studying gender differences in decision making processes indicates that schematic processing by women and men is different (Bem and Allen, 1974; Wajcman, 1991). Therefore, gender schemas can be considered a normative guide that causes unconscious or internalized action (Venkatesh & Morris, 2000, p. 117). Bem and Allen (1974) argue that women and men encode and process information using different socially constructed cognitive structures that, in turn, help determine and direct individuals' perceptions (as cited in Venkatesh & Morris, 2000).

Nelson & Watson (1995) showed that significant gender differences exist in regard to equality of access and performance outcomes (as cited in Spotts, Bowman & Mertz, 1997, p. 422). This appears to start as early as preschool, where males consistently spend more time in computing activities than their female peers (Spotts et al., 1997). Wajcman (1991) argues that studies from Britain, America, and Australia show that, whenever there is discretionary use of information technology machines, such as in school computer clubs, computer summer camps, or owning or wanting a home computer, boys vastly outnumber girls (p. 150). Research from Ventakesh and Morris (2000) found "active involvement in computer activities may ultimately translate into higher achievement for males in computer-based technology, both in academic and career settings" (p.118). Wajcman reemphasizes the following:

> Women's profound alienation from technology is accounted for in terms of the historical and cultural construction of technology as masculine... If technical competence is an integral part of masculine gender identity, why should women be expected to aspire to it? (Wajcman, 1991, p. 22)

Wajcman's passion for gender becomes clear from the statement above. The gender slant towards boys/men to be more inclined to want to learn and understand computers, ultimately costs women an equal chance of wanting to aspire to use technology.

The literature discussed thus far shows a profound difference between males and females and their relationships with technology, where males have been found to use technology more. However, the literature is also a bit controversial. Results from researchers Spotts et al. (1997) showed that males rated their knowledge and experience with some innovative technologies higher than females ranked themselves. But, regarding frequency of use, no significant differences were found, with the exception of video, where females indicated slightly more frequent use. Both rated technologies as important to instruction (p. 421). Kotrlik and Smith's (1989) research found no significant differences among males and females in anxiety towards technology. In a study conducted by the National Association of Business Teachers (1993), the results found that a larger proportion of the female educators perceived computer technology as an effective tool than the male educators. But the study also showed that more men had an increased desire to own a computer over females. In another study conducted by Ray, Sormunen, and Harris (1999), the researchers found that females had more positive attitudes concerning the computer's value in making users more productive. The study also found that females expressed more comfort that men in using the computer.

However, when doctoral students were surveyed, men demonstrated more comfort with a computer and the Internet (Ray et al., 1999).

Research shows contradictory evidence of gender influence on technology integration (Kotrlik & Smith, 1989; Spotts et al., 1997; Ray et al., 1999). However, the literature does not focus specifically on CTE teachers; therefore, gender could be a factor in determining whether a CTE teacher will integrate technology. This study will seek to evaluate this construct and its significance in technology adoption.

Years of Experience

Literature also shows that years of experience do have an impact on technology integration. In a study by the National Center for Education (2000), newer teachers were found to be more likely to use computers or the Internet to accomplish various teaching objectives, and teachers with nine or fewer users of teaching experience are more likely to teach using computers and the Internet than those with 20 or more years of experience (p. 1). Teachers with four to nine years of teaching experience were more likely to report frequent use of computers or the Internet to create instructional materials (47 percent) than teachers with 20 or more years of experience (35 percent) (National Center for Education, 2000, p. 1). The study continued with results on teachers' preparedness to use technology related to years of experience. Teachers with less teaching experience (three or fewer years) were more likely to feel well prepared to use computers and the Internet than teachers with 20 or more years of experience (National Center for Education, 2000, p. 2).

Dexter, Anderson, & Becker (1999) found that teachers with less than 10 years of experience were more likely to change and adapt to new ideas. Veteran teachers made changes as well, but these were more slight and gradual. One of the veteran teachers in the study stated:

> When I started out (integration technology) I was insecure, and, as such, I wanted to dominate the classroom. I still believe that the teacher should be organized in the classroom, but I think that he can organize his classroom in such a way that there is a lot more student participation. The easiest way to control a class is simply to lecture and run through [the material]. In many ways the kids think that is a great education…But they are very, very, passive and they are not active… (Dexter, Anderson, & Becker, 1999, p. 9)

The quote above shows the significance of an educator making a change to implement technology. Although insecurities, resistance, and pedagogy created barriers at first, the paradigm began to shift to when more students became more active. Teachers will need a period of time working and adjusting to technology before they become proficient. The years of experience with computers can go hand-in-hand with years of experience. Hadley and Sheingold (1993) contend that teachers need five to six years working with technology to develop expertise, and, when the teachers reach this level, they change their instructional strategies in the classroom environment.

Perceived Teaching Effectiveness

The specific relationship of technology integration to teachers' perceived teaching effectiveness has not been directly addressed in the literature beyond the research conducted by Kotrlik and Redmann. Pedagogical beliefs, however, are addressed in the literature and provide the basis for the research on the construct of perceived teaching effectiveness. Cuban (1997) states, “The knowledge, beliefs, and attitudes that teachers have shape what they choose to do in their classrooms and explain the core of instructional practices that have endured over time” (p. 256). Therefore, teachers’ self-perceived teaching effectiveness may be directly or indirectly related to instructional effectiveness (Redmann & Kotrlik, 2004).

Most teachers face a teacher-centered classroom, and, for technology to be implemented successfully, a shift from teacher-centered to learning-centered instruction will have to occur. The infusion of information technology into the teaching and learning domain creates shifts in the skill requirements of teachers from the instructional delivery to the instructional design (Rogers, 2000). Teaching is a complex cognitive skill. An expert teacher must work at the craft and develop highly organized systems of knowledge in an environment that can be unorganized, political, and pressure-intensive (Mishra & Koehler, 2006). Many systems of knowledge create teachers’ beliefs. Cuban (1997) observes that it is not a problem of resources that technology is not integrated in classrooms, but a struggle over core values of teachers. Confusion over definitions used to label and describe teacher beliefs occurs throughout the literature (Ertmer, 2005). Teachers’ beliefs influence their perceptions and judgments (Bandura, 1986, Pajares, 1992, Ertmer, 2005), and these beliefs tend to be associated with each teacher’s particular style of teaching (Ertmer, 2005). The potential power of beliefs can influence the behavior of integrating technology (Ertmer, 2005 & Fulton, 1999).

In a study that was conducted by the National Center for Educational Statistics (2000), the relationship between technology and teaching effectiveness is highlighted.

The study reported that only one-third of teachers felt they were well-prepared or very well prepared to use technology effectively (National Center for Educational Statistics, 2000, as cited in Redmann & Kotrlik, p. 78). The study also cited that teachers with fewer years of experience and those with more hours of professional development felt better prepared to use computers and the Internet for classroom instruction (National Center for Educational Statistics, 2000).

Because of the subjectivity of the construct of perceived teaching effectiveness, it becomes hard to quantify a relationship. However, the research shows (Redmann & Kotrlik, 2004; Kotrlik & Redmann, 2005; Ertmer, 2005) that the more training and support teachers receive, the more likely they are to perceive themselves as good teachers and implement technology.

Technology Anxiety

Little research has been found that addresses teachers' anxiety relative to implementing technology in the teaching-learning process. Most of the research on technology anxiety has been conducted in the area of computer anxiety (Chua, Chen & Wong, 1999; Redmann et al., 2003, p. 32). In 1983, Oetting (1983) described computer anxiety as both the anxiety felt when people experience interactions with computers and the anxiety associated with the concept of computers (p. 1). The 1980s were a time of great growth for the computer, and it was a new and unidentifiable machine (Campbell-Kelly & Aspray, 2004). Individuals were unsure of the capabilities and the concept of a machine conducting work that, up until the time, had been completed by people. Uncertainty created resistance and anxiety over learning to trust a machine.

As early as the 1970s, research found that individuals' perceptions of computers may depend on whether the individual views the computer as a competitor, cooperator, or a powerful friend (Bauer & Kenton, 2005). The original research on computer anxiety focused on computers as programs or instructional management tools using "word processors, databases, etc" (Redmann et al., 2003, p. 32). The comfort or computer literacy level users have in relation to the technology influences the ways communication occurs, its speed, and its effectiveness (Russell, 1995). A computer anxious person may find the technological processes intrusive and will need to overcome this fear before the technology can become invisible and effectively used (Russell, 1995; Chua et al., 1999). Fred Davis discusses this notion in the TAM model with the constructs of perceived use and perceived usefulness. The powerful effect of usefulness of a technological device on actual use is the biggest influence on whether an individual will use the technology (Davis, 1993). Therefore, the more useful a certain technology is viewed, the less likely there will be anxiety to use that technology.

Research of the area of computer anxiety has been conducted by several researchers, including Fletcher and Deeds (1994). Their research revealed little difference in computer anxiety among agriscience teachers and those of other disciplines (Redmann et al., 2003). Johassen (1985) found that computer anxiety was slightly lower in males than in females. However, in later research by Kotrlik and Smith (1989) using Oetting's computer anxiety scale, no statistical difference between men and women and computer anxiety was found. Fletcher and Deeds (1994) found that level of computer skills was a significant variable of computer anxiety. Individuals who possessed higher-level computer skills had less anxiety about using technology.

Computer anxiety has dominated the literature, but the less researched construct technology anxiety has begun to emerge. Technology anxiety differs from computer anxiety; it focuses in on anxiety evoked by technological tools in general, whereas computer anxiety focuses on anxiety related to personal computers (Meuter, Ostrum, Bitner, & Rountree, 2003). With the increasing global economy, more technologies have come into consideration within education (Deubel, 2007) and can cause a sense of renewed anxiety. Individuals who may have conquered the fear and anxiety of a personal computer must now begin to learn and comprehend new technologies being introduced an increasingly rapid pace (Meuter et al., 2003). Technology anxiety appears to be more relevant at a time when more than only computer-based technologies, such as mobile technologies, are available to students and teachers (Meuter et al., 2003). Technology anxiety can prove to be an influential construct in technology integration.

The placement of technology in classrooms without teacher preparation and curriculum considerations has produced high levels of anxiety among teachers (Budin, 1999, as cited in Redmann & Kotrlik, 2004, p. 78). Hooper and Rieber (1999) described five phases of teachers' use of technology: (a) familiarization, (b) utilization, (c) integration, (d) reorientation, and (e) evolution. It was asserted that teachers often do not progress past a utilization stage (Bauer & Kenton, 2005). In the utilization stage, teachers become prematurely satisfied with their limited use of technology, but lack a positive commitment to it and readily discard the technology at the first sign of trouble (Bauer & Kenton, 2005). Budin (1999) states that, since the implementation of computers in schools, there has been an underlying anxiety among teachers because they worry about how computers will affect student learning and their own work. Some teachers fear they may be replaced by computers while others fear losing control of their classrooms (Fabry & Higgins, 1997). Additionally, because many teachers will most likely know less than their students about technology, the fear and anxiety of embarrassment acts as a major deterrent to acquiring the skills to effectively use technology (Fabry & Higgins, 1997).

Barriers to Technology Integration

General opinion is that the computer revolution has had a major impact on education, but the impact seems to have just improved basic information retrieval and not influenced teaching methods and classroom structures (Earle, 2002, p. 9). A crucial factor for successful technology integration into the classroom is the teacher (Bitner & Bitner, 2002;), because what directly determines the instruction that takes place behind the classroom door is the teacher rather than external educational agenda or requirements (Chen, 2008). Researchers (Fabry & Higgins, 1997; Earle, 2002; Redmann and Kotrlik, 2004; Ertmer, 2005; Kotrlik & Redmann, 2005) include teacher's attitudes and resistance to change, concerns about funding, training deficiencies, hardware/software, and leadership as barriers to the effective implementation of technology integration.

The introduction of technology into educational settings has often been met with lukewarm support and with mixed results and this slow adoption has led to a time lag of technology use (Gumport and Chun, 1999). Paul Privateer (1999) refers to this as the "time-lag" that often separates the invention of a paradigm-altering technology from its everyday use (p. 60). Schools and the pedagogy of teaching have remained relatively unchanged for hundreds of years and therefore a change in how schools operate and methods of teaching to anything new can seem threatening (Fabry & Higgins, 1997; Privateer, 1999). A technology system that is not perceived as a way to help people perform their jobs better is less likely to be received favorably even if an organization has careful implementation (Davis, 1989, p. 320).

Ertmer (2005) classifies barriers into two categories, extrinsic (hardware, access, support, training) and internal (teacher's pedagogy and beliefs). Availability and accessibility of technology hardware and software, the presence of technical and institutional support, and staff development programs, and time restrictions are external sources that influence technology integration (Rogers, 2000, p. 459; Earle, 2002; Ertmer, 2005; Belland, 2009). A teacher's attitude, perceptions of teaching, and an individual's competency with technology categorize internal sources that influence technology integration (Rogers, 2000; Earle, 2002; Ertmer, 2005).

A major external barrier reducing integration of technology is the availability and accessibility to the necessary, useful, and relevant hardware and software (Hadley and Sheingold, 1993; Earle 2002; Keengwe, Onchwari, & Wachira, 2008). Problems scheduling enough computer time for different classes, and basic location of computer labs within the school create barriers for teachers, and lack of access to necessary software or restrictions by school district networks cause teachers to not implement technology into lessons (Becker, 1998; Rogers, 2000). Adding to difficulties with hardware and software is that of institutional and technical support. Institutions that do not employ the proper amount of technical support, show reduced rates in technology use (Rogers, 2000). Individuals do not feel compelled to use new hardware or software if lack of support is apparent. The risk of damage or the technology “not working” and not having support to assist, outweighs the want to use technology (Murphy & Terry, 1998; Earle, 2002; Ertmer, 2005; Keengwe, Onchwari, & Wachira, 2008).

Sufficient technology training and skill development is another category of an external barrier. Lack of teacher training in how to innovatively use technology is one of the major barriers preventing the infusion of technology in the classroom (Brand, G, 1997; Jacobsen, 2001; Gaytan, 2006; Keengwe, Onchwari, & Wachira, 2008; Belland, 2009). Millions of dollars have placed technology in K-12 classrooms, but there has been considerably less attention paid to helping teachers make the transition into a technology-rich learning environment. (US Department of Commerce, 1998; Gaytan, 2006). Gaytan argues, “simply investing in instructional technology, by itself, does mean that teachers will know how to use it” (p. 28). Instructors must be trained “not only to use technology, but also to shift the way in which they organize and deliver material” (Palloff & Pratt, 2000, p. 3). Dedicating resources, time, and accessibility allow teachers to become more comfortable with the ideas of technology and the advantages of using technology (Palloff & Pratt, 2000; Jacobsen, 2001; Earle, 2002). However, technology training must not only technical it must also include teaching faculty about learning theories and how to recognize learning styles. Teachers are accustomed to being experts and when they are novice learners they experience the same anxiety as a new learner (Rogers, 2000). "Being sensitive to these factors, while at the same time helping faculty come to grips with being a student again, is a key to success factor in helping faculty adopt new technologies" (Rogers, 2000, p. 24). The combination of technical skills and applied learning theories will catapult the paradigm shift from "teaching" to "learning" (Rogers, 2000, p. 24). This investment in the human capital of teachers can not necessarily be quantified but it will make a difference in the attitudes of the faculty towards the use of technology and in turn increasing the efficiency of using technology. Teachers properly trained in the effective integration of technology with positive attitudes, can have a significant impact on student learning (Harvey & Purnell, 1995; Gayton, 2006).

Time becomes an issue for both the individual and the institution. The lack of time to develop new courseware, new skills, or advanced applications prevents integration (Rogers, 2000; Belland, 2009). Teachers need time to earn how to use the hardware and software, time to plan, and time to collaborate with other teachers while institutions find time hard to accommodate (Keengwe, Onchwari, & Wachira, 2008, p. 562). Teachers also need time to develop and incorporate technology into their curriculum, which can often be an outdated (Belland, 2009).

Internal barriers prove to be the hardest to overcome (Ertmer, 2005). Changing the innate understandings and knowledge of an individual takes far more resources than overcoming external barriers (Russell, Bebell, O'Dwyer, & O'Conner, 2003; Ertmer, 2005). If a teacher feels that technology is important part of the curriculum, the more likely it will be integrated into the curriculum. If it is not in their pedagogy and the importance is not seen then technology is not integrated. (Russell et al., 2003) “A key step in increasing teachers’ uses of technology may be changing their beliefs about the importance of technology” (Russell et al., 2003, p. 303). In a study done by Andrew (2007) he found that although teachers believe that technology can make a difference in their teaching, many teachers could not break from the teacher centered classroom. The internal barrier of their overall pedagogical beliefs prevails and technology can not be integrated.

Barriers to technology integration are both external and internal and can prevent the integration of technology. However, barriers can be addressed and overcome to increase the implementation of technology. If educators can find the personal value of technology as a productive and learning tool (Fabry & Higgs, 1997) the next decade could create a more technological learning environment.

Summary

A review of the literature revealed Davis’ TAM, which provides a theoretical framework for this study to assess the extent that CTE integrates technology into the teaching-learning process. A review of technology adoption and technology integration was studied to obtain a foundation of the concepts. Kotrlik and Redmann’s Technology Integration Model was also examined as a method to classify teachers with technology integration. Technological history and education was evaluated to determine how technology has grown over the past decades and which constructs influencing technology motivate individuals to integrate technology. The literature review explored factors that influence and determine integration of technology in the teaching/learning process.

CHAPTER THREE

METHODOLOGY

This chapter presents an overview of the methods that were used to conduct the research study. An introduction of the study will be presented followed by the research design. Detailed sections will discuss the participants, sampling, instrumentation, data collection, and data design.

Introduction

This study implemented a non-experimental research design. According to Sproull (1995), the non-experimental design does not have an experimental variable but does have variables that can be measured. "A substantial proportion of quantitative educational research is non-experimental because many important variables of interest are not manipulable" (Johnson, 2001, p. 3). Johnson (2001) proposes that there are two dimensions to non-experimental research: the research objective and the time dimension (Johnson, 2001). The research objective design dimension evaluates whether the study is descriptive, predictive, or explanatory, and the time dimension determines if the design of the study is cross-sectional, longitudinal, or retrospective (Johnson, 2001). This study implemented an explanatory, cross-sectional, non-experimental quantitative survey research design. To understand predictive research, one needs to answer the following question: "Did the researchers conduct the research so that they could predict or forecast some event or phenomenon in the future (without regard or cause and effect)?" (Johnson, 2001, p. 9)

There have been several studies that document that the use of technology in the teaching-learning process has resulted in improve student learning (Mellon, 1999; Kotrlik, Redmann & Harrison, 2000; Huitt, 2003; Redmann, Kotrlik, & Douglas, 2003; Redmann & Kotrlik, 2004; Kotrlik & Redmann, 2005; Deubel, 2007). However, there is still a need for exploration of this pathway to education.

Research Design

The research design, or the plan for conducting research (Sproull, 1995), was created to fully outline the steps needed to conduct this research. To generate a study that explored and explained the level of technology integration that CTE teachers implement, an explanatory, non-experimental design was created. A research design in which an experimental variable is not introduced by the researcher but measures can still be taken, is a non-experimental design (Sproull, 1995). In a non-experimental design, most of the research processes are the same; the major difference lies in the ability to conclude cause and effect because of the lack of control (Sproull, 1995). In this study, a non-experimental, explanatory, cross-sectional, survey design was created. "A cross-sectional design examines characteristics of samples from different populations during the same time period" (Sproull, 1995, p. 372). To go hand-in-hand with the cross-sectional design, a survey was created to collect information from a sample to generalize to a larger population (Patten, 2005). To reach the largest population and make the study financially feasible, the survey produced was distributed via email through SurveyMonkey.com.

This research design met the purpose of a non-experimental design, where the relationship between or among variables will be observed or measured (Sproull, 1995). According to Sproull (1995), many non-experimental designs are used to determine the degree of predictability that something might happen in the future. Within this study, from the questions asked and answered, a predictability and explainability of level of technology integration was further explained for CTE teachers in North Carolina.

Participants

The population for this study is public secondary CTE teachers in North Carolina. Table 3.1 shows this population for the 2007-2008 school year; this includes those teaching in the areas of agriculture, business and information technology, family and consumer sciences, health occupations, marketing, technology, and trade and industrial. The frame for this study was provided by the North Carolina Department of Instruction (NCDPI), which included a list of 2,134 teachers and email addresses from the 2009 CTE Summer Conference. The list was then narrowed to accommodate the seven areas of interest. The frame for this study is shown in Table 3.2.

Table 3.1 *Enrollment and Teachers by Program Area (2008)*

CTE Program Area	Enrollment 07-08	Number of Teachers
Agriculture	48,542	444
Business and IT	344,428	2702
Family and Consumer Sciences	153,857	1437
Health Occupations	41,684	514
Marketing	44,387	541
Technology	72,472	567
Trade and Industrial	87,877	1332

(Public Schools of North Carolina State Board of Education Department of Public Instruction, 2008)

The participants for this study were derived from the 2009 Career and Technical Education Summer Conference. Participants came from a variety of disciplines, as shown in Table 3.2 below.

Table 3.2 *Teachers by Discipline, 2009 CTE Summer Conference*

CTE Program Area	Number of Teachers
Agriculture	223
Business and Information Technology	543
Family and Consumer Sciences	389
Health Occupations	156
Marketing	97
Technology	68
Trade and Industrial	256
Career Development	105

The CTE summer conference takes place each year as an opportunity for professional development, discipline strategy and planning, and relationship building. It is a chance for all CTE teachers in North Carolina to come and gain new ideas, evaluate the disciplines and plan for the future. The 2009 conference attendance was down due to the economic downturn but held strong with approximately 2500 CTE teachers attending.

Sampling

A population consists of all members of a defined category of elements such as people, events, or objects (Sproull, 1995). The population for this study was all CTE teachers in North Carolina. The accessible population for this study was CTE teachers attending the summer conference in 2009. To ensure an adequate sample can be observed to establish inferences for the entire group of CTE teachers in the accessible population, the sampling must be conducted. Sampling is the process of selecting subgroups from a population of elements such as people, objects, of events (Sproull, 1995). For this study, the sample is all CTE teachers in North Carolina and was drawn from the eight CTE program areas in the state of North Carolina. These eight areas were:

- Agricultural Education
- Business and Technology Education
- Career Development Education
- Technology Education
- Family and Consumer Sciences Education
- Health Occupations Education
- Marketing Education
- Trade and Industrial Education

Each of these categories included a variety of teachers with varying perceptions of technology and technology integration. Having a representative sample is the most desired goal in sampling (Sproull, 1995). In order to receive an equal input from all eight program areas, a stratified sample was used. This is a probability sampling method in which elements are selected from each designated subpopulation (stratum) of a population (Sproull, 1995). The strata are determined according to the differing types or amounts of a variable that the researcher decides may be associated with the major variable (Sproull, 1995). Stratified sampling will incorporate all the advantages of a random sampling, and increase the precision of the analysis because of its homogenous groupings (Sproull, 1995). An advantage of the stratified sample is that the method can control for variables that are possible sources of influence on the major variable (Sproull, 1995). The stratified sampling yields excellent results because it ensures a bias-free sample and controls for the variables used for stratification (Sproull, 1995).

The desire to generalize from a survey requires that an adequate sample be drawn (Hinkelmann & Kempthorne, 2008). “The determination of sample size is a common task for many organizational researchers. Inappropriate, inadequate, or excessive sample sizes continue to influence the quality and accuracy of research” (Bartlett, Kotrlik, & Higgins, 2001, p. 43). According to Bartlett et al. (2001), it is critical to base sample size on the primary variable of study. The primary variable in this study is technology integration; the sample size was calculated based on the KRTIS and TAM scale (five response items).

Bartlett et al. (2001) present Crochan’s formula for sample size for a continuous variable is as follows:

$$n = \frac{(t)^2 * (s)^2}{(d)^2}$$

t= “the level of risk the researcher is willing to take that true margin of error may exceed the acceptable margin of error” (Bartlett et al., 2001, p. 45). For this study the accepted margin of error is .05 (t=1.96).

s= “estimate of standard deviation in the population” (Bartlett et al., 2001, p. 45). This uses a five point scale and 98% of the data will fall six standard deviations.

d= “acceptable margin of error for mean being estimated” (Bartlett et al., 2001, p. 45). The acceptable margin of error is .02.

$$n = \frac{(1.96)^2 * (5/6)^2}{(5*02)^2} = 268$$

It is suggested that researchers account for the anticipated response rate (Bartlett et al., 2001). While the desired delivered sample is 268, it is critical to adjust for non-respondents based on previous response rates. Previous response rates with this type of population have varied between 50 and 57 percent (Redman and Kotrlik, 2003). With this in mind a conservative estimate (268/.35) would require the drawn sample size to be 765. To obtain a stratified sampling, the Table 3.3 was used.

Table 3.3 *Stratified Sample Calculations for North Carolina CTE Teachers*

CTE Discipline	Teachers per CTE Discipline	Discipline/ Total	Divided by Sample Size	Sample to be Collected from Each Discipline
Agriculture	222	0.121394	92.5	93
Business	543	0.295591	226.25	227
Technology Education	68	0.037017	28.33	29
Family and Consumer Science	389	0.211758	162.0833	162
Health and Occupations	156	0.084921	65	65
Marketing	97	0.052803	40.41	40
Trade and Industrial	256	0.139358	106.666	107
Career Development	105	0.057158	43.75	44

Comparing early and late survey submissions was the procedure for non-bias response bias. Descriptive statistics were used to compare technology integration level and perceived ease of use and usefulness from the participants. However, to make generalizations to specific CTE areas, the study over sampled and selected all individuals from the frame provided.

Instrumentation

"An instrument is whatever device is used to measure variables and can range from written or oral materials to physical devices" (Sproull, 1995, p.179). Some examples of instrumentation include questionnaires, rating scales, skills tests, checklists, and materials created by the researcher (Sproull, 1995). In considering instrumentation, there are two types of "published" instruments in the social and behavioral sciences (Patten, 2005). First, there are tests and scales published by commercial publishers and these have undergone extensive development to ensure reliability and validity (Patten, 2005). Second, there are noncommercial published instruments that have been created by the researcher for particular purposes (Patten, 2005). Along with considering the instrumentation, the researcher must also ensure that the instrumentation measures the variables appropriately, is sufficiently valid and reliable, yields the appropriate level of measurement, requires appropriate amount of time, is easy to administer and interpret, and is in the researchers budget (Sproull, 1995).

Because there is such a large variety of instrumentation, the researcher must choose the data collection method that is most advantageous to their study. For this particular study, the best instrumentation was the use of a survey. The instrument was administered via the internet, which is widely accessible for CTE teachers. Using a combination of instruments, the survey was created to completely understand and evaluate CTE teachers' perspectives of technology integration.

TAM was the first instrument and is related to the theoretical framework. From the TAM, 12 questions (six from each construct) were pulled into this study's survey to measure perceived usefulness and perceived ease of use. A step-by-step process was used to develop multi-item scales having high reliability and validity (Davis, 1989). The conceptual definitions of perceived usefulness and perceived ease of use were used to generate 14 candidate items for each construct from past literature (Davis, 1989). Pre-test interviews were then conducted to assess the semantic content of the items, and those items that best fit the definitions of the constructs were retained, yielding 10 items for each construct (Davis, 1989). A field study was then conducted of 112 users to create reliability and construct validity and the scales were further redefined to six items per construct (Davis, 1989).

The perceived usefulness scale attained Cronbach's alpha reliability of .97, and perceived ease of use achieved a reliability of .91 (Davis, 1989). Convergent and discriminant validity were tested using multitrait-multimethod (MTMM) analysis. The MTMM matrix contains the inter-correlations of items (methods) applied to the two different constructs (Davis, 1989). Convergent validity refers to whether the items comprising a scale behave as if they were measuring a common underlying construct (Davis, 1989). In order to demonstrate convergent validity, items that measure the same should correlate highly with one another (Davis, 1989). For perceived usefulness, the MTMM correlations were all 90 monotrait-hetermethod correlations were significant and perceived ease of use was at 86 out of 90 (Davis, 1989).

The discriminant validity is concerned with the ability of a measurement item to differentiate between objects being measured (Davis, 1989). The test for discriminant validity is that an item should correlate more highly with other items intended to measure the same trait than with either the same item used to measure a different trait or with different items used to measure a different trait (Davis, 1989). The discriminant validity test revealed that perceived usefulness and ease of use scales possess a high concentration of trait variance and are not strongly influenced by methodological artifacts.

Three scales from the work of Kotrlik and Redmann, found in Appexdix E, were used in the study. These included technology integration (KRIS), barriers to integration (KRBTI), and the technology anxiety scale (KRTAS). There were also are seven questions related to teachers' perceived teaching effectiveness. Kotrlik and Redmann's instrumentation (KRIS) was used to analyze technology integration in the survey. The technology integration scale contained four subscales: exploration, experimentation, adoption, and advanced integration (Redmann & Kotrlik, 2004). "These scales and all demographic items were developed by Redmann and Kotrlik after reviewing the literature and the face and content validity were evaluated by an expert panel of career and technical educators" (Redmann et al., 2003, p. 35). The standards for instrument reliability for Cronbach's alpha by Robinson, Shaver, and Wrightsman (1991) were used to judge the quality of the three scales in the instrument:

- .80-1.00 = exemplary reliability
- .70-.79 - extensive reliability
- .60-.69 = moderate reliability, and <.60 = minimal reliability

The following displays the results of all three instruments reliability:

- Technology Integration = .95
- Exploration Subscale = .84
- Experimentation subscale = .93
- Adoption subscale = .95
- Advanced Integration = .92
- Barriers Scale = .85
- Teacher Effectiveness = .91

(Redman, Kotrlik, & Douglas 2003, p. 35)

Data Collection

Data collection integrated elements of Dillman's (2007) total design method and recent literature on web-based survey techniques. Variables of interest in a study were measured by a type of instrumentation, and were collected. A data collection method is the means by which information about variables are collected (Sproull, 1995). There are four different data collection methods including interviewing; instrument administration; observation; and examination of documents, materials, and artifacts (Sproull, 1995). To best collect data from this study, instrument administration was used. Instrument administration is a data collection method in which participants respond to questionnaires, tasks, scales, or other devices (Sproull, 1995). These instruments are administered by a variety of methods including mail, telephone, online and face-to-face (Sproull, 1995). Dillman (2007) states that a researcher should have four contacts with participants. These four contacts include: "a pre-notice Letter, questionnaire mailing-including detailed cover letter, a thank you postcard, replacement questionnaire, and final contact" (Dillman, 2007, p. 302). All respondents received a pre-notification email describing the research project. The pre-notification email included the elements suggested by Dillman (2007) including what will happen in the research, what is the research is about, usefulness of survey, thank you, signature, and token incentive. All respondents with email that were returned in this stage as undeliverable were replaced by a continuation of the sampling procedure as described above. A pre-notification email was sent to the participants that were replaced in the sample. Two days following the initial pre-notification email, respondents were sent an email with a consent form and a link to the survey. This email was the second contact, and included “the request, reason for selection, usefulness of survey, confidentiality, token of appreciation, willing to answer questions, and a thank you” (Dillman, 2007, p. 302). A week following the first survey request, respondents received a follow-up email thanking them for participating and non-respondents received a follow up email stressing the importance of participation in this research project and asking for their participation one last time. This email included a link to the survey. Five days following the thank you, a replacement link was sent along with a follow-up requesting participation. Early and late respondents were compared to control for non-response bias.

For this study, approval from the Institutional Review Board (IRB) at North Carolina State University was secured. A list from the North Carolina Department of Education including eight departments of the CTE disciplines was also obtained. The survey was then distributed via SurveyMonkey and ConstantContact to the participants through email, and the results maintained through Survey Monkey. After results were maintained, SPSS software was used to analyze the data.

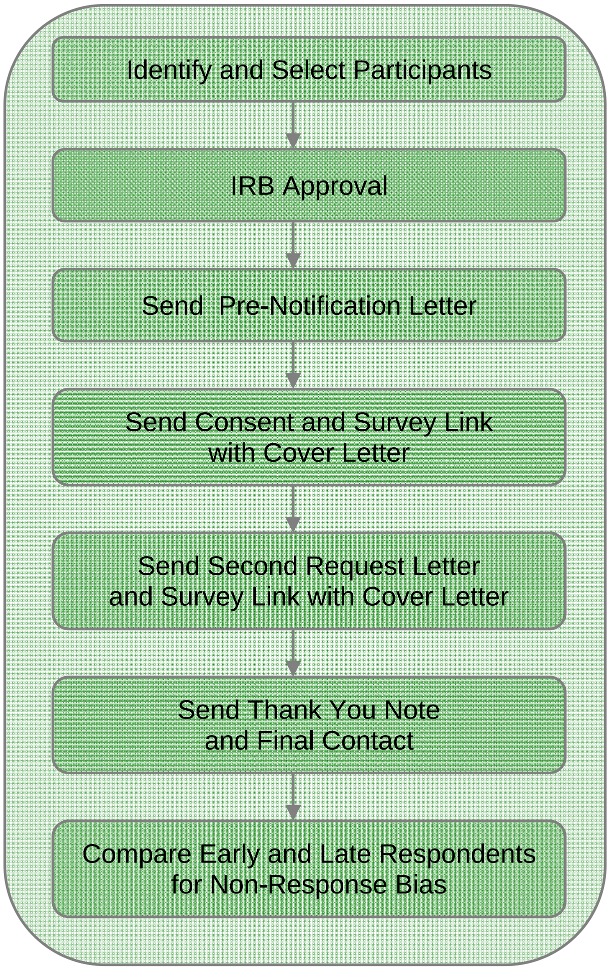

Figure 3.1

Data Collection Steps Modified from Bartlett (2009)

Data Analysis

The tasks involved in examining data may seem mundane and inconsequential, but they are essential to any analysis (Hair, Black, Babin, Anderson, & Tatham, 2006). Analysis of data allows the researcher to understand, interpret, and articulate results based on relationships that are more complex than previously encountered (Hair et al., 2006). Hair et al. also state, “A through knowledge of the variable interrelationships can aid immeasurably in the specification and refinement of the model as well as provide a reasoned perspective for interpretation of the results" (p. 41).

The first step of data analysis was to examine for response bias. According to Miller and Smith (1983), it is appropriate to compare early and late respondents on the major variable of interest. For this study, the four levels of integration and the factors to predict integration were compared for respondents and non-respondents with t-test and ANOVA analysis. Data was initially examined using a variety of techniques to ensure that assumptions were met for multivariate data analysis. Any missing data was addressed with an appropriate technique, such as replacing missing values with means or regression analysis.

A factor analysis was conducted to examine the construct validity of the technology integration scales and the TAM instrument. According to Hair et al. (2006), factor analysis is usually conducted on metric variables and to "analyze patterns of complex, multidimensional relationships" (p. 101). The following data analysis procedure for factor analysis is summarized from Hair et al. (2006): meeting the conceptual and statistical assumptions, identifying the criteria for extracting factors, and determining the appropriate rotation.

1) It is critical to meet the following assumptions:

   Conceptual assumption

   a) "Some underlying structure does exist" (p.113)

   Statistical assumption

a) Bartlett's test of sphericity shows correlations among the variables to be examined. Significance is measured at .05 or less.

b) The Measure of Sampling Adequacy (MSA) is between 0 and 1 but should exceed .50 for each individual variable and the overall test. In SPSS, MSA is assessed by the Kaiser-Meyer-Olkin (KMO).

2) After the assumptions are met, it is critical to identify the criteria for extracting factors. A common technique to identify the number of factors is the latent root criteria. According to Hair et al. (2006) eigenvalues greater than one are considered to be significant. The scree plot will also be examined to show a graphical representation of eigenvalues in relation to the number of factors (Heir et al., 2006).

3) An oblique rotation is "best suited to the goal of obtaining several theoretically meaningful factors or constructs because, realistically, few constructs in the real world are uncorrelated" (p.127). The OBLIMIN rotation is an oblique rotation available in SPSS or SAS (Hair et al., 2006).

At this point, it is appropriate to conduct the factor analysis then interpret the factor loadings. To examine the factor loadings, the following criteria was used: ±.3 to ±.4 were minimally acceptable, loadings greater than .5 were considered practically significant, and loadings over .7 show a well-defined structure (Hair et al., 2006). According to Hair et al. (2006), "most researchers report the results of the pattern matrix" (p. 130). Finally, factors were labeled, and Cronbach's alpha were conducted.

Research Objective 1 described the level of career and technical educators' technology integration with the four constructs of integration (exploration, experimentation, adoption, and advanced integration) as measured by the KRIS. Means, standard deviations, frequencies, and percents were used to meet these objectives. Research Objective 2 described career and technical educators' perceived usefulness and ease of use of technology, as measured using the TAM. Means, standard deviations, frequencies, and percents were used to meet these objectives.

Research Objective 3 explored the relationships between career and technical educators technology acceptance factors (perceived usefulness and ease of use of technology) and level of technology integration with the four levels (exploration, experimentation, adoption, and advanced integration). To meet this objective, correlational tests were used to analyze the data. Research Objective 4 explored what demographic variables, technology integration factors, perceived technology anxieties, barriers, and perceived teaching effectiveness explain the variance in technology integration within the levels of technology integration. Multiple regression was used to meet this objective.

Multiple regression was also be used to explain the variance in technology integration within the level of technology integration. Much research is correlational rather than experimental (Sproull 1995). "When the research design involves more than one predictor variable and a criterion variable, multiple regression is appropriate" (Sproull, 1995, p.308). According to Hair et al. (2006), multiple regression analysis is a general statistical technique used to analyze the relationship between single dependent variable and several independent variables" (p.169). Using multiple regression can help improve predication of a dependent variable. "The ability of an additional independent variable to improve the prediction of the dependent variable is related not only to its correlation to the dependent variable, but also the correlation of the additional independent variables" (Hair et al., 2006, p.186). When using multiple regression, it is necessary to start with the research problem, then the following stages are followed:

1. Research Problem: select objective, select dependent and independent variables
2. Research Design Issues: obtain an adequate sample size to ensure statistical power and generalizability
3. Creating Additional Variables and Assumptions in Multiple Regression: Do the individual variables meet normality, linerarity, homoscedasticity, and independence of error. (Hair et al., 2006, p. 189)

There are several purposes for using multiple regression, including predication and explanation of the dependent variable. The first objective is to maximize the overall predictive power of the independent variables as represented in the variable; predictive accuracy is always crucial to ensuring the validity of the set of independent variables (Hair et al., 2006). Multiple regression also provides an assessment of the degree and character of the relationship between dependent and independent variables. "This is done by examining the magnitude, sign, and statistical significance of the regression coefficient for each independent variable" (Hair et al., 2006, p.190). Therefore, in addition to their collective prediction, they may also have their own individual contribution to the variate and its predications (Hair et al., 2006).

Prediction and explanation are influenced by the sample size. The effects of the sample size are seen most directly in the statistical power of the significance testing and the generalizability of the result (Hair et al., 2006). The sample size also plays a role in the statistical power level of R^2.

Timeline, Expected Results, and Conclusion

A timeline for this research study is outlined in Appendix A. The timeline creates a visual representation of notable dates and research objectives. This was the guide to completion.

Previous studies suggest that CTE teachers are most active in the exploration and the adopting phases of technology integration (Redmann & Kotrlik, 2004). Expectations wer that many of the North Carolina CTE teachers will fall into these categories as well; however, difference constructs may influence the results.

Technology has become a part of a growing and changing society. U.S. Students (Deubel, 2007), calls for schools to teach more than basic skills and incorporate "21st century skills such as critical thinking and problem-solving skills, computer and technology skills, and communication and self-direction skills into their curriculum" (para. 3). Classroom teachers hold the key to student success with technology; however, the teachers should not be required to take on the entire burden (Jacobsen, 2001). The transformation from paper and pencil to technology will take effective leadership by visionary and knowledgeable school administrators, boards, and industry (Jacobsen, 2001). The results from this research can open a dialogue about how to better implement technology resources in classrooms.

CHAPTER FOUR

FINDINGS

The purpose of this study was to examine North Carolina CTE instructors' levels of technology integration and related factors that can be used to predict technology integration, including perceived technology anxieties, barriers, and perceived teaching effectiveness. This chapter will present the findings from research survey on technology integration and the CTE teacher. Results from this study will be added to the literature on the subject of technology integration. Pre-data analyses results including explanatory factor analysis and Cronbach's alpha tests for internal consistency will be reported. Factor scales and correlations are described and individual item factor loadings are also reported. Following the pre-data analysis descriptive results for demographic data are reported, with use of means, standard deviations, frequencies and percentages. This is followed by descriptions and analysis from the following research objectives:

- *Research Objective 1* – Describe the level of career and technical educators' technology integration with the four constructs of integration (exploration, experimentation, adoption, and advanced integration) as measured by the Kotrlik and Redmann Technology Integration Scale (KRIS).
- *Research Objective 2* – Describe career and technical educators' perceptions of technology usefulness and ease of use in the teaching and learning process, as measured using the Technology Acceptance Model (TAM) developed by Davis (1989).

- *Research Objective 3* – Explore the relationships between career and technical educators' technology acceptance factors (perceptions of technology usefulness and ease of use) and levels of technology integration with each of the four levels of integration (exploration, experimentation, adoption, and advanced integration).
- *Research Objective 4*– Explore which aspects of demographic variables; technology integration factors; and perceptions of such factors as technology anxieties, barriers, and teaching effectiveness explains a significant proportion of the variance in technology integration within each of the four levels of technology integration.

Data Collection

Of the 1775 surveys that were sent via ConstantContact, 143 were undeliverable, therefore a total of 1632 emails were sent to participants. Of the 1632 surveys emailed, 584 (35.7%) were opened on the first delivery and 371 (22.7%) individuals clicked onto the survey link to complete the survey.

To encourage individuals to complete the survey, a follow-up/thank you email was sent via ConstantContact. The email contained the link for the survey and incentives for completing the survey. From this email, 492 (30.2%) opened the survey and 142 (8.70%) individuals clicked onto the survey link. Although a total of 595 individuals clicked on the survey link, only 513 completed the survey, which constituted a final return of 31.4%.

Pre-Data Analysis

Preliminary data analysis was done to test missing data, non-response bias, ensure variables factored into the appropriate scales, and for reliability and validity of scales reported by Cronbach's alpha. To test the instrument's factors, the KRIS subscales and TAM subscales were assessed with explanatory factor analysis. Upon completion of these procedures better decisions of how to analyze the data could be concluded.

Non-Response Bias

According to Miller and Smith (1983), it is appropriate to compare early and late respondents on the major variable of interest. For this study, the four levels of integration and the factors to predict integration were compared for respondents and non-respondents with Analysis of Variance (ANOVA). Literature findings from Miller and Smith (1983) show late responders can be like non-responders.

Early and Late Respondents

The data was collected in two stages in accordance with Dillman (2007). A pre-notification letter was sent, respondents were then sent an email with a consent form and a link to the survey, followed by a thank you email for those that participated and a request for participation for those that did not complete the survey. From these two contacts, early and late responders were identified. Early responders were identified as the first 371 participants who responded to the first email/survey and late responders, 142, from the second contact. Analysis of variance (ANOVA) was run between early and late respondents with all variables from the survey. To identify the differences in categorical data (gender, age, and years of teaching) in the survey response rounds were analyzed by a chi-square. Table 4.1 shows the Analysis of Variance (ANOVA) among early and late responders on the following variables: exploration, experimentation, adoption, advanced integration, barriers, technology anxiety, teacher perceptions, perceived usefulness, and perceived ease of use.

Table 4.1 *Analysis of Variance Comparison of Early and Late Respondents on Technology Integration with Exploration, Experimentation, Adoption, Advanced Integration, Barriers, Technology Anxiety and Teacher Perceptions, Perceived Usefulness, and Perceived Ease of Use*

	Early (*n*=371)		Late (*n*=142)							
	M	*SD*	*M*	*SD*	Sum of Squares		Df	Mean Square	F	p
Exploration	18.09	4.23	18.30	4.27					.250	.617
					Between	4.50	1	4.50		
					Within	9211.57	511	18.02		
					Total	9216.07	512			
Experimentation	15.40	8.87	13.83	7.75					3.4	.063
					Between	255.85	1	255.85		
					Within	37619.2	511	73.61		
					Total	37874.1	512			
Adoption	59.60	13.13	59.02	15.5					.18	.671
					Between	34.52	1	34.52		

Table 4.1 Continued

	Early (*n*=341)		Late (*n*=142)		Sum of Squares		Df	Mean Square	F	p
	M	*SD*	*M*	*SD*						
					Within	978251	511	191.43		
Adoption					Total	97859.6	512			
Advanced Integration	14.25	5.09	13.46	5.44					2.3	.125
					Between	63.80	1	63.80		
					Within	13772.9	511	26.95		
					Total	13836.7	512			
Barriers	18.97	5.37	19.33	6.13					.44	.507
					Between	13.81	1	13.81		
					Within	15998.6	511	31.3		
					Total	16012.5	512			
Technology Anxiety	23.84	9.35	24.30	10.10					.24	.620
					Between	22.55	1	22.55		
					Within	46771.6	511	91.53		

Table 4.1 Continued

	Early (*n*=341)		Late (*n*=142)		Sum of Squares		Df	Mean Square	F	p
	M	*SD*	*M*	*SD*						
					Total	46794.2	512			
Teacher Perceptions	25.81	4.14	25.92	4.34					.07	.790
					Between	1.25	1	1.25		
					Within	9016.66	511	17.64		
					Total	9017.91	512			
Perceived Usefulness	25.21	4.50	24.95	5.41					.30	.582
					Between	6.90	1	6.90		
					Within	11635.8	511	22.77		
					Total	11642.7	512			
Perceived Ease Of Use	25.57	4.12	23.71	5.01					.10	.747
					Between	1.99	1	1.99		
					Within	9839.07	511	19.25		
					Total	9841.07	512			

Early respondents (*n* = 371, 22.7%) and the late respondents (*n*= 142, 8.70%) were not statistically significantly different in technology integration on the following variables:, exploration ($F = .250$, $p = .617$), experimentation ($F = 3.47$, $p = .063$), adoption ($F = .180$, $p = .671$), advanced integration ($F = .2.36$, $p = .125$), barriers ($F = .441$, $p = .507$), technology anxiety ($F = .246$, $p = .620$), teacher perceptions ($F = .071$, $p = .790$), perceived usefulness ($F = .303$, $p = .582$), and perceived ease of use ($F = .104$, $p = .747$).

Further analysis of the early and late responders investigates the differences between the categorical variables of age, gender, and years teaching. Table 4.2 provides an overview of the variables age, gender, and years of teaching using a chi-square analysis.

Table 4.2 *Chi Square Comparison of Early and Late Respondents by Categorical Demographic Characteristics of Gender, Age, and Years of Teaching*

	Early (*n*=371)		Late (*n*=142)
	X2	df	p
Age	4.69	4	.321
Gender	.278	1	.598
Years of Teaching	6.56	5	.255

Age (X2 = 4.69, *df*= 4, *p* = .321), gender (X2 = .278, *df*= 1, *p* = .598), and years of teaching (X2 = .6.56, *df*= 5, *p* = .255) were not statistically different for early or late respondents. Because there was a statistically insignificant difference between the early and late respondents on the variables, the respondents were examined as a full group within the study.

Factor Analysis

Prior to analyses applicable to the research objectives, an exploratory factor analysis was conducted to examine the construct validity of the technology integration and the TAM instrument sub-scales. According to Hair et al. (2006), factor analysis is usually conducted on metric variables and to “analyze patterns of complex, multidimensional relationships” (p. 101). Factor analysis was primarily performed in order to group items that have the same underlying meaning and to confirm variables placement within the sub-scales. The principal component analysis was conducted utilizing Oblimin with Kaiser rotation (Hair et al., 2006). Using factor analysis the structures of the four KRIS integration subscales, exploration, experimentation, adoption, and integration were determined. The results of factor analyses are summarized in the Table 4.3. The majority of the pre-existing KRIS factor scales were maintained. One exception was the factor scale, Advance Integration, in which one item moved from Integration to Adoption.

The advanced integration level consisted of 5 Likert Scale questions and the adoption level consisted of 15 Likert Scale questions. After analyzing the factor loadings, the first item (“I often require my students to use Internet web sites to complete their assignments.”) of the advanced integration level scale of the KRIS loaded higher on the adoption scale. After examining the statement for validity and after examination of the empirical data, the item was shifted to the adoption level scale. Exploration factor loadings ranged from .755 to .679. Experimentation factor loadings ranged from .904 to .807, confirming the factors positively loaded together.

Table 4.3 *Factor Loadings of KRIS Scale Items Adoption, Advanced Integration, Experimentation, and Exploration*

		Component Loadings		
	Adopt	Experimentation	Exploration	Advanced Integration
Adoption Item 3	.912			
Adoption Item 4	.911			
Adoption Item 6	.896			
Adoption Item 11	.891			
Adoption Item 12	.886			
Adoption Item 7	.881			
Adoption Item 14	.860			
Adoption Item 8	.856			
Adoption Item 1	.831			
Adoption Item 10	.757			
Adoption Item 9	.751			
Adoption Item 15	.747			
Adoption Item 13	.727			
Integration Item 1	.711			
Adoption Item 2	.689			
AdoptionI item5	.678			
Experimentation Item 5		.904		

Table 4.3 Continued

	Component Loadings			
	Adopt	Experimentation	Exploration	Advanced Integration
Experimentation Item 8		.899		
Experimentation Item 4		.885		
Experimentation Item 6		.878		
Experimentation Item 5		.854		
Experimentation Item 7		.851		
Experimentation Item 2		.849		
Experimentation Item 3		.826		
Experimentation Item 1		.807		
Exploration Item 3			.755	
Exploration Item 1			.726	
Exploration Item 4			.726	
Exploration Item 5			.681	
Exploration Item 2			.679	
Integration Item 4				-.922
Integration Item 5				-.918
Integration Item 3				-.713
Integration Item 2				-.567

The KRIS instrument included variables to assess the constructs of barriers to teaching (2 factors), perceived teaching effectiveness, and technology anxiety. Factor analysis demonstrated that four factors exist. The factors were technology anxiety, teacher perceptions, and barriers to technology. The technology anxiety scale had loadings ranging from .876 to .698. The teacher's perceptions scale had loadings ranging from .660 to .086. The barriers to technology had two factors, Time (barrier factor 1) and Availability/Support (barrier factor 2). Barrier factor 1 had loading from .695 to .575; barrier Factor 2 had loading ranging from -.825 to -.335. The factors were combined to examine barriers because of similarities in questions. Barriers to technology integration had factor loadings from .695 to -.335. The results of factor analyses KRIS scale items barriers, teaching perceptions, technology anxiety are summarized in Table 4.4.

Table 4.4 *Factor Analysis of KRIS Scale Items Barriers, Teaching Perceptions, Technology Anxiety*

	Component Loadings			
	Technology Anxiety	Teacher Perceptions	Barriers Factor 1	Barriers Factor 2
Technology Anxiety Item 7	.876			
Technology Anxiety Item 6	.865			
Technology Anxiety Item 8	.852			
Technology Anxiety Item 3	.852			
Technology Anxiety Item 12	.821			
Technology Anxiety Item 5	.803			
Technology Anxiety Item 4	.786			
Technology Anxiety Item 10	.781			
Technology Anxiety Item 2	.763			
Technology Anxiety Item 11	.749			
Technology Anxiety Item 9	.718			

Table 4.4 Continued

	Component Loadings			
	Technology Anxiety	Teacher Perceptions	Barriers Factor 1	Barriers Factor 2
Technology Anxiety Item 11	.749			
Technology Anxiety Item 9	.718			
Technology Anxiety Item 1	.698			
Teacher Perception Item 7		.806		
Teacher Perception Item 4		.804		
Teacher Perception Item 1		.786		
Teacher Perception Item 3		.781		
Teacher Perception Item 6		.773		
Teacher Perception Item 2		.721		
Teacher Perception Item 5		.660		
Barriers Item 8			.668	
Barriers Item 5			.575	
Barriers Item 9				-.366
Barriers Item 3				-.829
Barriers Item 2				-.769
Barriers Item 4				-.628
Barriers Item 1				-.335

Factor analysis on the TAM found both PU and PEOU loaded positively together. The PU loadings ranged from .936 to .851 and for PEOU .912 and .833. Table 4.5 provides the factor loadings for PU and PEOU.

Table 4.5 *Factor Analysis of TAM Scale Items Perceived Usefulness and Perceived Ease of Use*

	Component Loadings	
	Perceived Usefulness	Perceived Ease Of Use
Perceived Usefulness Item 3	.936	
Perceived Usefulness Item 2	.927	
Perceived Usefulness Item 4	.913	
Perceived Usefulness Item 5	.898	
Perceived Usefulness Item 1	.884	
Perceived Usefulness Item 6	.851	
Perceived Ease Of Use Item 6		.912
Perceived Ease Of Use Item 3		.912
Perceived Ease Of Use Item 5		.898
Perceived Ease Of Use Item 4		.888
Perceived Ease Of Use Item 1		.863
Perceived Ease Of Use Item 2		.833

Reliability

Cronbach's alpha was calculated to provide an estimate of reliability for all summated scales. According to Hair et al. (2006), reliability is "the extent to which a variable or set of variables is consistent in what it is intended to measure. If multiple measurements are taken, reliable measures will be consistent in their values" (p. 103). Cronbach's alpha measures internal consistency and is the most widely used method to estimate reliability (Hair et al., 2006). According to Nunnally (1970) a reliability coefficient of .70 is considered acceptable. The reliability for the constructs ranged from

.800 to .943. In Table 4.6 summarizes the estimates of reliability and the total number of items in each scale for the KRIS and TAM.

Table 4.6 *Reliability, Cronbach's Alpha, of Variables for KRIS and TAM Scales*

Items	α	N
Exploration: Exp1-Exp5	.800	5
Experimentation: Exp1-Exp9	.957	9
Adoption: Adopt1-Adopt15, Int1	.971	16
Integration: Int2-Int5	.887	4
Barriers to Integration: Barr1-Barr9	.839	9
Technology Anxiety: TechAnx1-TechAnx12	.950	12
Teachers' Perceptions: Percep1-Percep7	.879	7
Perceived Usefulness: PU1-PU6	.954	6
Perceived Ease of Use: PEOU1-PEOU6	.943	6

Note: Cronbach's Alpha > .70 is considered acceptable

The table above shows all variables have high internal consistency and reliability.

Analysis of Research Objectives

The following section will report the results for demographic data with use of means, standard deviations, frequencies and percentages. This is followed by descriptions and analysis from the research objectives.

Descriptive Findings

Of the 1632 CTE teachers sampled, the respondents to this study (*N*= 513, 31.4%) were CTE teachers employed by public secondary school systems in North

Carolina, who attended the 2009 CTE summer conference in Greensboro, NC. The following CTE disciplines represent the respondents: 43 (8.41%) agricultural teachers, 172 (33.6%) business and technology teachers, 24 (4.70%) career development teachers, 111 (27.27%) family and consumer science teachers, 48 (9.39%) health occupations teachers, 34 (6.65%) marketing teachers, 21 (4.11%) technology education teachers, and 58 (11.35%) trade and industrial teachers (see Table 4.7).

Table 4.7 *Participant Frequencies and Percents by CTE Discipline*

CTE Discipline	*f*	*P*
Agricultural Education	43	8.41
Business and Technology Education	172	33.66
Career Development Education	24	4.70
Family and Consumer Sciences Education	111	27.72
Health Occupations Education	48	9.39
Marketing Education	34	6.65
Technology Education	21	4.11
Trade and Industrial Education	58	11.35

Note. Results from survey respondents, 513 CTE teachers from 2009 CTE Summer Conference.

Participant's ages ranged from 20-70 years, with the majority age being between 50-60 (*n*=183, or 35.7%), the majority years of teaching between 0-5 (*n*=133 or 25.9%) and the majority gender female *(n*= 353 or 69.9%). Table 4.8 provides frequencies and percentages of the respondents' categorical demographic data, including age range, years of teaching, and gender.

Table 4.8 *Frequencies and Percentages of Participants Age Range, Years of Teaching, and Gender*

Age Range	*F*	*P*
20-30	46	9.0
30-40	81	15.8
40-50	166	32.4
50-60	183	35.7
60-70	37	7.2
Years of Teaching		
0-5	133	25.9
6-10	103	20.1
11-15	75	14.6
16-20	98	19.1
21-25	22	4.3
26-30	49	9.6
31-35	30	5.8

Table 4.8 Continued

Gender	*F*	*P*
Female	353	69.9
Male	152	30.1

Note. Results from survey respondents, 513 CTE teachers from 2009 CTE Summer Conference

Additionally, teachers were asked the sources of their technology training. Over 95% of the teachers gained knowledge about technology from workshops and or conferences (*n*=491 or 95.7%). The self-taught method, was the second highest technique identify by the CTE teachers (*n*=459 or 89.5%) to learn technology. College courses ranked as the third technique for learning technology with 71.9% of CTE teachers responding (*n*=402 or 71.9%). Teachers least likely obtained technology training from fellow colleagues (*n*=369 or 78.4%).

Table 4.9 *Frequencies and Percents of Sources of Technology Training for CTE Teachers*

Sources of Technology Training	*f*	*P*
Workshop/Conference	491	95.7
Self-Taught	459	89.5
Colleagues	402	78.4
College Courses	369	71.9

Note. Results from survey respondents, 513 CTE teachers from 2009 CTE Summer Conference.

Research Objective One

Objective one was to describe the level of career and technical educators' technology integration as measured by the four levels of integration using the following sub-scales of exploration, experimentation, adoption, and advanced integration. Using the KRIS instrument, participant's responses to the four technology integration subscales were measured to discover the extent to which technology is being integrated into the teaching/learning process. There were 33 Likert scale questions (1= Not Like Me At All, 2=Very Little Like Me, 3=Somewhat Like Me, 4=Very Much Like Me, and 5=Just Like Me) on the KRIS instrument. The KRIS instrument can be found in full in Appendix E. To calculate the integration levels, items were summated and divided by the total number of items to produce a grand means and standard deviation for each subscale. The highest integration level was adoption-using technology regularly (*M*=3.96, *SD*=.921). Example items within the adoption subscale included "I emphasize the use of technology as a learning tool in my classroom or laboratory" and "I assign students to use the computer to do content related activities on a regular basis" (Redmann and Kotrlik, 2004). The adoption level of integration indicates teachers have made physical changes in the classroom with technology becoming a focal point of the classroom.

The next highest level was exploration-thinking about using technology (*M*= 3.63, *SD*=.848). The exploration scale included items such as " I want to take a course to learn how to use technology in the teaching/learning process" and "I purchase books or other materials that can help me integrate technology in my teaching" (Redmann and

Kotrlik, 2004). KRIS' exploration level indicates teachers seek to learn about technology and how to use it.

Following exploration level was advanced integration-innovative use of technology (*M*= 2.80*, SD*=1.11). Example items from the advanced integration subscale included "I encourage students to design their own technology-based learning activities" and "I incorporate technology in my teaching to such an extent that my students use technology to collaborate with individuals in other disciplines" (Redmann and Kotrlik, 2004). The integration scale indicates teachers are using technology innovatively and pursue ways to use technology to improve teaching.

The least likely integration level was experimentation-beginning to use technology (*M*= 1.66*, SD*=.955). This subscale included items such as "I am just beginning to use instructional exercises that require students to use the Internet or other computer programs" and "I am just beginning to require my students to use the Internet to complete some of their assignments" (Redmann and Kotrlik, 2004). The experimentation scale indicates teachers are beginning to use technology and begin to use technology for presenting information. Table 4.10 displays means and standard deviations for participant's responses to individual items for the KRIS subscales adoption, exploration, advanced integration and experimentation. Table 4.11 provides an overview of the grand means and standard deviation for the summated items of the four subscales of the KRIS.

Table 4.10 *Means and Standard Deviations for CTE Teachers on the Individual Items for KRIS Subscales of Adoption, Exploration, Advanced Integration and Experimentation*

	CTE Teachers	
	M	*SD*
Adoption		
Adoption Item 3	4.22	.96
Adoption Item 4	4.11	1.10
Adoption Item 8	4.09	1.08
Adoption Item 10	4.08	.96
Adoption Item 7	4.06	1.10
Adoption Item 6	4.05	1.08
Adoption Item 1	4.04	.99
Adoption Item 12	4.00	1.09
Adoption Item 9	3.99	1.05
Adoption Item 11	3.97	1.11
Integration Item 1	3.97	1.12
Adoption Item 14	3.96	1.17
Adoption Item 2	3.95	1.16
Adoption Item 13	3.66	1.11
Adoption Item 5	3.64	1.20
Adoption Item 15	3.50	1.27

Table 4.10 Continued

	CTE Teachers	
	M	*SD*
Exploration		
Exploration Item 4	4.06	1.01
Exploration Item2	3.74	1.08
Exploration Item 3	3.67	1.11
Exploration Item 1	3.64	1.10
Exploration Item 5	3.02	1.36
Advanced Integration		
Integration Item 2	2.98	1.21
Integration Item 3	2.48	1.35
Integration Item 5	2.41	1.29
Integration Item 4	2.35	1.32
Experimentation		
Experimentation Item 5	1.74	1.36
Experimentation Item 1	1.70	1.12
Experimentation Item 6	1.70	1.09
Experimentation Item 9	1.68	1.11
Experimentation Item 4	1.67	1.11

Table 4.10 Continued

	CTE Teachers	
	M	*SD*
Experimentation		
Experimentation Item 2	1.66	1.16
Experimentation Item 8	1.62	1.10
Experimentation Item 7	1.61	1.04
Experimentation Item 3	1.55	1.09

Note. Scale: 1= Not Like Me At All, 2=Very Little Like Me, 3=Somewhat Like Me, 4=Very Much Like Me, and 5=Just Like Me.

Table 4.11 *Grand Means and Standard Deviations on Summated Items for KRIS Subscales of Adoption, Exploration, Advanced Integration and Experimentation*

	CTE Teachers	
	M	*SD*
Adoption	3.95	.919
Exploration	3.63	.848
Advanced Integration	2.50	1.11
Experimentation	1.66	.955

Note. Scale: 1= Not Like Me At All, 2=Very Little Like Me, 3=Somewhat Like Me, 4=Very Much Like Me, and 5=Just Like Me.

From the individual subscales, overall analysis can be drawn about the influence of each individual item within the KRIS subscales on the teaching and learning process.

Table 4.12 offers frequencies and percentages of participant responses to individual items in each sub scale of the KRIS.

Table 4.12 *Frequency and Percentages of Participant Responses for Individual Items for the Four Levels of Integration: Exploration, Experimentation, Adoption, and Integration*

	1		**2**		**3**		**4**		**5**[a]	
	F	***P***	***f***	***P***	***f***	***P***	***F***	***P***	***f***	***P***
Exploration										
1	25	4.9	46	9.0	142	27.7	157	30.6	132	25.7
2	21	4.1	42	8.2	127	24.8	163	31.8	147	28.7
3	22	4.3	55	10.7	128	25.0	154	30.0	140	27.3
4	10	1.9	33	6.4	90	17.5	146	28.5	216	42.1
5	94	18.3	87	17.0	127	24.8	96	18.7	96	18.7
Experimentation										
1	316	61.6	77	15.0	45	8.8	22	4.3	27	5.3
2	341	66.5	48	9.4	41	8.0	23	4.5	31	6.0
3	361	70.4	34	6.6	33	6.4	33	6.4	25	4.9
4	325	63.4	48	9.4	55	10.7	22	4.3	24	4.7

Table 4.12 Continued

	1		2		3		4		5[a]	
	F	***P***	***f***	***P***	***f***	***P***	***F***	***P***	***f***	***P***
Experimentation										
5	295	57.5	79	15.4	59	11.5	19	3.7	26	5.1
6	315	61.4	54	10.5	64	12.5	25	4.9	20	3.9
7	329	64.1	62	12.1	46	9.0	19	3.7	20	3.9
8	338	65.9	46	9.0	41	8.0	26	5.1	23	4.5
9	323	63.0	61	11.9	51	9.9	26	5.1	23	4.5
Adoption										
1	13	2.5	26	5.1	85	16.6	152	29.6	199	38.8
2	30	5.8	34	6.6	76	14.8	117	22.8	214	41.7
3	10	1.9	24	4.7	67	13.1	116	22.6	249	48.5
4	19	3.7	34	6.6	71	13.8	94	18.3	250	48.7
5	39	7.6	46	9.0	111	21.6	116	22.6	155	30.2
6	39	3.5	36	7.0	75	14.6	112	21.8	228	44.4
7	20	3.9	34	6.6	75	14.6	108	21.1	233	45.4

Table 4.12 Continued

	1		2		3		4		5[a]	
	F	***P***	***f***	***P***	***f***	***P***	***F***	***P***	***f***	***P***
Adoption										
8	20	3.9	28	5.5	69	13.5	115	22.4	229	44.6
9	13	2.5	43	8.4	78	15.2	132	25.7	199	38.8
10	12	2.3	19	3.7	92	17.9	138	26.9	203	39.6
11	22	4.3	37	7.2	83	16.2	116	22.6	209	40.7
12	21	4.1	35	6.8	76	14.8	121	23.6	211	41.1
13	29	5.7	46	9.0	108	21.1	149	29.0	133	25.9
14	25	4.9	47	9.2	81	15.8	97	18.9	218	42.5
15	47	9.2	59	11.5	96	18.7	113	22.0	159	31.0
Integration										
1	26	5.1	38	7.4	113	22.0	119	23.2	172	33.5
2	77	15.0	84	16.4	134	26.1	102	19.9	65	12.7
3	167	32.6	90	17.5	85	16.6	66	12.9	59	11.5
4	184	35.9	90	17.5	85	16.6	54	10.5	52	10.1

Table 4.12 Continued

5	170	33.1	89	17.3	100	19.5	60	11.7	47	9.2

[a]*Note. Scale*: 1= Not Like Me At All, 2=Very Little Like Me, 3=Somewhat Like Me, 4=Very Much Like Me, and 5=Just Like Me.

The KRIS scale also included the evaluation and influence of barriers to technology, perceptions of teaching effectiveness, and technology anxiety. The additional scales were used to further evaluate the level of technology integration among CTE teachers in North Carolina. Each scale evaluated an area that could affect the integration of technology in the classroom. To calculate these scales, items were summated and divided by the total number of items. Table 4.13 provides an overview of the grand means and standard deviation for the summated items of the three subscales: barriers, teacher perceptions, and technology anxiety.

Table 4.13 *Grand Means and Standard Deviations on Summated Items for KRIS Subscales of Barriers, Perceptions, and Technology Anxiety*

	CTE Teachers	
	M	*SD*
Barriers	2.11	.611
Perceptions	3.58	.585
Technology Anxiety	1.99	1.35

Note: Barriers Scale 1= Not a Barrier, 2=Minor Barrier, 3=Moderate Barrier, 4=Major Barrier, Perceptions Scale 1= Strongly Disagree, 2=Disagree, 3=Undecided, 4=Agree, 5=Strongly Agree, Technology Anxiety Scale 1= No Anxiety, 2=Some Anxiety, 3=Moderate Anxiety, 4=High Anxiety, 5=Very High Anxiety

The first scale evaluated was barriers to technology (M = 2.11, SD =.611). Teachers were asked to rate their magnitude that each barrier may prevent them from integrating technology into the teaching/learning process. Consisting of 9 Likert scale statements (1= Not a Barrier, 2=Minor Barrier, 3=Moderate Barrier, 4=Major Barrier). Example items within the barriers scale included "Availability of technical support to effectively use instructional technology in the teaching/learning process" and "Availability of effective instructional software for the courses I teach" (Redmann and Kotrlik, 2004). Table 4.14 displays grand means and standard deviations for participant's responses to individual items from the Barriers of Technology scale of the KRIS.

Table 4.14 *Means and Standard Deviation for CTE Teachers on the Individual Items for the KRIS Subscale of Barriers to Technology Integration*

	CTE Teachers	
	M	*SD*
Barrier Item 1	2.69	.924
Barrier Item 2	2.36	1.06
Barrier Item 3	2.34	1.15
Barrier Item 4	2.32	.972
Barrier Item 9	2.22	.973
Barrier Item 7	1.87	.782
Barrier Item 6	1.77	.800
Barrier Item 5	1.74	.866
Barrier Item 8	1.73	.859

Note. Scale: 1= Not a Barrier, 2=Minor Barrier, 3=Moderate Barrier, 4=Major Barrier.

From the individual subscales, overall analysis can be drawn about the influence of each individual item within the KRIS subscales on the teaching and learning process. Table 4.15 offers frequencies and percentages of participant responses to individual items in the subscale barriers.

Table 4.15 *Frequency and Percentages of Participant Responses for Individual Items for the KRIS Subscale Barriers*

	1		2		3		4[a]	
	f	***P***	***f***	***P***	***f***	***P***	***f***	***P***
Barriers								
1	61	11.9	127	24.8	164	32.0	109	21.2
2	142	27.7	105	20.5	120	23.4	95	18.5
3	168	32.7	82	16.0	86	16.8	120	23.4
4	118	23.0	148	28.8	118	23.0	74	14.4
5	237	46.2	129	25.1	65	12.7	28	5.5
6	231	41.5	146	28.5	79	15.4	15	2.9
7	178	34.7	166	32.4	99	19.3	11	2.1
8	242	47.2	122	23.8	69	13.5	25	4.9
9	139	27.1	145	28.3	112	21.8	64	12.5

[a] *Note. Scale:* 1= Not a Barrier, 2=Minor Barrier, 3=Moderate Barrier, 4=Major Barrier.

To determine teachers' perceptions of their own teaching effectiveness, the Perceptions of Teaching Effectiveness scale *(M*=3.57, *SD* =.585*)* was used. Teachers responded to 7 Likert scale questions (1= Strongly Disagree, 2=Disagree, 3=Undecided, 4=Agree, 5=Strongly Agree). All items in the scale were worded in superlative language (Redmann and Kotrlik, 2004). By strongly agreeing with the statements, teachers perceived themselves as effective in their teaching. Items from the scale included "I am highly effective in teaching content in my courses" and "My students would rate me as one of the very best teachers they have ever had" (Redmann and Kotrlik, 2004).

Statements in the scale are represented in Table 4.16

Table 4.16 *Means and Standard Deviations for CTE Teachers on the Individual Items for the KRIS Subscale Perceptions of Teaching Effectiveness*

	CTE Teachers	
	M	*SD*
Perception Item 2	4.18	.713
Perception Item 6	3.68	.838
Perception Item 7	3.66	.858
Perception Item 3	3.65	.757
Perception Item 5	3.47	.764
Perception Item 4	3.46	.760
Perception Item 1	2.69	.249

Note. Scale: 1= Strongly Disagree, 2=Disagree, 3=Undecided, 4=Agree, 5=Strongly Agree.

From the individual subscales, overall analysis can be drawn about the influence of each individual item within the KRIS subscales on the teaching and learning process. Table 4.17 provides frequencies and percentages of participant responses to individual items in the subscale perceptions of teaching effectiveness.

Table 4.17 *Frequency and Percentages of Participant Responses for Individual Items for the KRIS Subscale Perceptions of Teaching Effectiveness*

	1		**2**		**3**		**4**		**5**[a]	
	f	***P***	***F***	***P***	***f***	***P***	***F***	***P***	***f***	***P***
Perceptions										
1	5	1.0	31	6.0	125	24.4	211	41.1	74	14.4
2	5	1.0	8	1.6	44	8.6	230	44.8	159	31.0
3	4	.8	25	4.9	153	29.8	205	40.0	59	11.5
4	8	1.6	25	4.9	205	40.0	159	31.0	44	8.6
5	7	1.4	35	6.8	181	35.3	184	35.9	38	7.4
6	10	1.9	21	5.3	132	25.7	201	39.2	75	14.6
7	13	2.5	22	4.3	144	28.1	190	37.0	78	15.2

[a] *Note. Scale:* 1= Strongly Disagree, 2=Disagree, 3=Undecided, 4=Agree, 5=Strongly Agree.

CTE teachers were asked to rate the magnitude that technology anxiety towards technology prevented them from integrating technology into the teaching/learning process. The Technology Anxiety scale consisted of 12 Likert scale questions (1= No Anxiety, 2=Some Anxiety, 3=Moderate Anxiety, 4=High Anxiety, 5=Very High Anxiety). Example items from the scale included “How anxious do you feel when you are faced with using new technology” and “How anxious do you feel when you cannot keep up with important technological advances” (Redmann and Kotrlik, 2004). The analysis of the data revealed that CTE teachers are feeling some anxiety when thinking of integrating technology in the teaching/learning process *(M*=1.99, *SD* =1.35*)*. Statements in the scale are represented in Table 4.18.

Table 4.18 *Means and Standard Deviations for CTE Teachers on the Individual Items for the KRIS Subscale of Technology Anxiety*

	CTE Teachers	
	M	*SD*
Technology Anxiety Item 11	2.44	1.10
Technology Anxiety Item 3	2.11	.996
Technology Anxiety Item 10	2.05	1.01
Technology Anxiety Item 12	2.04	1.04
Technology Anxiety Item 2	2.04	.902
Technology Anxiety Item 5	2.00	.989
Technology Anxiety Item 7	1.97	.953
Technology Anxiety Item 4	1.95	1.07
Technology Anxiety Item 6	1.91	.947
Technology Anxiety Item 9	1.88	1.09
Technology Anxiety Item 8	1.87	.927
Technology Anxiety Item 1	1.65	..826

Note. Scale: 1= No Anxiety, 2=Some Anxiety, 3=Moderate Anxiety, 4=High Anxiety, 5=Very High Anxiety.

Further analysis can be drawn about the influence of each individual item within the KRIS subscales on the teaching and learning process. Table 4.19 offers frequencies and percentages of participant responses to individual items in the subscale of technology anxiety.

Table 4.19 *Frequency and Percentages of Participant Responses for Individual Items for the KRIS Subscale Perceptions of Technology Anxiety*

	1		**2**		**3**		**4**		**5**[a]	
	f	***P***	***f***	***P***	***f***	***P***	***f***	***P***	***f***	***P***
Tech Anxiety										
1	253	49.3	125	24.4	55	10.7	17	3.3	3	.6
2	143	27.9	191	37.2	81	15.8	26	5.1	10	1.9
3	145	28.3	176	34.3	76	14.8	35	6.8	17	3.3
4	215	41.9	113	22.0	68	13.3	34	6.6	19	3.7
5	171	33.3	167	32.6	65	12.7	28	5.5	17	3.3
6	191	37.2	150	29.2	69	13.5	26	51	11	2.1
7	173	33.7	162	31.6	69	13.5	29	5.7	12	2.3
8	202	39.4	144	28.1	63	12.3	30	5.8	7	1.4
9	230	44.8	116	22.6	48	9.4	28	5.5	25	4.9
10	165	32.2	161	31.4	65	12.7	37	7.2	17	3.3
11	108	21.1	149	29.0	99	19.3	57	11.1	31	6.0
12	175	34.1	151	59.4	66	72.9	35	6.8	20	3.9

[a]*Note. Scale:* 1= No Anxiety, 2=Some Anxiety, 3=Moderate Anxiety, 4=High Anxiety, 5=Very High Anxiety.

Research Objective Two

Objective two sought to describe the level of career and technical educators' perceptions of technology usefulness and ease of use in the teaching and learning process, as measured using the Technology Acceptance Model (TAM). There were 12 Likert scale questions (1= Extremely Unlikely, 2=Not Likely, 3=Undecided 4=Likely, and 5=Extremely Unlikely) which examined PU and PEOU. PU scale *(M* = 4.18, *SD* = .783) evaluated whether teachers perceived technology to be useful. Items from the PU scale included "Using technology in my job would enable me to accomplish tasks more quickly" and "Using technology in my job would increase my productivity" (Davis, 1989). The PEOU *(M* = 3.93, *SD* = .716) assess teachers' perceptions on technologies perceived ease of use. Examples from the PEOU scale included "Learning to operate technology would be easy for me" and "I would find it easy to get technology to do what I want it to do" (Davis, 1989). Based on the survey results, CTE teachers perceived technology to be useful in the teaching/learning process. Although the mean was calculated undecided with perceived ease of use of technology, the numbers show no difference be calculated as teachers likely perceive technology as easy to use. Table 4.20 provides an overview of the grand means and standard deviation for the summated items of the TAM scale.

Table 4.20 *Grand Means and Standard Deviations on Summated Items for TAM Subscales of Perceived Usefulness and Perceived Ease of Use*

	CTE Teachers	
	M	*SD*
Perceived Usefulness	4.18	.783
Perceived Ease of Use	3.93	.716

Note. Scale: 1= Extremely Unlikely, 2=Not Likely, 3=Undecided 4=Likely, 5=Extremely Likely.

Table 4.21 shows the means and standard deviations for each individual item in the TAM subscales perceived usefulness and perceived ease of use.

Table 4.21 *Means and Standard Deviations for CTE Teachers on the Individual Items for TAM Subscales of Perceived Usefulness and Perceived Ease of Use*

	CTE Teachers	
	M	*SD*
Perceived Usefulness		
Perceived Usefulness Item 6	4.41	.724
Perceived Usefulness Item 1	4.22	.889
Perceived Usefulness Item 4	4.14	.902
Perceived Usefulness Item 5	4.12	.902
Perceived Usefulness Item 3	4.12	.937
Perceived Usefulness Item 2	4.10	.919
Perceived Ease of Use		
Perceived Ease of Use Item 5	4.09	.765
Perceived Ease of Use Item 6	4.04	.828
Perceived Ease of Use Item 1	3.98	.841
Perceived Ease of Use Item 4	3.89	.809
Perceived Ease of Use Item 3	3.88	.803
Perceived Ease of Use Item 2	3.70	.913

Note. Scale: 1= Extremely Unlikely, 2=Not Likely, 3=Undecided 4=Likely, 5=Extremely Likely.

Analysis can also be drawn about the influence of each individual item within the TAM subscales on the teaching and learning process. Table 4.22 offers frequencies and percentages of participants responses to individual items in the TAM subscale of technology Perceived Usefulness and Table 4.23 provides frequencies and percentages of participants responses to individual items in the TAM subscale of technology Perceived Ease of Use.

Table 4.22 *Frequency and Percentages of Participant Responses for Individual Items for the TAM Subscale Perceived Usefulness*

	1		**2**		**3**		**4**		**5**[a]	
	f	***P***	***f***	***P***	***f***	***P***	***f***	***P***	***f***	***P***
Perceived Usefulness										
1	9	1.8	22	4.3	45	8.8	146	28.5	212	41.3
2	10	1.9	24	4.7	64	12.5	147	28.7	188	36.0
3	13	2.5	22	4.3	57	11.1	141	27.5	195	38.0
4	12	2.3	17	3.3	58	11.3	156	30.4	192	37.4
5	8	1.6	24	4.7	65	12.7	144	28.1	191	37.2
6	6	1.2	5	1.0	31	6.0	155	30.2	237	46.2

[a] *Note. Scale:* 1= Extremely Unlikely, 2=Not Likely, 3=Undecided 4=Likely, 5=Extremely Likely.

Table 4.23 *Frequency and Percentages of Participants Responses for Individual Items for the TAM Subscale Perceived Ease of Use*

	1		**2**		**3**		**4**		**5**[a]	
	f	***P***	***f***	***P***	***f***	***P***	***f***	***P***	***f***	***P***
Perceived Ease Of Use										
1	7	1.4	30	5.8	53	10.3	215	41.9	127	24.8
2	12	2.3	45	8.8	88	17.2	200	39.0	88	17.2
3	7	1.4	22	4.3	85	16.6	216	42.1	100	19.5
4	4	.8	30	5.8	80	15.6	210	40.9	105	20.5
5	5	1.0	13	2.5	62	12.1	208	40.5	145	28.3
6	8	1.6	19	3.7	61	11.9	200	39.0	143	27.9

[a] *Note. Scale:* 1= Extremely Unlikely, 2=Not Likely, 3=Undecided 4=Likely, 5=Extremely Likely.

Research Objective Three

Objective three explored the relationship between career and technical educators' technology acceptance factors (perceptions of technology usefulness and ease of use) and levels of technology integration with each of the four levels of integration (exploration, experimentation, adoption, and advanced integration).Using the Pearson Correlation test, an examination of the bi-variate between each of the subscales of the KRIS and the subscales of the TAM were observed. Correlations measure the degree of association between two variables. A positive value creates a positive association and a negative value creates an inverse or negative association and can help explain connections and relationships (O'Rourke, Hatcher, & Stepanski, 2005). Table 4.24 provides cross-tabulations and displays correlations (Pearson's) correlations between the KRIS variables and the TAM perceived usefulness.

Table 4.24 *Relationship between the KRIS Variables and the TAM's Perceived Usefulness as Measured by Pearson's Correlation*

	Perceived Usefulness		
KRIS Variables	r	Interpretation	*p*
Advanced Integration	.343	Moderate	<.001
Adoption	.452	Moderate	<.001
Exploration	.409	Moderate	<.001
Experimentation	-.077	Negligible	.113
Barriers	-.368	Moderate	<.001
Technology Anxiety	-.289	Low	<.001
Teacher Perceptions	.223	Low	<.001

Note. n =513. Davis's (1971) descriptors are as follows: .70 or higher = very strong association, .50 to .69 = substantial association, .30 to .49 = moderate association, .10 to .29 = low association, .01 to .09 = negligible association.

Advanced integration, adoption, and exploration had a statistically moderate relationship with perceived usefulness based on Davis' interpretations. Barriers had a statistically negative moderate relationship with perceived usefulness. The interpretation of the correlation between technology and teacher perceptions was low and technology anxiety had a statistically negative low relationship. Finally, experimentation did not have a significant relationship with perceived usefulness.

A correlational test was also used to analyze the relationship between KRIS variables and perceived ease of use in integrating technology in the teaching/learning process. Table 4.25 provides cross-tabulations and displays correlations (Pearson's) correlations between the KRIS variables and the TAM perceived ease of use.

Table 4.25 *Relationship between the KRIS Scale Variables and the TAM's Perceived Ease of Use as Measured by Pearson's Correlation*

	Perceived Ease of Use		
KRIS Variables	r	Interpretation	*p*
Integration	.453	Moderate	<.001
Adoption	.557	Substantial	<.001
Exploration	.375	Moderate	<.001
Experimentation	-.240	Low	.113
Barriers	-.460	Moderate	<.001
Technology Anxiety	-.615	Substantial	<.001
Teacher Perceptions	.302	Moderate	<.001

Note. n =513. Davis's (1971) descriptors are as follows: .70 or higher = very strong association, .50 to .69 = substantial association, .30 to .49 = moderate association, .10 to .29 = low association, .01 to .09 = negligible association.

Advanced Integration, exploration, and teacher perceptions had a statistically moderate relationship with perceived ease of use and barriers had a negative moderate relationship. The subscale Adoption had a substantial relationship with perceived ease of use and technology anxiety had a statistically substantial negative relationship with perceived ease of use. The interpretation of the correlation between experimentation and perceived ease of use was negatively low.

Research Objective Four

Objective four explored which demographic variables; technology integration factors; and perceptions of such factors as technology anxieties, barriers, and teaching effectiveness explained a significant proportion of the variance in technology integration within each of the four levels of technology integration. Using a stepwise regression model, the variables that were the most influential on technology integration and the teaching and learning process were entered. The following independent variables were used as potential explanatory variables for the KRIS model: the grand means of the barriers, the grand means of teachers' perceptions of their teaching effectiveness, technology anxiety, the number of sources of technology training used by the teacher (source1-source4), the grand means of perceived usefulness, the grand means of perceived ease of use, age and gender.

Dependent variables were entered into the model one at a time in the following order: exploration, experimentation, adoption, and advanced integration. Beta weights (standardized multiple regression coefficients) were analyzed to review the variables that were significant in the prediction of exploration (Hatcher, O'Rourke, & Stepanski, 2005). However, Beta coefficients should only be used as a guide as relative importance of the independent variable (Hair et. al, 2006).

Regression One- Exploration

Exploration was the dependent variable used in the first regression (ANOVA F=26.5, P=<.001). The analysis revealed a total of nine variables explained 32.6% of the variance in the teachers reported level of exploration in the KRIS model. Specifically PU explains the largest amount of variance (R^2=.134) in exploration. Eight other variables explained the variance: technology training by completing college courses (additional R^2=.060), age (additional R^2=.037), the PEOU (additional R^2=.030), technology training by participation in workshops/conferences (additional R^2=.032), gender (additional

R^2=.13), technology anxiety (additional R^2=.008), barriers to technology integration (additional R^2=.006), and technology training from colleagues (additional R^2=.006). From the model, technology training represented was very influential in teacher's exploration of technology. As technology training, perceived use, perceived ease of use increased and technology anxiety and barriers to technology decreased, CTE teachers' exploration of technology integration increased. According to Cohen (1988), a regression model that explains 32.6% of the variance denotes a large effect size. Remaining variables from the survey did not explain a significant amount of the variance and therefore were excluded from the regression model. Table 4.26 provides an overview of the independent variables that influenced the dependent variable of exploration.

Table 4.26 *Multiple Regression Analysis in Explaining the Variance to the Technology Integration Scale Exploration (KRIS)*

Explanatory Variables	*F*	*P*	R^2	*R Change*	*F Change*	*P of F Change*	*Effect Size*
Exploration	26.5	<.001					Large
Perceived Usefulness (PU)			.134	.134	51.3	<.001	
Technology Training (sources3)			.194	.060	17	<.001	
Age			.231	.037	10.3	<.001	
Perceived Ease of Use (PEOU)			.261	.030	6.1	<.001	

Table 4.26 Continued

Technology Training (sources2)	.293	.032	2.8	<.001
Gender	.306	.013	4.7	<.001
Technology Anxiety	.314	.008	4.2	<.001
Barriers	.320	.006	3.3	<.001
Technology Training (College Courses)	.326	.006	2.5	<.001

Note. Cohen (1988): R^2>.0196 = small effect size, R^2>.13= moderate effect size, R^2>.26 = large effect size.

Analysis of Variance (ANOVA) is used in statistics as a group of statistical methods and procedures that determine variance among variables (Hair et al., 2006). ANOVA provides a statistical test to show whether samples are from equal means (Hair et al., 2006). Further results of the regression analysis are presented in Table 4.27 to examine the amount of variance that KRIS variables and TAM variables explained in exploration.

Table 4.27 *Stepwise Multiple Regression Analysis to Explore if KRIS Variables and TAM Variables Explain a Significant Amount of Variance in Exploration*

Source of Variation	SS	df	MS	F	p	
Regression	2961.40	9	329.04	26.51	.000	
Residual	6130.99	494	12.41			
Total	9092.40	503				
	Overall R2		B	Beta	t	p
Constant (Exploration)	32.6%		-.273		-.134	.894
Step 9						
Perceived Usefulness			.168	.189	4.212	.000
Technology Training: College Courses			1.813	.192	4.806	.000
Age			.827	.208	5.522	.000
Perceived Ease of Use			.276	.287	5.282	.000
Technology Training: Workshop/Conferences			3.420	.153	4.039	.000
Gender			-.932	-.101	-2.633	.009
Technology Anxiety			.058	.132	2.773	.006
Barriers			-.070	-.091	-2.132	.034
Technology Training: Colleagues			.858	.082	2.049	.038
Excluded Variables						
Years Teaching					.049	.961
Technology Training: Self Taught					.075	.940
Teacher Perceptions					1.409	.160

Note. *p<.05

Of the nine variables that entered the model, the three with the highest standardized Beta coefficients were: 1) perceived ease of use (*Beta* = .287, *p*=.000); 2) age (*Beta* =.208, *p*=.000); and 3) technology training: college courses (*Beta* = .192, *p*=.000). The positive Beta coefficient of these variables indicates that the perception participants have with these variables influences how likely they are to explore technology in the classroom with one unit change in the independent variable the dependent variable changes by one.

Regression Two- Experimentation

Experimentation was the dependent variable entered into the second regression model (ANOVA *F*=17.8, *P*=<.001). A total of four variables explained 12.5% of variance in the teachers reported level of experimentation in the KRIS model, with technology anxiety (R^2=.087*)* showing the most variance. The three other variables explaining the variance include: the grand means of technology training from colleagues (additional R^2=.017), gender (additional R^2=.011), and barriers (additional R^2=.010). As technology anxiety, lack of technology training, and increased perceptions of barriers increased, teachers were less likely to experiment with technology. Gender also influenced the experimentation of technology as 70% of participants in the research were female (see Table 4.28). According to Cohen (1988), a regression model that explains 17.8% of the variance denotes a moderate effect size.

Table 4.28 *Multiple Regression Analysis in Explaining the Variance to the Technology Integration Scale Experimentation (KRIS)*

Explanatory Variables	F	P	R^2	*R Change*	*F Change*	*P of F Change*	*Effect Size*
Experimentation	17.8	<.001					Moderate
Technology Anxiety			.087	.087	30.0	<.001	
Technology Training (sources4)			.104	.017	18.8	<.001	
Gender			.115	.011	7.5	<.001	
Barriers			.125	.010	3.7	<.001	

Note. Cohen (1988): R^2>.0196 = small effect size, R^2>.13= moderate effect size, R^2>.26 = large effect size.

Further results of regression analysis are presented in Table 4.29 to examine the amount of variance that KRIS variables and TAM variables explained in experimentation.

Table 4.29 *Stepwise Multiple Regression Analysis to Explore if KRIS Variables and TAM Variables Explain a Significant Amount of Variance in Experimentation*

Source of Variation	SS	df	MS	F	p	
Regression	4550.88	4	1137.72	17.85	.000	
Residual	31796.23	499	63.72			
Total	36347.12	503				
	Overall R2		B	Beta	t	p
Constant (Experimentation)	12.5%		7.289		4.576	.000
Step 4						
Technology Anxiety			.233	.263	5.703	.000
Technology Training: Colleagues			-2.374	-.114	-2.697	.007
Gender			1.997	.108	2.532	.012
Barriers			.173	.113	2.463	.014
Excluded Variables						
Age					.153	.879
Years Teaching					-.094	.925
Technology Training: Self Taught					-1.275	.203
Technology Training: Workshop/Conference					-.720	.472
Technology Training: College Courses					-.281	.779
Teacher Perceptions					-.190	.850
Perceived Usefulness					1.806	.072
Perceived Ease of Use					.014	.989

Note. *p<.05

Of the four variables that entered the model, the standardized Beta coefficients were: 1) technology anxiety (*Beta* = .263, *p*=.000); 2) technology training: colleagues (*Beta*=-.114, *p*=.007); 3) barriers (*Beta* = .113, *p*=.014); and 4) gender (*Beta* = .108, *p*=.012). The positive Beta coefficient of technology anxiety and barriers indicates an influence of how likely they are to experiment with technology in the classroom. The negative Beta coefficient shows an inverse influence on the dependent variable of experimentation.

Regression Three-Adoption

Adoption was the dependent variable used in the third regression (ANOVA *F*= 65.5, *P*=<.001). Six variables explained 44.2% of the variance in the mean of the adoption scale, including the grand means of PEOU (R^2=*.284*) showing the most variance. Five other variables explaining the variance including the following: the grand means of barriers to technology (additional R^2=*.089*), gender (additional R^2=*.026*), the grand means of teachers' perceptions (additional R^2=*.019*), technology training by college courses (additional R^2= *.016*), and the grand means PU (additional R^2=*.008).* PU explains 44% of the variance in the adoption model and has a positive effect on teachers' integration of technology. Barriers have a negative influence on the integration of technology. According to Cohen (1988), a regression model that explains 44.2% of the variance denotes a large effect size. Remaining variables did explain enough of the variance and were excluded from the model. Table 4.30 provides results from the adoption regression model.

Table 4.30 *Multiple Regression Analysis in Explaining the Variance to the Technology Integration Scale Adoption (KRIS)*

Explanatory Variables	F	P	R^2	*R Change*	*F Change*	*P of F Change*	*Effect Size*
Adoption	65.5	<.001					Large
Perceived Ease of Use (PEOU)			.284	.284	133.9	<.001	
Barriers			.373	.089	50.2	<.001	
Gender			.399	.026	38.5	<.001	
Teachers' Perceptions			.418	.019	21.2	<.001	
Technology Training (sources3)			.434	.016	13.2	<.001	
Perceived Usefulness (PU)			.442	.008	10.8	<.001	

Note. Cohen (1988): R^2>.0196 = small effect size, R^2>.13= moderate effect size, R^2>.26 = large effect size.

Additional results of the regression analysis are presented in Table 4.31 to examine the amount of variance that KRIS variables and TAM variables explained in adoption.

Table 4.31 *Stepwise Multiple Regression Analysis to Explore if KRIS Variables and Tam Variables Explain a Significant Amount of Variance in Adoption*

Source of Variation	SS	df	MS	F	p	
Regression	48191.10	9	8031.85	65.59	.000	
Residual	60859.87	497	122.45			
Total	109050.98	503				
	Overall R2		B	Beta	t	p
Constant (Adoption)	44.2%		33.746		6.314	.000
Step 6						
Perceived Ease of Use			.910	.272	6.302	.000
Barriers			-.816	-.307	-8.040	.000
Gender			-4.218	-.132	-3.860	.000
Teacher Perceptions			.521	.149	4.226	.000
Technology Training: College Courses			4.132	.127	3.665	.000
Perceived Usefulness			.334	.109	2.684	.008
Excluded Variables						
Age					1.148	.251
Years Teaching					.598	.550
Technology Training: Self Taught					1.114	.266
Technology Training: Workshops/Conference					1.551	.121
Technology Training: Colleagues					1.742	.082
Technology Anxiety					1.474	.141

Note. *p<.05

Of the six variables that entered the model, two variables influenced adoption more than the others. The standardized Beta coefficients for these two variables were: 1) barriers (*Beta* = -.307, *p*=.000); 2) perceived ease of use (*Beta* =-.272, *p*=.000). The third influential variable was teachers' perceptions (*Beta* = .149, *p*=.010). The negative Beta coefficient of technology barriers indicates with more barriers, the less likely teachers are to move to the adoption level of technology integration. With one unit of change in the independent variable, the dependent variable changes by one and in the case of barriers, it is a negative change. The positive Beta coefficient shows influence on the dependent variable of adoption.

Regression Four-Advanced Integration

For the last regression the dependent variable, advanced integration, was used. Five variables explained 29.3% of the variance. Of the five variables, PEOU (R^2=.187) showed the most variance. The remaining variables influencing the model were: the grand means of teachers' perceptions (additional R^2=.049), the grand means of barriers to technology (additional R^2=.035), the grand means of PU (additional R^2=.016), and the mean of technology training through workshops/conferences (additional R^2=.006). As PEOU, teacher perceptions, PU and technology training increase and barriers decrease, teachers are more likely to fall in the advanced integration subscale. According to Cohen (1988), a regression model that explains 41.3% of the variance denotes a large effect size. The other variables did not explain enough of the variance and were not included in the model. Table 4.32 provides results from the advanced integration regression model.

Table 4.32 *Multiple Regression Analysis in Explaining the Variance to the Technology Integration Scale Advanced Integration (KRIS)*

Explanatory Variables	F	P	R^2	*R Change*	*F Change*	*P of F Change*	*Effect Size*
Advanced Integration	41.3	<.001					Large
Perceived Ease of Use (PEOU)			.187	.187	73.8	<.001	
Teachers' Perceptions			.236	.049	37.7	<.001	
Barriers			.271	.035	15.4	<.001	
Perceived Usefulness (PU)			.287	.016	11.8	<.001	
Technology Training (sources2)			.293	.006	8.9	<.001	

Note. Cohen (1988): R^2>.0196 = small effect size, R^2>.13= moderate effect size, R^2>.26 = large effect size.

Further results of the regression analysis are presented in Table 4.33 to examine the amount of variance that KRIS variables and TAM variables explained in advanced integration.

Table 4.33 *Stepwise Multiple Regression Analysis to Explore if KRIS Variables and TAM Variables Explain a Significant Amount of Variance in Advanced Integration*

Source of Variation	SS	df	MS	F	p	
Regression	2965.20	5	593.04	41.34	.000	
Residual	7142.99	498	14.3			
Total	10108.19	503				
	Overall R2		B	Beta	t	p
Constant (Advanced Integration)	29.3%		-3.084		-1.546	.123
Step 5						
Perceived Ease of Use			.216	.212	4.427	.000
Teacher Perceptions			.221	.208	5.280	.000
Barriers			-.151	-.187	-4.367	.000
Perceived Usefulness			.141	.151	3.346	.001
Technology Training: Workshops/Conferences			1.884	.080	2.122	.034
Excluded Variables						
Age					.104	.917
Gender					1.189	.235
Years Teaching					.250	.802
Technology Training: Self Taught					-.517	.605
Technology Training: College Courses					1.548	.122
Technology Training: Colleagues					.294	.769
Technology Anxiety					-.085	.933

Note. *p<.05

Of the six variables that entered the model, the three highest standardized Beta coefficients were: 1) perceived ease of use (*Beta* =-.212, *p*=.000); 2) teacher perceptions (*Beta* =.208, *p* =.000); 3) barriers (*Beta* = -.187, *p* =.000). The positive Beta coefficient shows the more influence of the variables on the dependent variable, the more likely participants will integrate technology in the teaching/learning process. The negative Beta coefficient of technology barriers indicates an inverse relationship with the dependent variable advanced integration.

Summary

This chapter reported the findings from the research conducted. A survey was distributed to the CTE teachers that attended the North Carolina summer conference for Career and Technical education. Descriptive statistics revealed the age and years of teaching for the participants to be of 50-60 (*n*=183, or 35.7%), the majority years of teaching between 0-5 (*n*=133 or 25.9%) and the majority gender female *(n*= 353 or 69.9%) The KRIS survey was used to analyze how CTE teachers integrated technology into their classrooms. Description statistics were conducted to evaluate research objectives one and two. Correlations were performed to address research objective three and stepwise regression was conducted to explore the variance for research objective four.

Findings from research objective one revealed that teacher's were in the exploration and adoption phases of technology integration. To calculate the integration levels, items were summated and divided by the total number of items to produce a grand means and standard deviation for each subscale. The highest integration level was adoption-using technology regularly (*M*=3.96, *SD*=.921). The next highest level was exploration-thinking about using technology (*M*= 3.63*, SD*=.848). Descriptive statistics from research objective one also explained teachers found little technology anxiety towards implementing technology in the classroom.

Descriptive statistics were conducted for research objective two to describe the level of career and technical educators’ perceptions of technology usefulness and ease of use in the teaching and learning process. Findings from the statistical test found teachers perceived technology useful but teachers were undecided on whether the ease of use of technology would influence integrating technology in the teaching/learning process.

Correlations were used to compare the KRIS with the TAM for research objective three. The majority of the KRIS subscales had a moderate to low relationship with the TAM subscales of PU and PEOU. With subscales experimentation, barriers, and technology anxiety showing a negative relationship in both subscales.

For analysis of research objective four, a stepwise regression was done to evaluate which variables explained the variance within each model. Findings from the regression model included deterrents from completely integrating technology into the classroom; perceived use of the technology, perceived ease of use, barriers to technology, technology training, perceptions of teaching effectiveness, gender and age. Each of the listed variables influenced the models.

Analysis of the four research objectives in this study gives insight into how technology is or is not being implemented in the teaching/learning process. Knowledge of factors that impede teachers from implementing technology allows for discussion and recommendations.

CHAPTER FIVE

CONCLUSIONS, DISCUSSION OF FINDINGS, AND RECOMMENDATIONS

In this chapter a review of research results, along with a discussion of significant findings, are presented. Recommendations will also be presented for policy, further research and practical implication.

An integral part of twenty- first century jobs and the workforce culture is technology (Bailey & Stefaniak, 2002; Plomp, Anderson, & Law, 2009). Computer systems are a vital necessity in organizations and education is not immune to the immersion of technology (Bailey & Stefaniak, 2002). In today's classroom educators have more access to technology and have the capabilities to see what a powerful tool it can be in the teaching/learning process (Machnaik, 2002; Kotrlik and Redmann, 2004). As technology progresses education is affected but CTE is especially impacted due to the nature of the disciplines. CTE prepares youth for a wide range of careers that include varying levels of education (Public Schools of North Carolina, 2003). The field of CTE has moved from vocational education and practical education to a field that prepares students for variety postsecondary options.

The literature revealed CTE teachers have an interest in technology but often do not implement technology to the full extent. However, to prepare students for the 21st century workforce, CTE teachers must educate themselves on the full implementation of technology. The purpose of this study was to examine North Carolina CTE instructors' levels of technology integration and related factors that can be used to predict technology integration, including perceived technology anxieties, barriers, and perceived teaching effectiveness. Findings from the research of this study will assist in identifying the extent that CTE teachers are integrating technology into their classrooms and will contribute to the creation of a CTE teacher profile and development strategies to increase technology integration.

The body of literature on the use and integration of technology in the classroom provided the basis for the study. The literature review began with an overview of technology integration versus technology adoption. The second section introduced Fred Davis' TAM, which provided the theoretical framework for this study. The third section discussed the development of the Kotrlik and Redmann's Technology Integration Scale and the scale's impact on the research of technology integration. The fourth section examined technological history and education. The final section examined constructs influencing technology integration, which included gender, years of experience, perceived teaching effectiveness, technology anxiety, and barriers to integrating technology.

Methodology of the study included the instrument selected, sample calculations, sample contact information, participant notification, and the data collection process. This study implemented an explanatory, cross-sectional, non-experimental quantitative survey research design. A survey was sent to participants based on the KRIS scale and TAM instrument. Non-response bias was examined by comparing early and late responders. Pre-data analysis using exploratory factor analysis and Cronbach's alpha for reliability was conducted. Data were collected via Survey Monkey and analyzed using SPSS software. Research objectives were addressed using descriptive and analytic procedures.

Discussion of Findings

Today's educators have wider access to computer technology and are beginning to recognize as a tool in the teaching/learning process (Machnaik, 2002). Therefore, it is imperative for CTE professionals to stay abreast of current technologies and business practices to prepare students for the workforce. CTE empowers students by providing a range of learning opportunities that serve different learning styles (Plank, Deuce, & Estacion, 2005). Using technology within instruction often creates a learning environment that integrates a variety of learning styles and is similar to the workplace (Plank et al., 2005; Brand, 2008). This study was guided by four research objectives; each objective was observed to obtain knowledge of technology integration and the teaching/learning process.

Demographic Data

Personal and work related demographic characteristics of participants were presented in the study. Both were reported with means, standard deviations, frequencies, and percents. The respondents to this study (*N*= 513, 28%) were CTE teachers employed by public secondary school systems in North Carolina, and who attended the 2009 CTE summer conference in Greensboro, NC.

Personal variables included gender and age. The majority of the teachers that responded were female and were from a variety of ages between 20 and 70. Work related variables included years of teaching and technology training sources. The largest category of the respondents had between 0-5 years teaching experience, followed by 6-10 years of teaching. Additionally, teachers were asked the sources of their technology training. Almost all of the responding teachers gained knowledge about technology from workshops and or conferences. Followed by the self-taught method, college courses, and teachers least likely obtained technology training from fellow colleagues.

Research Objective One

Research objective one sought to describe the level of career and technical educators' technology integration as measured by the four levels of integration using the following sub-scales of exploration, experimentation, adoption, and advanced integration. Participants reported the adoption subscale was most like them and the experimentation subscale was least like them The KRIS scale also included the evaluation and influence of barriers to technology, perceptions of teaching effectiveness, and technology anxiety. The additional scales were used to further evaluate the level of technology integration among CTE teachers in North Carolina. Each scale evaluated an area that could affect the integration of technology in the classroom. Participants reported they were undecided on the influence of their perceptions of their teaching, had little to no barriers to implementing technology, and showed little to no anxiety in using technology.

Conclusion One. The highest frequency of participants from this study were 50-60 years old, had between 0-5 years work experience, and were female. These demographic variables indicate a possibility of teaching as a second career for the CTE teachers at the 2009 summer conference (McCaslin and Parks, 2002).

Conclusion Two. The majority, over 95%, are learning about technology through workshops/conferences. This was furthermore supported by the teachers reporting that "I attend conferences/workshops on how to integrate technology in my teaching." is very much like them. This conclusion is similar to Kotrlik and Redmann's (2004, 2005) research of CTE teachers in Louisiana.

Conclusion Three. Respondents from the 2009 summer CTE conference had the highest integration level of adoption-using technology regularly followed by exploration-thinking about using technology. Teachers are exploring the use of technology on a regular basis and are adopting technology in the classroom. The teachers are beginning to experiment with technology and have not integrated technology at an advanced integration level. Research conducted by Redmann and Kotrlik (2004) revealed similar results with teachers in the exploration and adoption phases of the KRIS model.

In 2009 all schools in the United States had computers in place (Plomp et al., 2009). And because all schools have implemented computers, the perception is that teachers have also adopted technology in the classroom. Although investments in instructional technology have increased over the past decade, it does not mean that teachers know how to use the technology (Brand, 2008; Belland, 2009).This study sought to look beyond the use of computers and investigate if teachers were not only integrating computers but other technology sources including; the Internet, interactive media, and satellites. Findings supported teachers adopted computers in the classroom with the statement "I assign students to use the computer to do content related activities on a regular basis" is very much like them. But answered only somewhat like me to the statement "I incorporate technology in my teaching to such an extent that my students use technology to collaborate with other students in my class during the learning process."

Therefore, teachers have adopted the use of the computer but have not adopted other technologies in the classroom.

Conclusion Four. Technology barriers play a minor role in the integration of technology in the teaching and learning process. Of the nine barrier items surveyed, participants responded to the statement “Enough time to develop lessons that use technology” as the greatest minor barrier. Research supports this barrier as time becomes an issue for both the individual and the institution (Brand, 1997; Rogers, 2000; Belland, 2009). The lack of time to develop new courseware, new skills, or advanced applications prevents integration (Rogers, 2000; Belland, 2009). In order to fully implement technology and use it efficiently, teachers need time to learn how to use the technology and see the usefulness (Brand, 1997). Similar results were found by Redmann and Kotrlik (2004, 2005).

Conclusion Five. Teachers are undecided in their perceptions of their teaching. However, the analysis from data collection showed 44.8% (n = 230) agreed with the statement “I am highly effective in teaching the content in my courses.” Teachers’ self-perceived teaching effectiveness may be directly or indirectly related to instructional effectiveness (Redmann & Kotrlik, 2004). As Cuban (1997) stated, teacher’s knowledge, beliefs, and attitudes shape how they will conduct instructional practices. Redmann, Kotrlik and Douglas (2003), Kotrlik and Redmann (2004, 2005) found similar results in their study of Louisiana CTE teachers.

Conclusion Six. Respondents from this study have little to no technology anxiety. Of the respondents, 29% showed some anxiety when attempting to keep up with technological advances. This was furthermore supported by the teachers reporting to the statements “How anxious do you feel when you cannot keep up with important technological advances?” and “How anxious do you feel when you are faced with using new technology?” gave them some anxiety. Similar results were found by Redmann, Kotrlik, and Douglas (2003) and Kotrlik and Redmann (2004, 2005).

Research Objective Two

Research objective two sought to describe the level of career and technical educators’ perceptions of technology usefulness and ease of use in the teaching and learning process, as measured using the Technology Acceptance Model (TAM). Teachers perceived technology as useful.

Conclusion One. Individuals tend to accept or reject technology for a plethora of reasons. The extent to which they feel it will help them perform their job better is referred to as perceived usefulness (Davis, 1989, Venkatesh, 2000). The study found that respondents do perceive technology as useful and would be useful in their jobs. This was additionally supported by teacher’s responses to the statements “I would find technology useful in my job” and “Using technology in my job would enable me to accomplish tasks more quickly” as it is likely like them. Davis (1989) found correlating results in measuring perceived usefulness with computer system use.

Conclusion Two. An individual can perceive the technology useful but also think it will be too hard to use and therefore fails to use the technology. The notion that the performance benefits are outweighed by the effort to learn the application is referred to as perceived ease of use (Davis, 1989, p. 320). The study found that respondents were neither supportive nor non supportive of the concept perceived ease of use. Teachers were undecided on statements “It would be easy for me to become skillful at using technology” and “I would find technology easy to use”.

Research Objective Three

Research objective three explored the relationship between career and technical educators’ technology acceptance factors (perceptions of technology usefulness and ease of use) and levels of technology integration with each of the four levels of integration (exploration, experimentation, adoption, and advanced integration). From multiple disciplinary vantage points, PU and PEOU are indicated as fundamental and distinct constructs that are influential in decisions to use information technology (Davis, 1989). TAM assumes that beliefs about PU and PEOU are always the primary determinants of use decisions (Mathieson, 1991). Using the Pearson Correlation test, an examination of the bi-variate between each of the subscales of the KRIS and the subscales of the TAM were observed.

Conclusion One. Of the seven subscales of the KRIS, three subscales (advanced integration, adoption, and exploration) had a moderate positive relationship with perceived usefulness. This means that as perceived usefulness increased, participants were more likely to fall in the exploration, adoption, and integration subscales.

Davis (1989) defines perceived usefulness as “the degree to which a person believes a particular system would enhance his or her job performance” (p. 320). And follows with the definition of useful: “capable of being used advantageously” (Davis, 1989, p.320). When a user has a positive use performance and the technology proves to be advantageous, then a repeat performance is more likely (Davis, 1989; Venkatesh, 1999). The three subscales of technology integration, explained by Kotrlik and Redmann (2003, 2004), influenced by perceived usefulness were advanced integration, adoption, and exploration. Once a teacher explored technology and found a positive use, then he/she was more likely to continue to use and move into the higher levels of adoption and advanced integration of technology integration.

Conclusion Two. Several of the subscales had negative or low relationships with perceived usefulness. Subscale, teacher perceptions had a low positive relationship with perceived usefulness. Therefore, teachers' perceptions of their teaching had a low impact on their view of the usefulness of technology. The subscale barriers had a moderate decreasing negative relationship with perceived usefulness. With more barriers to technology, perceived usefulness of technology decreases. Technology anxiety had a low negative relationship with perceived usefulness; as a result, the more a teacher has anxiety about technology the more likely they are to view technology as non useful.

Conclusion Three. The seven subscales of this study were analyzed with perceived ease of use. Of the seven subscales, three subscales (advanced integration, exploration, and teacher perceptions) had a moderate positive relationship and one (adoption) had a substantial positive association. Therefore, teachers in the adoption phase of integrating technology perceive technology as easy to use. And the higher a teacher's perceptions of their teaching process, the more technology is perceived easy to use.

Conclusion Four. Technology anxiety and perceived ease of use also share a substantial relationship-- however, as a negative correlation. The more technology anxiety increases the more technology is perceived as hard to use.

Research Objective Four

Objective four explored which demographic variables; technology integration factors; and perceptions of such factors as technology anxieties, barriers, and teaching effectiveness explained significant proportion of the variance in technology integration within each of the four levels of technology integration. Using a stepwise regression model, the variables that were the most influential on technology integration and the teaching/learning process were entered. Four regression models were conducted to analyze which variables explained the most variance for each subscale; exploration, experimentation, adoption, and advanced integration.

Conclusion One. Perceived usefulness, technology training: college courses, age, perceived ease of use, technology training: workshop/conferences, gender, technology anxiety, barriers, and technology training: colleagues explained a significant amount of the variance within the subscale of exploration. Perceived usefulness explained the most variance. Perceived ease of use was an effective predictor of the teacher's integration of technology in the exploration subscale. As teachers' further explored with technology, perceived ease of use increased. Two items, barriers and technology anxiety, were negatively related to exploration with technology. When barriers and technology anxiety increased, exploration decreased.

Conclusion Two. Technology anxiety, technology training: colleagues, gender, and barriers explained 12.5% of the variance with the subscale experimentation. Technology anxiety showed the most variance. With more technology anxiety, the less likely a teacher would be to experiment with technology. The study found as technology anxiety, lack of technology training, and increased perceptions of barriers increased, teachers' were less likely to experiment with technology.

Conclusion Three. Perceived ease of use, barriers, gender, teacher perceptions, technology training: college courses and perceived usefulness explained a significant amount of the variance within the subscale adoption. Perceived ease of use explained the most variance. As teachers moved into the adoption phase, perceived ease of use increased and when barriers increased, teachers' implementation of technology decreased. The study found as perceived ease of use, teacher perceptions and perceived usefulness increased and as barriers decreased, teachers were more likely to adopt technology.

Conclusion Four. Perceived ease of use, teacher perceptions, barriers, perceived usefulness, and technology training: workshops/conferences explained 29.3% of the variance of the subscale advanced integration, with perceived ease of use showing the most variance. As in the adoption scale, as teacher's moved into the advanced integration phase, technology use was more likely to be perceived as easy. However, a significant obstacle to advanced integration of technology was not barriers. Barriers to technology were an effective predictor of advanced integration; when barriers increased, teachers did not integrate technology at an advanced level.

Summary

Participants in this study were CTE teachers from the 2009 CTE summer conference. The CTE teacher in the study was between 50-60 years of age, had under five years of teaching experience and was female. The majority of participants were in the exploration or adoption phases of technology integration in the teaching learning process, with over 95% learning their technology knowledge through workshops/conferences. Teachers were not very active in the experimentation and advanced integration phases. These results were similar to those found in studies done by Redmann and Kotrlik in 2004 and 2005.

Teachers in the study do not experience significant barriers or technology anxiety, which contradicts the literature. However, these results coincide with the Redmann and Kotrlik (2004) study of CTE teachers in Louisiana. Results from this study showed teachers were undecided on their self-perceived teaching effectiveness. These results differ from those of Redmann and Kotrlik (2004) slightly as their study found teachers perceived themselves as good teachers regardless of their strength using technology (p. 89).

Teachers in the study use traditional methods for training including college courses, colleagues, workshops/conferences, and self-directed learning. The majority of teacher's used workshops/conferences for technology training. This conclusion corresponds with Redmann and Kotrlik's (2004) findings but contradicts with Kotrlik, Redmann and Harrison's (2000) findings that found self-directed learning as the main source of training.

Perceived usefulness, technology training, perceived ease of use, gender, and teacher perceptions influence teacher's decisions to integrate technology in the teaching/learning process. Perceived usefulness and perceived ease of use are significant predictors of whether teachers will integrate technology and increases as teachers move into different phases of technology integration. Barriers and technology anxiety are also negative predictors of implementation of technology in the teaching/learning process. This study supports the literature review and previous studies conducted by Redmann and Kotrlik, whose studies were the inspiration for this research.

Recommendations

General Recommendations

Over the past three decades technology use in the classrooms has progressed through several phases. Initially, computers were used merely for printing and administrative work during the 1980's. Then in the 1990s technology was used to expand student learning, the computer moved from a delivery tool to an instrument (Siegle, 2004, p. 33). Now the emphasis in the classroom has merged to learner-centered with every child succeeding. As a result a new phase of technology has emerged, data driven virtual learning (Siegle, 2004). This stage is developing rapidly; therefore, it has become imperative for the CTE teacher to fully embrace technology in the classroom. Spitzer, Eisenberg, and Lowe (1998) suggest that there are two requirements for effective integration of technology skills: 1) the skills must directly relate to the content area and to the classroom assignments, and 2) the skills themselves need to be tied together in a logical and systematic model of instruction (p. 215). This study provides insight into how CTE teachers are currently integrating technology into the classroom using the KRIS scales. Understanding what influences teachers can provide guidance on how to increase the integration of technology and the CTE teacher.

Recommendation One. Professional development programs specifically for CTE teachers should be done on a continual basis to keep teachers up to date on technology. The study confirmed in each of the four regression models, technology training influenced the dependent variable. Ninety six percent of the participants stated receiving technology training from workshops/conferences; therefore, a continued use of workshops and conferences is needed to educate teachers on new technology and technology usage. Lack of teacher training in how to innovatively use technology is one of the major barriers preventing the infusion of technology in the classroom (Brand, G, 1997; Jacobsen, 2001; Gaytan, 2006; Keengwe, Onchwari, & Wachira, 2008; Belland, 2009). Millions of dollars have placed technology in K-12 classrooms, but there has been considerably less attention paid to helping teachers make the transition into a technology-rich learning environment. (US Department of Commerce, 1998; Gaytan, 2006).

However, as Spitzer, Eisenberg, and Lowe (1998) suggest for successful implementation of technology, skills must directly relate to the content area and to the classroom assignments. Therefore, professional development should be developed to focus specifically on the CTE teacher as it relates to a particular discipline. Previous research can confirm (Redmann & Kotrlik, 2004; Kotrlik & Redmann, 2005; Ertmer,

2005) that the more training and support teachers receive, the more likely they are to perceive themselves as good teachers and implement technology.

Recommendation Two. This study found in each of the regression analysis, perceived usefulness and perceived ease of use highly influenced whether a teacher would integrate technology. To increased perceptions of ease of use, technology should be used frequently within school activities both in and outside the classroom. This recommendation works hand in hand with continued professional development. Previous research done by Wilen-Daugenti (2009) for higher institutions offered recommendations and suggestions of how to shift the teaching/learning paradigm to include technology. Wilen-Daugenti (2009) proposed the idea of a “Connected Centers of Excellence” (p. 114). This idea address how to create a central hub where knowledge is created, shared, and resourced and institutions can connect on and off campus (Wilen-Daugenti, 2009, p. 114). The core mission of the hubs would be to stay abreast on the latest technologies and providing training on a regular basis for teachers and other educational facilitators.

To initiate the idea, one central area is created to be the hub. Wilen-Daugenti (2009) suggests the library as a place of interest as the library is an advent of new technologies. Building on Wilen-Daugenti’s idea for the higher institution, the researcher recommends the library for the secondary school. However, to allocate a specific area within the library dedicated solely to the purpose of technology training and learning. This would also be a place where open source technology could be used to share technology and teaching strategies with other teaching professionals.

Recommendation Three. The researcher recommends the upgrade of CTE curriculums to include current technology. Integrating technology into the North Carolina State Course of Study (NCSCOS) will start the discussion of using the technology in force. The researcher recommends creating a task force including teachers from all of the CTE disciplines from both K-12 and higher education to review curriculums within the NCSCOS and update to include technology enhancements. Including technology in the course of study will assist in increasing student's preparation for 21st century learning skills while also providing teachers with exposure to integrating technology within the classroom.

Recommendation Four. The research recommends changes from the foundation of teaching education, improvement of teacher preparation courses for CTE teachers both as education majors and for lateral entry degrees. The study found that among participants, 71.9% received their technology training from college courses. The majority of participants were between 50-60 years of age with 0-5 (n = 133) years of teaching experience, therefore, a conclusion could be drawn that teaching is a second career. As a result, these participants would be returning to the classroom as adult learners to obtain a teaching license. Adult learners are relevancy oriented and practical (Brookfield, 2002). Adult learners focus on the aspects that will be most useful to them (Brookfield, 2002); therefore, programs should focus on the practicality of including technology in the teaching/learning process. Programs within the teaching field should included methods for teaching with technology and how to use for student centered learning. Technology should be used to enhance lessons and prepare students for the 21st century.

Recommendations for Future Research

Existing research showed most of the research studies revolving around the use of computers. Kotrlik and Redmann (2004) established a method in which to research technology methods other than computers. With the research tool KRIS, researchers are able to include a variety of technologies that better encompass the school technology terrain. Kotrlik and Redmann's research found CTE teachers in Louisiana fall into the exploration and adoption phases of technology integration, which this study further confirmed. The majority of participants from this study were explorers or adopters. This study, however, did include the TAM which evaluated a teacher's perceived usefulness and perceived ease of use towards technology. This added another layer of research to explain why teachers integrate technology.

Additional research is suggested to investigate even further why teachers fall into the exploration and adoption phases of technology integration using a qualitative method. The qualitative method would offer insight into teacher's emotions and understanding of what encompasses technology integration.

Recommendation One. Because technology is changing at a rapid pace, the researcher recommends the KRIS survey be updated/modified to include more current technologies. Although the KRIS offers a comprehensive look at technology as a whole, newer technologies have been developed and should be included.

Recommendation Two. This study's findings are generalizable to the participants that attended the 2009 CTE summer conference. The research recommends for future research to explore more of the CTE teachers within the state of North Carolina and all over the country. This is similar to the recommendations by Kotlik, Redmann, and Harrison (2000, 2004, 2005).

Recommendation Three. Future research should be done using a variety of delivery methods to reach a larger population. Due to the restrictions that occur within the school systems, some participants were unable to complete the survey due to the survey being blocked. Offering a paper copy as an alternative could have increased the return rate and could be used in future research.

Recommendation Four. The study found participants fell within the exploration and adoption phases of technology integration. To further understand and collect more in depth data, qualitative methods could be used to fill in the gaps of quantitative methods.

Limitations

The study is limited by the sample of secondary CTE teachers. It is also limited by the self-reported perceptions and responses from the CTE teachers. In addition, there is a limitation in the narrow literature regarding CTE teachers and technology integration: such narrow literature often results similar perspectives from the same authors in different studies.

Sample Size. This study is limited to the generalization of the 2009 CTE summer conference; therefore, the results are limited to the participants of the summer conference.

Participant Interpretation: Although the definition of technology integration was defined at the beginning of the survey, participants completed the survey based on their own interpretations of the questions and relationship to technology. The survey was also completed as a self-reported survey. As a result, some individuals may not be as completely honest, have lack of information, or had time restrictions.

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APPENDIX

APPENDIX A

Timeline

Written Comprehensive Exams	August 20th - October 7th
Have Completed Proposal for Chair	November 4th
Send to Committee	March 24nd
April Dissertation Proposal Defense	April 7th
Make Revisions	April 12-16th
IRB	April 12th
Recruit Participants/Data Collection/Complete Chapter 2	April 15th-20th
Survey reminders sent out weekly	April 26th – May 7th
Final edits to Chapter 3	May 10th-May 20th
Analyze data/ Write Chapter 4	May 20th-June 25th
Submit to Chair	November 18th
Revisions	Month of October
Submit to Committee	November 29th
Complete Revisions	November/December
Defense	January
Send to Graduate School	April

APPENDIX B

Budget

Paper	$50
Printer Ink	$100
Gasoline	$300
Kinko’s Spiral Binding	$100
Animoto Video Technology	$30
SAS Student Editions	$100
Survey Monkey Monthly Cost	$20 (x 6) = $120
Survey Incentives	$300
Total	**$1100.00**

APPENDIX C

Request to use the KRIS

December 3, 2008

Joe W. Kotrlik
School of Human Resource Education and Workforce Development
Louisiana State University
142 Old Forestry Building, South Stadium Dr.
Baton Rouge, LA 70803

Dear Dr. Kotrlik,

My name is Sharon Torrence Jones and I am currently a doctoral student at North Carolina State University. Currently, I am working on my proposal and would like to request permission to use your Kotrlik-Redmann Technology Integration Model Survey as a data collection tool for my research. Dr. James Bartlett, my committee chair, suggested your research to me. Your work has intrigued me and I would like to research technology integration and the Career and Technical Education teacher in the state of North Carolina.

I appreciate your time and consideration.

Regards,

Sharon Torrence Jones
North Carolina State University
Doctoral Student

APPENDIX D

Permission to use the KRIS

Subject: Re: Permission for KRIS use
From: Joe W Kotrlik <kotrlik@isu.edu>
Date: Mon, January 5, 2009 2:19 pm
To: sharonlynn6800@yahoo.com

Sharon, I received your signed agreement. I have attached two files:

KRTIS-TECHNICAL.DOC – documentation of scale quality for all four scales
KRTIS-2005.DOC – complete KRTIS instrument

The items in the instrument are in a table format. Since you are only planning to use the adoption scale, you can simply delete the rows you do not plan to use. I have left all rows in for now so that the instrument will correspond with the technical documentation.

I assume that we will receive a copy of your data and your analysis by December 2010. If you need more time, just let us know.

Good luck with your dissertation.

Joe Kotrlik

Joe W. Kotrlik, Professor
LSU School of Human Resource Education & Workforce Development
142 Old Forestry Bldg., S. Stadium Drive
Baton Rouge, LA 70803-5477
225.578.5753 / Fax 225.578.5755 / kotrlik@lsu.edu

APPENDIX E

KRIS Instrument

Technology Integration
in Teaching/Learning

INSTRUCTIONS*: There are four levels of technology use described in this section. Each level of technology use is defined in the sub-section title below. Using the scale on the right, please bubble in the response that indicates how much each statement describes you and your efforts to integrate technology in the teaching/learning process.*

1	**Not like me at all**
2	**Very little like me**
3	**Some like me**
4	**Very much like me**
5	**Just like me**

Statements	Not like me	Very little like me	Somewhat like me	Very much like me	Just like me
ExplorationBThinking About Using Technology					
1. I want to take a course to learn how to use technology in the teaching/learning process.	1	2	3	4	5
2. I talk with my principal or fellow teachers about using technology in my instruction.	1	2	3	4	5
3. I read about how I can use technology in my teaching.	1	2	3	4	5
4. I attend conferences or workshops on how to integrate technology in my teaching.	1	2	3	4	5
5. I purchase books or other materials that can help me to integrate technology in my teaching.	1	2	3	4	5
Experimentation B Beginning to Use Technology					
6. I *am* ***just now*** considering incorporating technology into my classes.	1	2	3	4	5
7. I am ***just beginning*** to use presentation software to teach lessons *(e.g., Powerpoint, Corel Presentations, etc.)*.	1	2	3	4	5
8. I am ***just beginning*** to use the Internet to find information or materials for my lessons.	1	2	3	4	5
9. I am ***just beginning*** to use instructional exercises that require students to use the Internet or other computer programs.	1	2	3	4	5
10. I am ***just beginning*** to use technology to involve students in games or simulations.	1	2	3	4	5
11. I am ***just beginning*** to experiment with ways to use technology in the classroom.	1	2	3	4	5
12. I am ***just beginning*** to rearrange my classroom or laboratory to accommodate technology.	1	2	3	4	5
13. I am ***just beginning*** to require my students to use the Internet to complete some of their assignments.	1	2	3	4	5

Statements	Not like me	Very little like me	Somewhat like me	Very much like me	Just like me
14. I am ***just beginning*** to assign students to use technology to do content related activities.	1	2	3	4	5

Please continue to the next page Λ

AdoptionBUsing Technology Regularly					
15. I discuss with students how they can use technology as a learning tool.	1	2	3	4	5
16. I have made physical changes to accommodate technology in my classroom or laboratory.	1	2	3	4	5
17. I emphasize the use of technology as a learning tool in my classroom or laboratory.	1	2	3	4	5
18. I assign students to use the computer to do content related activities on a regular basis.	1	2	3	4	5
19. I use technology based games or simulations on a regular basis in my classroom or laboratory.	1	2	3	4	5
20. I use technology to encourage students to share the responsibility for their own learning.	1	2	3	4	5
21. I expect my students to use technology to enable them to be self-directed learners.	1	2	3	4	5
22. I expect my students to use technology so they can take on new challenges beyond traditional assignments and activities.	1	2	3	4	5
23. I regularly pursue innovative ways to incorporate technology into the learning process for my students.	1	2	3	4	5
24. I expect my students to fully understand the unique role that technology plays in their education.	1	2	3	4	5
25. I design learning activities that result in my students being comfortable using technology in their learning.	1	2	3	4	5
26. I expect students to use technology to such an extent that they develop projects that are of a higher quality level than would be possible without them using technology.	1	2	3	4	5
27. I am more of a facilitator of learning than the source of all information because my students use technology.	1	2	3	4	5
28. I incorporate technology in my teaching to such an extent that it has become a standard learning tool for my students.	1	2	3	4	5
29. I incorporate technology in my teaching to such an extent that my students use technology to collaborate with other students in my class during the learning process.	1	2	3	4	5
IntegrationBInnovative Use of Technology					
30. I often require my students to use Internet web sites to complete their assignments.	1	2	3	4	5
31. I encourage students to design their own technology-based learning activities.	1	2	3	4	5
32. I often require my students to use e-mail to complete their	1	2	3	4	5

Statements	Not like me	Very little like me	Somewhat like me	Very much like me	Just like me
assignments.					
33. I incorporate technology in my teaching to such an extent that my students use technology to collaborate with individuals or at other locations *(other classes, other schools, other states or countries, etc.)*.	1	2	3	4	5
34. I incorporate technology in my teaching to such an extent that my students use technology to collaborate with individuals in other disciplines.	1	2	3	4	5

Kotrlik-Redmann Barriers to Technology Integration in Instruction (KRBTI)

Barriers to the Integration of Technology in the Teaching/Learning Process. Circle the response that best represents the magnitude of each barrier below that may prevent you from integrating technology into the teaching/learning process.	Not a barrier	Minor barrier	Moderate barrier	Major barrier
1. Enough time to develop lessons that use technology.	1	2	3	4
2. Scheduling enough time for students to use the Internet, computers, or other technology in the teaching/learning process.	1	2	3	4
3. Availability of technology for the number of students in my classes.	1	2	3	4
4. Availability of technical support to effectively use instructional technology in the teaching/learning process.	1	2	3	4
5. Administrative support for integration of technology in the teaching/learning process.	1	2	3	4
6. My ability to integrate technology in the teaching/learning process.	1	2	3	4

7.				
My students= ability to use technology in the teaching/learning process.	1	2	3	4
8.				
Type of courses I teach.	1	2	3	4
9.				
Availability of effective instructional software for the courses I teach.	1	2	3	4

Kotrlik-Redmann Technology Anxiety Scale (KRTAS)

Technology Anxiety. Circle the response for each statement that best represents your level of technology anxiety.	No anxiety	Some anxiety	Moderate anxiety	High anxiety	Very High anxiety
1. How anxious do you feel when you think about using technology in instruction?	1	2	3	4	5
2. How anxious do you feel when you are not certain what the options on various technology will do?	1	2	3	4	5
3. How anxious do you feel when you are faced with using new technology?	1	2	3	4	5
4. How anxious do you feel when you think about your technology skills compared to the skills of other teachers?	1	2	3	4	5
5. How anxious do you feel when someone uses a technology term that you do not understand?	1	2	3	4	5
6. How anxious do you feel when you try to learn technology related skills?	1	2	3	4	5
7. How anxious do you feel when you try to understand new technology?	1	2	3	4	5
8. How anxious do you feel when you try to use technology?	1	2	3	4	5
9. How anxious do you feel when you fear you may break or damage the technology	1	2	3	4	5

you are using?

10. How anxious do you feel when you avoid using unfamiliar technology?	1	2	3	4	5
11. How anxious do you feel when you cannot keep up with important technological advances?	1	2	3	4	5
12. How anxious do you feel when you hesitate to use technology for fear of making mistakes you cannot correct?	1	2	3	4	5

Teacher's Perceptions of Their Own Teaching Effectiveness

INSTRUCTIONS: Circle the response that best represents your level of agreement with each statement about your teaching effectiveness, **even though you may or may not use technology.**

Statements	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
1. I am among the very best teachers at my school.	1	2	3	4	5
2. I am highly effective in teaching the content in my courses.	1	2	3	4	5
3. My students would rate me as one of the very best teachers they have ever had.	1	2	3	4	5
4. The other teachers in my school would say that I am one of the best teachers at this school.	1	2	3	4	5
5. All of my students would evaluate my courses as excellent.	1	2	3	4	5
6. I am a role model for other teachers in my school.	1	2	3	4	5
7. My principal would say that I am one of the best teachers at this school.	1	2	3	4	5

Demographic Items

•	**Personal Information**. Please provide the information requested by writing it in the column to the right of each question or placing a check mark (Y) in the blank.	
1.	Your age (in years):	•
2.	Your gender (**M** for male or **F** for female):	•
3.	Years teaching experience:	•
•	**Sources of Technology Training You Have Used?** *(For the next four items, place a check mark* (Y) *in the column to the right for each source you have used.)*	• Y
4.	Self-taught	•
5.	Workshops/Conferences	•
6.	College courses	•
7.	Colleagues	•

APPENDIX F

Request to use TAM Instrument

October 25, 2009

Fred D. Davis
Distinguished Professor
David D. Glass Chair in Information Systems
Sam M. Walton College of Business, University of Arkansas
Information Systems Department
301 Business Building
Office: WCOB216
Fayetteville, AR 72701

Dear Dr. Davis,

My name is Sharon Jones and I am currently a doctoral student at North Carolina State University. Currently, I am working on my proposal and would like to request permission to use your Final Measurements Scales for Perceived Usefulness and Perceived Ease of Use from your research and development of the Technology Acceptance Model as a data collection tool for my research. I found your questions in your 1989 article *Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology*. Dr. James Bartlett, my committee chair, suggested your research to me. Your work has intrigued me and I would like to research technology integration and user acceptance with the Career and Technical Education teacher in the state of North Carolina.

I appreciate your time and consideration.

Regards,

Sharon Jones
North Carolina State University
Doctoral Student

APPENDIX G

Permission to use TAM Instrument

From: Fred Davis <FDavis@walton.uark.edu>
Add to Contacts
To: Sharon Jones <sharonlynn6800@yahoo.com>

Dear Ms Jones,

Thank you for your inquiry. You have my permission to use TAM and adapt its scales for your interesting study of technology integration in the classroom. Please reference source publications in your dissertation or papers resulting from your study. I hope your research generates insights about how to advance acceptance of teaching technology, both among the teachers and the students. Let me know if there is more documentation that is needed.

Best wishes,

Fred Davis

APPENDIX H

TAM Instrument

Perceived Usefulness

1. Using technology in my job would enable me to accomplish tasks more quickly

    likely---unlikely

2. Using technonlogy in my job would enable me to accomplish tasks more quickly

    likely---unlikely

3. Using technology in my job would increase my productivity

    likely---unlikely

4. Using technology would enhance my effectiveness on the job

    likely---unlikely

5. Using technology would make it easier to do my job

    likely---unlikely

6. I would find technology useful in my job

    likely---unlikely

Perceived Ease Of Use

1. Learning to operate technology would be easy for me

    likely---unlikely

2. I would find it easy to get technology to do what I want it to do

    likely---unlikely

3. My interaction with technology would be clear and understandable

likely---unlikely

4. I would find technology to be flexible to interact with

likely---unlikely

5. It would be easy for me to become skillful at using technology

likely---unlikely

6. I would find technology easy to use.

likely---unlikely

APPENDIX I

IRB Approval

Subject: IRB Approval for, "Technology Integration in the Teaching and Learning Process in Career and Technical Education Programs in North Carolina"

From: Abby Cameron <resaecamer2@gw.ncsu.edu>

To: James Bartlett <jebartl3@gwced.ncsu.edu>; sharonlynn6800@yahoo.com

Bartlett and Torrence 1443-10 Exempt.doc (27KB)

Dear Dr. Bartlett and Ms. Torrence,

The IRB has received and reviewed your protocol submission. After administrative review, the IRB office determined that the study is exempt from the federal regulations outlined in 45CFR46, which relate to the protection of human subjects, and qualifies for administrative approval. The study does not require further IRB review.

If you make any changes to the study, you will need to resubmit to the IRB office. An official letter declaring the study exempt from 45CFR46 and administratively approving the study is attached to this email.

If you have any further questions, feel free to call our office at 919.515.4514.

Thank you.

Abigail Cameron
SPARCS Assistant
abigail_cameron@ncsu.edu

APPENDIX J

Data Collection Materials

Pre-Notification Email

Good Morning,

My name is Sharon Jones and I am currently working on my doctoral degree. I am a Career and Technical education teacher and am conducting my research on technology integration in with the CTE teacher.

In a few days you will receive an email request to complete a survey for my research on technology integration. It will seek to find the levels of technology integration and where we fall as a CTE discipline on the spectrum of integration.

I am writing in advance because many people like to know ahead of time that they will be contacted. The study is an important one that will help fellow teachers and administrators understand how technology is being used in the classroom and how we can use technology to enhance learning.

Thank you for your time and consideration in completing the survey. It is only with the generous help of people like you that the research can be successful.

Sincerely,

Sharon Jones
Career and Technical Education Teacher
Doctoral Candidate, NC State University

First Contact Email

Welcome to My Dissertation Research

Dear Fellow CTE teacher,

I am writing to ask for your help in a study of North Carolina CTE teachers. This study is to analyze the level of technology integration of the CTE teacher. I am conducting research on technology integration and how we as CTE teachers integrate technology in the classroom. You are receiving this email as I am contacting a random sample of CTE teachers in North Carolina. Results from the survey will be used to help fellow teachers and administrators understand how technology is being used in the classroom and how it can be used to enhance learning.

Your answers are completely confidential and will only be returned as summaries in which no individual's answers can be identified. Upon completion of the research, your email will be deleted and you will never be connected to your answers in anyway. This survey is voluntary. However, you can help very much by taking a few minutes to share your experiences and thoughts about technology.

The link to the survey is below:

http://www.surveymonkey.com/s/F9BPDLG

I appreciate your time and participation with this study.

Sincerely,

Sharon Jones

Career and Technical Education Teacher

NC State Doctoral Candidate

Second Contact Email

Dear Fellow CTE teacher,

Two weeks ago, a survey seeking your input on technology integration was emailed to you. Your name was drawn randomly from a list of Career and Technical Education teachers in the state of North Carolina.

If you have already completed the survey, please accept my sincere thanks. If not, please do so today. I am especially grateful for your help because it is only by asking people like you to share your experiences and thoughts that changes can be made with technology.

The link to the survey is below:

http://www.surveymonkey.com/s/F9BPDLG

I appreciate your time and participation with this study.

Sincerely,

Sharon Jones

Career and Technical Education Teacher

NC State Doctoral Candidate

Thank You Email

Dear (Participant's Name),

Thank you so much for your participation! I appreciate it so much. Attached is a handout I put together of some technology websites that may be helpful in your classroom. You have also been entered into the raffle and I will draw next week.

Thanks again as your time is greatly appreciated.

Regards,

Sharon Jones

Career and Technical Education Teacher

NC State Doctoral Candidate