12-2015

# The Relationship between Pre-Service Teachers' Basic Technology Competence, Technology Self-Efficacy and Perceptions of Adopting Educational Applications on iPads for Classroom Use

Rebecca Ann Martindale
*University of Arkansas, Fayetteville*

The Relationship between Pre-Service Teachers' Basic Technology Competence, Technology Self-Efficacy and Perceptions of Adopting Educational Applications on iPads for Classroom Use

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in Curriculum and Instruction

by

Rebecca Martindale
University of Arkansas
Bachelor of Arts in Communications, 1996
University of Arkansas
Master of Education in Educational Technology, 2004

December 2015
University of Arkansas

This dissertation is approved for recommendation to the Graduate Council

_______________________________
Dr. Barbara Gartin
Dissertation Director

_______________________________
Dr. Cheryl Murphy
Committee Member

_______________________________
Dr. Felicia Lincoln
Committee Member

_______________________________
Dr. Wen-Juo Lo
Committee Member

**Abstract**

iPads and tablets are the latest technological tools that schools are adopting for classroom use. Yet, according to the *Teacher's Use of Educational Technology in U.S. Public Schools: 2009 Report,* 25-50% of the teacher population surveyed report rarely or never using basic classroom technologies (LCD projectors, whiteboards, document cameras and computers) for teaching (Gray, Thomas, & Lewis, 2010). A modified Perceived Characteristics of Innovating (PCI) instrument originally developed by Moore & Benbasat (1991) was used to determine intention to integrate educational applications on iPads for classroom use. Multiple regression analysis was conducted to determine whether technology competence or technology self-efficacy were predictors of intentions to adopt educational applications on iPads for classroom use. Technology competence was found to be a predictor of scores on the PCI instrument. Specifically, four sub-domains of technology competence (telecommunications skills, basic computer skills, setup-maintenance-troubleshooting equipment, and spreadsheet skills) were found to be the best model for predicting PCI scores. Further research into the relationship of technology competence to innovation adoption is recommended.

**Acknowledgements**

Special thanks are extended to Dr. Barbara Gartin and Dr. Cheryl Murphy with the College of Education and Health Professions for all of their assistance with helping me achieve my academic goals. It would be impossible to make it to this stage in my professional career without their help. Also, a special thanks goes out to Elaine Terrell for her long-time friendship and commitment in our quest to become scholar practitioners in education technology. Thanks to my family: daughter Stormy Nolen for telling me every day that I can do it, to my son Dustin Davis who simply thinks his mom rocks and to my dad Rollin Martindale who keeps asking me when I'm going to be finished. And, finally to my husband Dr. Dana Leighton: your patience and belief in my abilities to succeed never cease to amaze me. You lift me up in all things.

**Dedication**

This is dedicated to my mother Janice Montiel Rodgers-Ragsdale who unfortunately departed before seeing me complete my doctorate. She loved to brag on my accomplishments whether they were deserved or not. Thanks mom. This is for you.

**Table of Contents**


Chapter One: Introduction ........ 1

Significance of the Problem ........ 2

Theoretical Basis for the Study ........ 5

*Barriers to technology adoption.* ........ 5

*Innovation adoption and diffusion theory.* ........ 7

*Innovations and innovation attributes in education.* ........ 11

Purpose of the Study ........ 13

Definitions ........ 14

Chapter Two: Review of the Literature ........ 17

Classroom Technology Expectations ........ 17

Current Use of Technology ........ 20

History of Education Technology Policy ........ 23

Teacher Licensure Requirements ........ 24

Making a Case for Long-Term Technology Professional Development ........ 27

Technology Competence and Self-Efficacy ........ 34

Chapter Three: Methods ........ 40

Research Questions and Hypotheses ........ 40

Research Design ........ 41

Participants ........ 41

Models ........ 42

Instruments ........ 43

*Perceived characteristics of innovating (PCI) instrument.* ........ 44

*Basic technology competencies for educators instrument (BTCEI).* ........ 46

*Technology self-efficacy instrument (TSE)* ........ 48
*Demographic questions*. ........ 51
Sampling ........ 52
Human Subjects Considerations ........ 52
Chapter Four: Results ........ 54
Analysis Strategy ........ 54
Response Rates ........ 54
Demographics ........ 55
Instrument Reliability ........ 56
Normality, Linearity, and Residuals ........ 56
*Outliers* ........ 56
Question 1 ........ 57
*Bivariate results*. ........ 57
*Multiple regression results*. ........ 58
Question 2 ........ 59
*Bivariate results*. ........ 60
*Multiple regression results*. ........ 60
Chapter Five: Discussion ........ 64
Summary ........ 64
Findings ........ 66
*Research question one*. ........ 66
*Research question two*. ........ 68
Recommendations ........ 69
Conclusion ........ 70

Limitations of the Study ........ 71

Implications for Practice ........ 71

Future Research ........ 72

References ........ 74

Appendixes ........ 82

Appendix A – Implied Informed Consent Form for Educational Research ........ 82

Appendix B – Sample request to faculty to participate in dissertation research ........ 83

Appendix C – IRB approval ........ 84

*IRB Official Stamp* ........ 85

*IRB Modification* ........ 86

Appendix D – Perceived Characteristics of Innovating Survey Instrument ........ 87

Appendix E – Technology Self-Efficacy Survey Instrument ........ 89

Appendix F – Technology Competence Survey Instrument ........ 90

Appendix G – Demographic Questions for Survey ........ 92

**List of Figures**

Figure 1 – Proposed Research Model of the Predictors of Innovation Adoption ......................... 42

Figure 2 – Research Model of the Predictors of Innovation Adoption by Domain ...................... 43

**List of Tables**

Table 1 - Attributes of Innovations from Rogers (2003) and Moore & Benbasat (1991) ............ 10

Table 2 - Technology Self-Efficacy Scenarios ............................................................................ 50

Table 3 - Means, Standard Deviations, Intercorrelations, and Coefficient Alpha Estimates for PCI Score, Technology Competence and Technology Self-Efficacy Variables........................... 57

Table 4 - Standard Multiple Regression Analyses of Technology Competence Score and Modified Technology Self-Efficacy Score on PCI Score (intention to adopt educational applications on iPads for classroom use) ........................................................................ 58

Table 5 - Means, Standard Deviations, Intercorrelations, and Coefficient Alpha Estimates for PCI Score, and Nine Technology Competence Sub-Domains..................................................... 60

Table 6 - Beta Weights and Uniqueness Indices for Multiple Regression Analyses Predicting PCI Score .......................................................................................................................... 60

Table 7 - Summary of Stepwise Multiple Regression Analyses Predicting PCI Score................ 62

# Chapter One: Introduction

According to the Partnership for 21st Century Skills, the knowledge and skills taught in American schools do not match the needs of a global and technologically driven workforce (McDougall, 2010). Everywhere you look there are smart phones, iPads, and notebook computers that are portable extensions of people and their lives. These technologies motivate and allow users to collaborate, connect and create in new ways that are changing and growing at exponential rates. The general population has adopted the use of these technologies in their daily routines, but educators still hesitate to incorporate them in education for teaching and learning.

Educational technology continues to be a growing component of teacher professional development with organizational standards created and published through various entities such as the International Society for Technology in Education (ISTE), the U.S. Department of Education's Office of Education Technology, and the Partnership for 21st Century Skills. Federal and state educational agencies currently require technology integration by teachers in K-12 classrooms as part of the subject matter curriculum. Yet, according to the *Teacher's Use of Educational Technology in U.S. Public Schools: 2009 Report,* 25-50% of the teacher population surveyed reported rarely or never using basic classroom technologies (LCD projectors, whiteboards, document cameras and computers) for teaching (Gray, Thomas, & Lewis, 2010). Understanding the relationship between pre-service teachers' basic technology competence, technology self-efficacy, and perceptions about adopting a new technology could provide insight into how to create professional development activities that will increase technology use in the classroom.

**Significance of the Problem**

Technology purchases for students in public schools are growing. Although most initiatives are well intended, they often end unsuccessfully with abandonment of projects due to a lack of proper implementation (Barshay, 2014). According to Barshay, "this year alone, schools are projected to spend almost $10 billion on education technology, a $240-million increase from 2013…" (p. 2). There are many reasons to promote technology use in classrooms. Technology can empower teachers and learners through collaboration with their peers, professional organizations and communities (U.S. Department of Education, 2010). Technologies allow the extension of learning through the use of simulations, explanations, and demonstrations that present the subject matter in new ways encouraging different paths of access to learning (Mishra & Koehler, 2006).

Learners are growing up and living in an information society that is instantly accessible with knowledge and information literally at their fingertips. Mobile technologies including tablets and smart phones are relatively inexpensive, portable, and have characteristics that allow for interactivity. Yet, a lack of teacher expertise, traditional views of teachers' practices and beliefs, and self-efficacy with technology impact how and whether teachers and their students use technology in the classroom (McDougall, 2010). In order to develop a technologically literate student population, teachers need to select and utilize technologies for teaching and learning to motivate, engage and connect learning within schools and beyond (U.S. Department of Education, 2010).

In order to be effective, teachers need to learn to provide students with authentic experiences, which can be accomplished with technologies that link content to real world activities. Technologies that allow contribution and collaboration on the World Wide Web (i.e., blogs, wikis, forums, podcasts, vodcasts, social media) permit students to become active participants in solving real world problems or creating solutions to societal issues. Using distance education platforms, technology can extend the learning environment, allowing students to experience the application of content beyond the classroom. However, teachers need to develop opportunities for authentic experiences extending the classroom experiences beyond the traditional school building boundaries (U.S. Department of Education, 2010). For teachers, successful technology integration is about constant change and the need to be flexible, open-minded and ready for collaborative experiences.

Despite the speed and growth of the Internet and the multitude of applications that are available, free of charge, and easy to use, teachers are still lagging behind in terms of using technologies for teaching (Groff & Mouza, 2008). Changing curriculum priorities, and lack of confidence in use of new media are used many times as justifications by teachers for not incorporating technology into instruction (McDougall, 2010).

Because younger persons are now growing up in a technologically oriented world, the assumption would be that there are differences in technology adoption by age demographic. One could wrongfully assume that by virtue of age, incoming pre-service teachers will be well equipped to embrace technological advances for classroom teaching and have positive attitudes towards integration. However, Pegler, Kollewyn and Crichton (2010) found that generational differences in teachers are not good predictors of technology integration. The fact that younger incoming teachers are more tech savvy than their more experienced counterparts will not necessarily solve technology integration problems in the classroom, because teaching experience and perceptions about technology proficiency are strongly correlated (McDougall, 2010). In 2011-12 the average age of teachers in the United States was 42.6 years (Goldring & Bitterman, 2013). This demographic was learning about technology in colleges of education during the onset of the microcomputer revolution (1989-1995). Although computers were being integrated during that time, their use lacked innovation and was integrated in minimalistic ways: teaching word processing or used for drill and practice (Reiser, 2001). Presently, teachers are still using simple beginner applications such as word processing, spreadsheets, PowerPoint and databases (Lawless & Pellegrino, 2007), "Word processing and basic-skills practice are the most frequent uses of computers in instruction, whereas the use of applications that engage analytical thinking and problem solving through simulations and other media is relatively infrequent" (pp. 580-581).

There are external factors for the teacher that may impede or eliminate the integration of technologies including: time constraints, current skill levels with targeted technologies, administrative and technical support, the new Common Core Standards, creating differentiated instruction for learners and general day-to-day classroom management. With so many different items competing for teachers' attention it is understandable that they tend to gravitate to what they know avoiding those things that are difficult. Although technology integration may not be easy it is important that teachers expose students to technologies especially those that activate critical thinking. Promoting classroom technology use can empower teachers and learners through motivation and collaboration.

A key to successful use of technologies for classroom instruction is the adaptability of technologies to instructional needs and teacher skill. A teacher's ability to integrate technology into the classroom is a necessary component of a child's technology use (Kent & McNergney, 1999). Mishra and Koehler stated that:

> Teachers will have to do more than simply learn to use currently available tools; they also will have to learn new techniques and skills as current technologies become obsolete. This is a very different context from earlier conceptualizations

> of teacher knowledge, in which technologies were standardized and relatively stable (2006, p. 1023).

Colleges and universities as well as K-12 schools, continue to offer technology integration courses, workshops and professional development activities to pre-service and in-service teachers as a supplement to learning to teach with technology. Instead technology integration should be seen as a primary source of education balanced throughout the program activities of teaching and learning to teach. There are exemplary models of technology integration; however, they are exceptions and not the norm in the daily lives of many in-service and pre-service teachers. Most pre-service teachers learn basic competencies or technical aspects of technologies (word processing, databases, spreadsheets, presentation tools, media) in a single course in their academic programs. In-service teachers also pick up minimal amounts of procedural training on software technologies during a few hours annually for professional development activities. The training needed to build self-efficacy (belief in the ability to accomplish a task) is often not accomplished because of the lack of time being put into technology education for classroom use. The issue then becomes whether or not educators of teachers should maintain the current methods for teaching technology integration or move towards long-term solutions that focus on building self-efficacy for accomplishing technology integration. When a teacher or pre-service teacher is faced with integrating a new technology, which is more important: basic technology competencies or self-efficacy with using technologies?

## Theoretical Basis for the Study

**Barriers to technology adoption.** Whether or not a teacher adopts a technology is not a singular event but rather a compilation of attitudes and beliefs held over time (Straub, 2009). Learning how to incorporate new ideas or innovations into teaching happens in specific contexts including university and public school settings, which reflect teacher competency through assessments that often measures rote or procedural learning in opposition to meaningful reflective mastery of teaching (Berliner, 2004). Lack of exposure to messages about technology integration and modeling of technology use by pre-service teacher education programs can negatively impact future technology integration practices (Belland, 2009). Students' attitudes towards technology can be both positively and negatively influenced by teachers' technology use/non-use (Crompton, 2012). When teachers' beliefs align closely with classroom practices the use of technology takes on a role that enriches, transforms and acts as a supplement to reinforce classroom learning (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012).

There are many different factors that influence successful technology integration by teachers with the teacher being central to the process. Teachers often work in isolation and are the primary decision makers when it comes to choosing technology for classroom use (U.S. Department of Education, 2010). Teacher characteristics such as technology proficiency and the degree to which a technology differs with respect to their educational practice can impact integration (Zhao, Pugh, Sheldon, & Byers, 2002). Some factors that support technology integration include teacher readiness, beliefs, and availability of technology (Inan & Lowther, 2010), as well as strong teaching efficacy, computer self-efficacy, and favorable attitudes towards computers in education (Sang, Valcke, Braak, & Tondeur, 2010). Factors that can negatively influence teacher technology use include lack of technology skills, attitudes and beliefs not in favor of technology integration, concerns about introduction of computers, lack of familiarity with support resources, and lack of exposure to or modeling of technology use in teacher education programs (Belland, 2009; Groff & Mouza, 2008).

Teachers face two types of barriers when it comes to technology integration: (a) first-order barriers, which include tangible items such as access to technology, training, and support, and (b) second-order barriers, which include intangibles such as beliefs about teaching with technology (Ertmer, 1999). Both first-order and second-order barriers are linked and one can influence the other. Factors that influence technology integration can be broken down further into those over which the teacher has control, and those over which they do not (Groff & Mouza, 2008). Factors that seem to be in direct control of the teacher include: (a) the context in which the technology will be implemented, (b) factors related to the teacher (the innovator), and (c) factors associated with the technology enhanced project (the innovation; Groff & Mouza, 2008; Zhao et al., 2002). The foci for the present research include the first-order barrier of basic technology competency and the second-order barrier of technology self-efficacy and (a) how these two barriers are related, and (b) if either is a predictor of innovation adoption.

**Innovation adoption and diffusion theory.** Straub (2009) discussed theories of innovation adoption and diffusion in which “adoption theory examines the individual and the choices an individual makes to accept or reject a particular innovation” and "diffusion theory takes a macro perspective on the spread of an innovation across time” (p. 626). Rogers’ Diffusion Theory focuses on how new ideas (innovations) are adopted and the factors that influence those decisions (Rogers, 2003). Teachers typically implement and use new technologies based on professional development activities that many times are training them how to use a new technology (mechanics) as opposed to integrating the technology into the curriculum (using technology to support learning). Dingfelder and Mandell (2011) suggest that diffusion research can bridge the research-to-practice gap for effective interventions in Autism programs and could also do the same with understanding technology adoption in schools. The innovation attribute component of Diffusion Theory (perceived attributes that predict the rate of innovation adoption) is instrumental in understanding whether a newly introduced innovation will be accepted or rejected by a group. Diffusion Theory has not typically dominated the field of education. According to Rogers:

> The number of educational diffusion studies totaled 23 in 1961 (5 percent of all diffusion research), 71 in 1968 (6 percent), 336 in 1981 (11 percent), and 359 in 1994 (9 percent of all diffusion publications). Since then, the number of new educational diffusion publications has slowed to a trickle (Rogers, 2003, Chapter 2, Section Education, para. 1).

Rogers Diffusion Theory is a cross disciplinary, foundational theory for understanding adoption of any new innovation. According to Rogers (2003), "The results of diffusion research have been incorporated into basic textbooks in social psychology, communication, public relations, advertising, marketing, consumer behavior, public health, rural sociology, and other fields" (Chapter 3, Section The Status of Diffusion Research Today, para. 1). His research found that "An important factor regarding the adoption rate of an innovation is its compatibility with the values, beliefs, and past experiences of individuals in the social system" (Chapter 1, Section Why Did the Diffusion of Water Boiling Fail?, para. 1) and equally as important, "the diffusion of innovations is a social process, even more than a technical matter" (para. 2). Diffusion Theory focuses on how new ideas (innovations) are adopted and the factors that influence those decisions. Rogers defines diffusion as: "…the process by which (a) an innovation (b) is communicated through certain channels (c) over time (d) among the members of a social system. The four main elements are the innovation, communication channels, time and the social system" (Rogers, 2003, Chapter 1, Section Four Main Elements in the Diffusion of Innovations, para. 1).

An element of the present research will include characteristics or attributes of innovations as defined by Rogers and extended by Moore and Benbasat (1991).

Innovation attributes play a key role in predicting whether or not faculty or students will integrate technologies into teaching and learning (Ward & Parr, 2010). According to Rogers (2003), there are five descriptive attributes of innovations, which are characteristics that influence an individual's decision to reject or adopt something new. Individual perceptions of these attributes are predictors of the rate of adoption or "relative speed with which an innovation is adopted by members of a social system" (Kindle loc. 5397-5408). The five perceived attributes of innovations are relative advantage, compatibility, complexity, trialability, and observability (Table 1). Relative advantage, compatibility, trialability and observability are positively related to the rate of adoption while complexity is negatively related (Kindle loc. 5404). Rogers states that "Innovations requiring an individual-optional innovation-decision are generally adopted more rapidly than when an innovation is adopted by an organization" (Kindle loc. 4597-4598) and that "49-87 percent of the variance in the rate of adoption of a new innovation can be explained by innovation attributes" (Kindle loc. 4590). Because teachers are the primary innovation-decision maker in the classroom it would benefit to understand what factors are related to their choices in adopting a new innovation. Thus, an extended view of Rogers Diffusion of Innovations Theory (Diffusion Theory) developed by Moore and Benbasat (1991) will be used to understand pre-service teachers perceptions about adopting a new innovation.

Further innovation attribute research extended Roger's five attributes to include an additional three items for studying the initial stage of innovation adoption changing the focus from the attributes of the innovation itself to perceptions about using the innovation. Moore and Benbasat (1991) developed a 38-item instrument, *The Perceived Characteristics of Innovating (PCI) Survey*. The instrument contained eight scales that included Roger's five attributes with the addition of three more and is used as a tool to study the initial adoption of innovations. Moore and Benbasat believed that previous innovation adoption instruments focused on perceptions of innovation characteristics instead of perceptions of using the innovation, which was thought to be a predictor of use.

Table 1

*Attributes of Innovations from Rogers (2003) and Moore & Benbasat (1991)*

| Resource | Innovation Attributes | Meaning |
|---|---|---|
| Rogers, E. M. (2003). *Diffusion of innovations* (5 ed.). New York, NY: Free Press. | Relative advantage | Is the new innovation better than one that precedes it? |
| | Compatibility | The degree to which an innovation is comparable with values, experiences and needs of the adopter. |
| | Complexity | Is the new innovation difficult to understand and use? |
| | Trialability | Can the new innovation be experimented with on a trial basis? |
| | Observability | Will the results of using the new innovation be visible to others? |
| Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, *2*(3), 192-222. Retrieved from http://pubsonline.informs.org/journal/isr | Image | The degree to which using the innovation enhances the adopter's status in the social system. |
| | Voluntariness of use | Is the new innovation voluntary to use or of free will? |
| | Result demonstrability | Will the new innovation be demonstrated so that its advantages are more visible and more likely to be adopted? |

The PCI Survey instrument developed by Moore and Benbasat will be used in this study to determine how likely teachers are to adopt a newly presented innovation.

**Innovations and innovation attributes in education.** Davis, Hartshorne, and Ring (2010) found that pre-service teachers' views on innovations and innovative teaching falls into five unique areas: "resistance to an innovation, awareness of innovation, exploration of innovation, identification with innovation and integration as innovation" (p. 14). Pre-service teachers that showed *resistance to an innovation* held teacher-centered philosophies with relationship to learning and tended to resist integrating technologies presented by their schools. *Awareness of innovation* indicated they felt that using technology was being innovative in itself and that simply exposing children to technology could meet the instructional needs of the children. These pre-service teachers thought "innovation is using technology" (p. 14). Those pre-service teachers that were at the *exploration of innovation* stage often showed a naive understanding of technology and were more focused on staying up with the latest technologies. They had a lesser understanding of learning and developmental theories and how the technology could be integrated to support those. In opposition, those that were characterized as *identifying with innovation* had very clear understandings of their population, developmental theory and the demands of developing curriculum for their classrooms. They also held a belief that "innovation is being an effective teacher" and "expressed openness towards novelty, endorsing a role for technology in education" (p. 15). Finally, those that expressed *integration as innovation* were characterized as "technologists" by the researchers: "They appeared open to novelty, exuded confidence in their abilities to work with technology, and held a view of innovation that was liberated from any specific form of media" (p. 16). Davis et.al. (2010), hypothesized that because of the variances in the range of beliefs these pre-service teachers held on innovations, that each group could potentially "require different types of interventions in order to develop conceptions of innovation more fully aligned with the field" (p. 18). An important point the researchers made regarding teachers and technology integration was stated as follows:

> Technology in the hands of a merely adequate teacher will lack the experience and thoughtful motivation necessary to embed it with the context of sound teaching practice. Conversely, technology in the hands of an exemplary teacher will not necessarily result in integrated meaningful use. Unless a teacher views technology use as an integral part of the learning process, it will remain a peripheral ancillary to his or her teaching (p. 19).

Bourgonjon, Grove, Smet, Looy, Soetaert, & Valcke (2013) looked at personal innovativeness as a factor in their model to determine teachers' integration of commercial video games into education. The researchers looked specifically at how this characteristic relates to experience with video games, perceived usefulness of and teachers' concerns about complexity of using the games. They found that personal innovativeness was a positive predictor of experience using video games and, although a weak relationship existed, was a statistically significant predictor of usefulness. Personal innovativeness has also been shown to have a negative relationship with the complexity attribute. The more innovative the teacher the less they viewed the complexity of the product as an issue. The teachers in the study had tendencies to be users of educational games and saw usefulness in such products for teaching (Bourgonjon et al., 2013). Agarwal & Prasad (1998, as cited by Lai & Chen, 2011) defined willingness to try out new information and communication technologies as personal innovativeness. Lai and Chen (2011) found that personal innovativeness was a key influence on teachers' use of blogging in the classroom.

Innovation and innovation attributes are an important factor in the development of pre-service teacher's education and training for technology integration. Using Moore and Benbasat's PCI survey tool, the present research will seek to understand factors influencing participants' willingness to adopt the presented technology (educational applications on iPads) in future classrooms. The primary focus of the present research is to determine which is a predictor of intentions to adopt educational applications on iPads: technology competence or technology self-efficacy.

**Purpose of the Study**

The purpose of this study is to examine how pre-service teachers perceive themselves on basic classroom technology competency skills (basic computer operation skills, setup-maintenance-troubleshooting equipment, word processing, spreadsheets, databases, networking, telecommunication, media communications and social-legal-ethical issues), and technology self-efficacy. The intention was to determine if a relationship exists between these two constructs and perceptions about adopting a new innovation specifically, educational applications on iPads. Understanding the relationship that technology self-efficacy and technology competence have on potential adoption of a new innovation can assist schools in preparing professional development to either promote skills training or to create training to support long-term development of technology self-efficacy to assist teachers with successful technology integration.

The members of the social system in which an innovation is being diffused are classified into adopter categories of innovativeness and include: (a) innovators, (b) early adopters, (c) early majority, (d) late majority and (e) laggards (Rogers, 2003, Chapter 1, Section Innovativeness and Adopter Categories, para. 1). Innovators, early adopters, and early majority users are key to diffusing an innovation into a social system. If a school can identify persons according to attributes that predict use, then they can be targeted as innovators to beta test new ideas and assist with ramping up integration of a new technology throughout the social-network of the school. The information obtained from this study can also assist colleges of education in developing curriculum that prepares pre-service teachers to integrate technology into their educational practices by creating more self-efficacy based programs, or by focusing on developing technology competence with technologies that support innovation adoption.

**Definitions**

**Adopter Categories**—In diffusion theory, these are how the members of a social system are categorized based upon how innovative they are. The categories include innovator, early adopter, majority adopter, late adopter and laggard.

**Adoption**—A decision to use an innovation.

**Compatibility**—An innovation attribute that focuses on whether or not an innovation is perceived by the user to be consistent with their past experiences, current needs, and existing values.

**Complexity**—An innovation attribute that focuses on how difficult an innovation is to use and understand.

**Decision**—An activity in which a choice must be made to reject or adopt an innovation.

**Diffusion**—A process by which members of a social system communicate a new innovation through various means.

**Diffusion of Innovations Theory**—Developed by Everett Rogers this theory tries to explain the speed at which new ideas or innovations spread throughout social systems.

**Image**—An innovation attribute developed by Moore and Benbasat that extends beyond Rogers's original definitions of attributes. Image refers to whether or not the person's status is enhanced within the social system due to using a new innovation.

**Innovation**—Anything that can be deemed as "new" by an individual or group that needs to adopt.

**Innovativeness**—A spectrum of adoption where the adoption of new innovations is portrayed on a time continuum (early versus late) for the classification members.

**Innovation Attributes**—Characteristics of new innovations that are positively or negatively related to adoption by the members of a social system.

**Membership Classification**—Occurs when an individual or group falls in the spectrum of adopter categories as outlined by Rogers. The categories include: innovators, early adopters, early majority, late majority, and laggards.

**Observability**—Innovation attribute that focuses on whether the results of the new innovation are visible to others.

**Rate of Adoption**—How long or at what speed an innovation is adopted by the members of a social system.

**Relative Advantage**—Innovation attribute that focuses on whether or not a new innovation is better than one that came before.

**Result Demonstrability**—An innovation attribute developed by Benbasat and Moore that extends beyond Roger's original definitions of attributes. Result demonstrability states that an innovation is more likely to be adopted if it can be demonstrated with the innovations advantages being visible to future adopters.

**Self-Efficacy** - The judgments that a person makes regarding their abilities to successfully pursue and accomplish an activity

**Trialability**—An innovation attribute that focuses on whether or not a new innovation can be experimented with on a limited basis by the persons attempting to adopt it.

**Voluntariness**—An innovation attribute developed by Benbasat and Moore that extends beyond Roger's original definitions of attributes.  Voluntariness refers to the individual having some control over whether or not to adopt an innovation: having free will.

## Chapter Two: Review of the Literature

The use of technology in classrooms today is low and many research studies have strived to understand how to increase teachers' use of new innovations for classroom instruction. Current technology expectations and uses as well as education technology policy, licensure requirements, professional development, technology competence and self-efficacy with respect to classroom technology can assist with understanding why the research questions were chosen for this study.

### Classroom Technology Expectations

The federal government in 2016 will increase the budget for education technology grants by state from zero dollars in the previous two years to millions of dollars in funding (U.S. Department of Education, 2015). Teachers have been and are feeling the pressure to use technology from federally funded agencies that support technology spending, as well as public opinion regarding the need for technology integration into the classroom (Kent & McNergney, 1999). Perceptions among teachers (especially those that teach early childhood education) is that their responsibility is to teach the core of their subject matter, and that technology is a diversion from that necessity (McDougall, 2010).

In 2010, the United States Department of Education's Office of Educational Technology published a report entitled *Transforming American Education: Learning Powered by Technology* (U.S. Department Of Education, 2010). The report included a national long-range plan provided by the Secretary of Education that attempted to promote: (a) student learning through technology integration into the curriculum, (b) increased access to technology in schools targeting families with incomes below the poverty line, and (c) the use of technologies to assist states in systemic educational reform. Viewing technology as a catalyst to prepare and connect teachers the NETP report states: "Professional educators will be supported individually and in teams by technology that connects them to data, content, resources, expertise, and learning experiences that can empower and inspire them to provide more effective teaching for all learners" (p. 39). The report focuses on learning that is powered by technology and stresses five essential components: learning, assessment, teaching, infrastructure, and productivity.

To stay relevant in an information rich society, teachers and schools need to reinvent themselves to include technology integration (McDougall, 2010). According to Kent and McNergney (1999) "…research on technology and teacher instruction suggests that teacher education programs need to model technology use if pre-service teachers are to acquire the necessary expertise to integrate technology into their own teaching" (p. 13).

Successful implementation of technologies relies on variables attributed to both teacher and learner characteristics including four specific characteristics: (a) teacher preparation (including content and education technology fluency), (b) class size, (c) learner academic achievement, and (d) learner engagement (Clarke, Dede, Ketelhut, Nelson, & Bowman, 2006). The identity of the primary teacher is being challenged by the expectations that they should be change agents for technological progress in schools to prepare students to become 21st century learners (McDougall, 2010).

According to the Occupational Outlook Handbook 2010-11, teachers must not only be licensed to teach their preferred subject, they must be experts in social development, coaching, instructional design, communications, program planning and evaluation, assessing new methods of instruction, diversity, special education, law, classroom research, technology integration, and correctional disciplinary practices (U.S. Bureau of Labor Statistics, U.S. Department of Labor, 2010). According to the report teachers often work in isolation, have unmotivated students who cannot be transferred from their care, and experience stress from large class sizes, heavy workloads, long hours, low pay and run down facilities without modern amenities.

Although teachers may understand the need for technology integration, they do not often change their habits nor do they readily embrace classroom technologies. Belland (2009) looked at technology from the standpoint of "habitus" or a person's learned dispositions to appreciate or do certain things. His research argues that these habits are what ultimately explain why teachers do or do not integrate technology into the curriculum more so than other constructs such as self-efficacy or beliefs. John McDougall, a leader in Canadian science and technology policy and innovation, posits that a lack of teacher expertise, traditional views of teacher practices and beliefs, and self-efficacy with technology impacts how and whether teachers and their students use technology in the classroom (McDougall, 2010). Thus, the lack of training on the effective and efficient use of technology can become a barrier to its inclusion in classrooms.

Technologies allow us to inspire learning through the use of simulations, explanations and demonstrations that represent the subject matter in new ways that are more accessible to learning (Mishra & Koehler, 2006). Gibson, Aldrich, and Prensky (2007) found that 42% of teachers that were players of video games valued individualization and customization as teaching strategies in the classroom. Technologies equip our teachers and students with tools such as tablets and smart phones that have interactive characteristics and are extremely portable. Although teachers may understand motivation as a characteristic for technology integration, often they do not utilize technologies simply because they do not have the skills to do so.

Electronic learning resources engage individual learner's personal interests by connecting web-learning resources to learning standards, providing options for adjusting the challenge level of learning tasks to avoid boredom or frustration, and bridging informal and formal learning in and out of school (Browne, 2011; U.S. Department of Education, 2010). The right technologies used appropriately for teaching and learning can motivate, engage and connect learning within schools and beyond (U.S. Department of Education, 2010). Using technology in the same ways that professionals use them in their careers (i.e., graphic artists, scientists, engineers) can provide students with motivational opportunities that furnish insight into future career possibilities (U.S. Department of Education, 2010). Enthusiastic teacher proponents of technology see available technologies as primary motivators and engagement variables in student education, which gives the perception that learning is taking place (McDougall, 2010). Yet, the data from the *Teacher's Use of Educational Technology in U.S. Public Schools: 2009* report still do not support technology integration on a scale necessary to help students gain a competitive edge (Gray, Thomas & Lewis, 2010).

**Current Use of Technology**

The National Center for Educational Statistics (NCES) on behalf of the Office of Educational Technology in May of 2010 released results from the *Teacher's Use of Educational Technology in U.S. Public Schools: 2009* report (Gray, Thomas, Lewis, & Tice, 2010). The data presented were from a teacher-level survey that was sent to a sampling list of 4,133 full time teachers in the 50 states and the District of Columbia with a 65% weighted response rate. The report provided eleven tables of data based on various uses of technology broken down into characteristics such as school instructional level (elementary, secondary), enrollment size, community type (city, suburban, town, rural), percentage of students eligible for free and reduced lunch, main teaching assignment (math, English, etc.), and teaching experience (number of years).

In terms of availability and computer use the NCES data showed that overall 95% of teachers either had computers in their classroom or access to computers. However, the frequency of computer use in the classroom during instructional time showed that 40% used them “often”, 29% “sometimes”, 19% rarely and 10% used computers never (p. 6). In most instances of technology use the teachers’ reported use is higher than that of their reported use of students’ frequency of use. Technologies that showed small differences in use were database software for analyzing data (teachers 44% students 45%), and the use of social networking sites (teachers 8% and students 7%). Students’ creation or use of graphics or visual displays was higher than the instructors use by 13% along with drill and practice uses of software by 19%.

Data regarding communications technologies used to interact with both parents and students included eMail, list-serv, online bulletin boards for class discussions, teacher web pages, course or teacher blogs, and instant messaging used to send out information and updates. Email was the highest form of written communication when interacting with parents (59% for general communications and 79% for individual concerns). Yet, the use of communications technologies for student interaction were low: eMail/list-serv 24%, email to address individual concerns 30%, online bulletin board for class discussions 11%, course teacher web page 28%, course teacher blog 5%, and instant messaging 3%.

The report also gathered information on the various kinds of education and training that prepared teachers to make effective use of technology in the classroom as well as how many hours were spent (in the 12 months prior to the survey) for professional development activities related to education technology integration. Undergraduate and graduate teacher education programs data reflected “Not Applicable” when it came to preparation for making effective use of education technology for instruction (21% undergrad, 31% graduate) while those that felt that teacher education programs provided a "Major or Moderate Extent" in preparation for technology use were also low (25% undergrad, 33% graduate). Most teachers (61%) felt that a "Major or Moderate Extent" of the training that prepared them to use technology was via professional development activities or by school staff responsible for education technology training. A large majority felt that the training they received was through professional development training (78%).

The frequency of hours spent within the previous 12 months of activities related to learning educational technology included none (13%), 1-8 hours (53%), 9-16 hours (18%), 17-32 hours (9%) and 33 or more hours (7%). In order for a technology to be well implemented it has to be a part of the daily routines of the teachers in the classroom (Voogt, Almekinders, Van Den Akker, & Moonen, 2005). Variables such as time and experience both with using computers and teaching are needed to establish expertise (Becker, 1994) and "at least five years of computer use are required for teachers to develop computer expertise" (Sheingold & Hadley, 1990, p. 284).

The data presented in this report supports the need for improving both pre-service education and in-service professional development to support technology usage in classrooms. In 1999, the year before the NETP report, Kent and McNergney reported that only 1/2 of teachers surveyed by Education Week felt that they had appropriate training to regularly integrate technology into their lessons. McDougall (2010) posited that a lack of teacher expertise, traditional views of teacher practices and beliefs, and self-efficacy with technology impact how and whether teachers and their students use technology in the classroom. She identified teacher training as a factor that needed to be addressed if full integration of technology in classrooms was to be accomplished. Thus, the lack of training on the effective and efficient use of technology becomes a barrier to its inclusion in classrooms.

Historically educational policy has played a part in recognizing the need for professional development that supports teachers with technology integration. Part of this recognition is an understanding that change with respect to technology is a difficult transition.

**History of Education Technology Policy**

In their analysis of education policy over the past 20 years Culp, Honey, and Mandinach (2005) attempted to answer education technology questions such as why we invest and how we rationalize investing in technologies in schools. They also looked at how technologies are being implemented effectively and attempted to establish highest recommended priorities on how to accomplish this. The policy analysts covered assumptions that have been made for the impacts of technology on learning and how those have changed over time. The analysis consisted of 28 reports that were selected through a two-stage process based on (a) nominations from education technology leaders about what top 10 reports they considered important to policy in the last 10 years, and (b) using a series of criterion that included audience reach of the report, specificity of education technology, focus on k-12 schools and the roles technology should play, and concrete recommendations for achieving technology goals. In the area of technology support and investment sustainment the researchers found 6 core recommendations that they felt had remained consistent over time and a 7th recommendation that has become prominent based on the telecommunications technologies growth sector. The key recommendation that is relevant to this research is core item three which is to "provide more sustained, high-quality professional development and overall support for teachers seeking to innovate and grow in this domain" (p. 286). According to the report:

> Teacher professional development has been one of the enduring themes across the past 20 years and is often highlighted in these reports as the single most important step toward the infusion of technology into education (p. 292).

All of the reports reviewed addressed both in-service and pre-service teacher education, however, in-service was more consistently covered across the reports. The emphasis in these reports pointed to the need for technology learning incentives, more pre-service curriculum, and state certification requirements. Several of the reports reviewed recognized that technology integration is difficult because of the shifting nature of technologies, budgets that make financial sustainment difficult and how the overall public perceptions shape the roles of technology in education. Although infrastructure investments have increased via Internet connectivity and student to computer ratios are getting smaller, the "high quality use of technology" is still in an evolutionary state (p. 299). Of larger concern to the researchers is the gap between investments in innovations in schools and research that supports and is specific to how technology is or should be a key component in teaching and learning (p. 302). Another area that is lacking when it comes to technology integration is in the area of teacher licensure.

**Teacher Licensure Requirements**

The Educational Testing Services (ETS) in 1992 attempted through two projects to (a) compile information on teacher licensure requirements in the U.S. for subject areas taught in K-12 schools and (b) identify what important skills and knowledge new teachers should have through conducting a job analysis research (Wesley, Klem, & Reynolds, 1992). These research studies were precursors to the development of the Praxis Series of Professional Assessments for Beginning Teachers tests for teacher licensure. The ETS researchers compared items in the first project to the results of the General Principles of Teaching and Learning domain in the jobs analysis project to determine what agreement existed among states regarding what new teachers should know. The jobs analysis contained a 65 item inventory sent to 1,851 practicing professionals that consisted of classroom teachers, college faculty and school administrators with a 45% return rate. The information on teacher licensure collected from the 50 states was compared to five dimensions of the job analysis in which dimension three, Management of Learning Process, included information on instructional media and technology. There were two sub-domains identified under instructional media and technology: (a) instructional media technology and (b) computer literacy and technology. Of the 50 states surveyed only 20 had requirements for instructional media technology and nine had requirements for computer literacy and technology. Although the requirements for instructional media and technology were found in fewer than half of the states surveyed, the importance of technology received high scores in the overall survey by respondents. One of the professional organizations surveyed recommended technology integration along with six other areas as standards for use in teacher preparation. The overall summary of the report implies that because there is consensus on seven basic areas of teacher knowledge, states should put forth more effort in including these into teacher licensure.

When becoming a professional teacher in the U.S. the requirements for licensure typically target literacy skills, pedagogical skills, and content related knowledge. The types of assessments vary on a spectrum from multiple-choice tests to those that require observations, evaluations, and accumulating portfolios of work. Seventy-four percent of states use basic skills testing (reading, writing, and math), 66% require tests of content knowledge, 52% require pedagogical testing, and 18% use performance assessments using outside evaluators in making licensure decisions (Youngs, Odden, & Porter, 2003). Many states implement the Praxis I Core Academic Skills for Educators (basic skills), and Praxis II Subject Assessments (content knowledge) developed by the Educational Testing Service (ETS). Praxis II has one Technology Education test (#5051) that is specific to professionals planning to teach technology in the schools (Praxis: For Test Takers: Test Centers and Dates, 2015). Currently there are no standard or core tests within Praxis that assist state licensing bodies with understanding the knowledge and skills teachers bring to the classroom for technology integration. There are no initial tests that determine whether colleges of education have performed their duties with respect to preparing future teachers to use technology effectively in the classroom. Future school employers, universities, or colleges of education have no basis for understanding the knowledge and skills that first year teachers bring with them to be effective at assisting K-12 students in becoming technologically literate. Based on this information we can only assume that new teachers will receive technology training on the job through Professional Development Activities (PDAs).

Professional development plans are instituted at the district, school, discipline, and individual level to assist in achieving licensure and academic goals of the institution. Credits required to keep licenses valid differ from state-to-state as do the types and amounts of activities that a teacher can choose. For example, one state might require 60 credit hours per year while another requires 150 credit hours over a four-year period. Although there is an initiative to create national Common Core Standards in educational practice each state is responsible for designing licensure standards for continuing education. Typically PDAs are defined in official state documents and include information such as regulatory authorities and statutes, purposes and definitions of professional development, time requirements, categories and sub-categories of activities with maximum and minimum allowable credits, content or focus areas, and process standards. Because of the discontinuity of standards across states it is especially difficult to aggregate and understand common technology-related standards for teaching and learning. The 2005-06 U.S. Department of Education's report, *Evaluation of the Enhancing Education Through Technology Program Final Report* stated: "…only 27 states reported having minimum technology standards in place for teachers in 2006-07" (Bakia, Means, Gallagher, Chen, & Jones, 2009, p. 22). Although teachers have choices in what types of professional development activities they participate in, often times the education and training offered by the school district may restrict the number of choices available.

**Making a Case for Long-Term Technology Professional Development**

How teachers view themselves in the learning process (instructivist or constructivist) determines how they use and choose technologies for student use (Diaz & Bontenbal, 2000). Traditional instructional practices (instructivist) are seen as teacher-centric where constructivist practices are more student-centric. The role of technology professional development should focus on aligning PDAs with student-centered practices so that teachers are more inclined to change their own instructional practices instead of maintaining existing practices that short term skills-based technology training reinforce (Matzen & Edmunds, 2007). According to Matzen & Edmunds "when teachers become comfortable with technology to the point where they can integrate it more effectively, they use it in ways that emphasize a more constructivist, learner-centered approach" (p. 419). Their research suggests that intensive professional development that makes connections between teaching practice, curriculum and technology can support teachers in changing current practices to constructivist based student-centered technology use.

Teachers report that often they feel a lack of support after technology PDAs as well as feeling that their lack of skills and low comfort levels with technology are impediments to successful integration (Keengwe & Onchwari, 2009). The infrastructure for PDAs regarding technology integration is typically limited in breadth and scope; many PDAs are superficial focusing on how to use the technology as opposed to creating integration that supports curriculum development. Additionally, teachers face the dilemma of choosing which professional development activities to fit into their schedules. Thus, subject specific content may take precedence over technological content because educators continually are being asked to focus on raising test scores for their schools.

Education technology is a growing component of professional development with organizational standards created and published through various entities such as the International Society for Technology in Education (ISTE), which provides technology guidelines for teachers and students, the US Department of Educations' Office of Education Technology, and the Partnership for 21st Century Skills. Although these grassroots initiatives exist the standards for technology integration are ultimately set by the states and finally decided by the teacher regarding which technologies to learn and integrate. Variables that inhibit integrating technology in education such as time and lack of professional collaboration far outweigh the positive aspects of technology integration such as student motivation and interest. In research interviews teachers that initially cited time as a limiting factor for technology integration later admitted that not having adequate interest in or the appropriate amount of experience with technologies, as deterrents to implementing them in the classroom (McDougall, 2010). Pre-service teachers have been found to support the belief that lack of appropriate resources such as PDAs and technical support are direct impediments to being innovative with technology in the classroom (Davis, Hartshorne, & Ring, 2010).

Research has shown that teacher education students are not being exposed to technologies as much as non-education majors. In a comparison of pre-service, in-service and non-teacher education students on ability, confidence, and use of technology skills as outlined by the International Society for Technology in Education (ISTE) standards, Rheem, Long and Dicky (2001) found that non-teacher education students not only took more technology classes than education majors (3 to 1), they also scored higher on demonstrating knowledge about how technology is used in business and industry, having knowledge of computer parts and peripherals, using terminology related to computer technology appropriately in verbal communication, using computers to create databases/spreadsheets and using emerging technologies to enhance professional productivity and/or support instruction. Of all three groups of education majors in their study (elementary, middle and secondary education majors), none met the technology criterion that required them to: (a) create multimedia presentations using digital cameras, (b) use computers and other technologies such as interactive instruction or audio/video conferencing, (c) use other distance learning applications to enhance professional productivity and/or support instruction, or (d) request and use appropriate assistive and adaptive devices for students with special needs.

The state's role in how PDAs for teachers are carried out runs along a spectrum from allowing districts to make all decisions to highly regulated activities, starting from pre-service through in-service, with the efficacy of the programs not being clearly evident (Loeb, Miller, & Strunk, 2009). In the *What Works Clearinghouse Report of 2007,* only 9 out of 1,300 studies reported provided causal evidence of PDA impacts (2007, as cited by Loeb et al., 2009). However, the research found that "…programs with more hours of PDA training for teachers lead to positive and significant effects on student outcomes" (Loeb, Miller, & Strunk, 2009). This policy brief also pointed to another literature review by Hill (2007) that supported the idea that the "most effective programs (PDAs) involve a substantial time commitment, such as two- or four-week summer programs" (as cited by Loeb et al., p. 223).

Long-term professional development has been shown to provide challenges and supports with respect to a teachers "work-life" (Yamagata-Lynch, 2003). Yamagata-Lynch (2003) cited positive and negative important experiences on teachers' work-life from a year-long PDA that included sharing ideas and examining other teachers' projects (positive), feelings of pressure to complete started projects (negative), competing priorities and tension (negative), developing skills and confidence through external connections (positive), and reflecting on failures and successes with integration (positive). Through this project, the participating teachers developed a successful technology integration project, which built self-confidence not only for teachers but also groups of teachers and school district administrators. Many of the teachers in the program went on to act as role models for technology leaders inspiring other teachers to integrate technology. Shorter-term PDAs (six-weeks in length) have been shown to increase participants' self-efficacy and competence with integrating technologies for curriculum use (Overbaugh & Lu, 2008). For sustainable long-term changes, professional technology development must focus on the individual teacher and exist within their educational settings over long periods of time and move away from traditional approaches that view learners and situations as homogenous (Wells, 2007).

Many research studies have supported various ideas on how best to change the landscape of PDAs for in-service and pre-service teacher education. According to Wells (2007) the design of technology professional development that is successful should focus on key design factors that are high quality, sustainable, and result in teachers changing practice to adopt new knowledge and skills. Wells's research analysis provided a list of indicators that researchers and educators agreed were necessary for successful technology professional development. The list included such items as collaboration, time for learning that is embedded in the job, focusing on small groups of participants instead of targeting large groups, and making technology PDAs relevant to teachers' goals and schools reform efforts. According to Kimmel, Deek, Farrell & O'Shea

(1999), “Efficacy can be a major factor in shaping teachers’ willingness and ability to make appropriate adaptations in teaching practice” (p. 248). Yearlong intensive professional development programs for teachers learning to work with students that have disabilities have shown that self-efficacy expectations can be developed by providing experiences of success with children in the PDA training environment prior to classroom integration (Kimmel, Deek, Farrell, & O'Shea, 1999).

Many researchers have presented ideas for creating PDAs that support developing self-efficacy with technology. According to Plair (2008), “technology fluency” involves knowing when and how to use technology that will enhance the learning process (p.71). Plair suggests that the time has come for the introduction of an intermediary or “knowledge broker” that can assist teachers working in isolation with the process of meaningful technology integration to support learning (p. 71). Plair envisions the role of the “knowledge-broker” as a lifelong learner and disseminator of technology use information that is passed back to the teacher. The “knowledge-brokers” also masters strategies and techniques, are excellent at explaining technology infusion into curriculum in just-in-time contexts, and act as a catalysts for change (pp. 72-73).

Other PDA change ideas involve team-based approaches to technology integration in which a teacher coordinates with specialists such as software, graphic design, and technology pedagogy for product development. These approaches are envisioned as better avenues for actualizing technology integration and equitably distributing the workload, which is a major impediment to integration (Diaz & Bontenbal, 2000). Team based approaches have worked successfully with teacher education faculty to provide individual as-needed support and ultimately result in faculty continuing to integrate technology into their own teaching (Slavit, Sawyer, & Curley, 2003). Students in the team based study also reflected benefits of faculty modeling of technology use by focusing on the uses of technology in their own educational projects.

Polly and Hannafin (2010) provide evidence-based recommendations on developing what they call Learner-Centered Professional Development (LCPD) that included focusing on student learning, ownership of PDAs by teachers, ongoing pedagogical and content knowledge development, collaboration and reflective practices. The idea is that in order to support teachers and focus more on the learner there needs to be connectivity and reciprocity between the interaction of PDAs, teacher learning, implementation of technology in the classroom and student learning outcomes.

Situated professional development for technology integration, in which teachers' needs for technology are specifically met, as opposed to that of focusing on technology competencies that a teacher must have, are taking place to allow teachers to learn to use technology through practice (Sugar, 2005). Situated PDAs allow the teacher to retain autonomy for technology decision-making, which in turn provides self-confidence needed to support technology use. As an alternative to traditional in-service technology workshops, Sugar researched the use of a technology coach to provide situated professional development. Participating teachers overwhelming felt that this approach to learning and integrating technology was far superior to traditional PDAs. The activities used in the technology coach research included not only focusing on skills development but also included those related to technical support, the creation of curricular resources and projects for curriculum integration. According to Sugar (2005)

> …a technology coach may be a remedy for those teachers who are initially reluctant and skeptical to adopt new technologies in their classroom. They need the extra confidence boost and cajoling from their technology coach to feel confident to start using a particular technology (p. 564).

The University of Alabama's Master Technology Teacher program works as a collaborative partnership between the university and local schools to provide long-term technology integration for pre-service and in-service teachers (Wright, 2010). This research found that allowing participants to learn about basic technologies in a non-threatening workshop model became a support for developing confidence and comfort levels with technology use.

Professional Development activities that focus on the needs of the teachers and make adjustments to attend to the comfort levels with technology have shown significant increases in reported skills and technology levels after implementing changes such as increased PDA days, adding summer workshops, and follow-up support (Bullock & Schomberg, 2002). Gaytan and McEwen (2010) argue that PDAs only tend to measure a teachers self-efficacy, perceptions of their competence, or the integration of skills into their class curriculum ignoring the effects on student learning. Their research resulted in the creation of a five level model for planning and evaluating PDA programs that specifically target student-learning outcomes (Gaytan & McEwen, 2010). In the evaluation stage, each level, which included gaining feedback from participants, participants' learning, organizational support, changed instructional practices and student impact, followed from and built upon the last level. For planning PDAs they then reverse the evaluation steps, which include student learning outcomes, desired changes in instructional practices, organizational support, participants learning goals and logistics of PDAs, to support changing attitudes of teachers about the positive impacts of technology integration.

For technology to be useful in the classroom, significant changes to the current professional development system will need to take place including how our teachers, administrators and other support teams interact and learn about educational technologies. What should be the focus of PDAs? Should we maintain the current path of teaching the mechanics of basic technologies such as word processing, blogs, databases and spreadsheets, or should we develop long-term training that builds not only basic technology competence but self-efficacy as well?

**Technology Competence and Self-Efficacy**

Confidence (self-efficacy) and competence with technologies are instrumental as to whether or not teachers and administrators support and integrate technology into the curriculum. Loogma, Kruusvall, and Ümarik (2012) found that Information and Computing Technologies (ICT) competence in teachers (especially e-Learning and computer skills) were predictors of innovativeness in the use of e-Learning technologies. Research has also shown that teacher technology competency can be predicted by a teacher's openness to change (Baylor & Ritchie, 2002). Technology competence, however, is not always equal in terms of the types and pedagogical ways that they are used in the classroom. Aust, Newberry, O'Brien and Thomas (2005) developed a social networking model for technology integration called "Learning Generation" and found that teachers involved were confident in their abilities to use basic technology applications (word processing, online resources, basic computer use) but were less confident in technologies that support constructive learning applications (spreadsheets, databases, and presentation software) that support critical thinking skills. When viewed through the lens of administration technological competence can change the dynamic of support for technology in schools. When school leaders have high levels of Information and Computing Technology (ICT) knowledge, specifically knowing about management and mechanics of technologies (i.e., technology competence), they tend to champion technology use in their schools. When they have low levels of ICT experience or involvement using technology tools (i.e., technology self-efficacy), they do not support technology integration efforts (Stuart, Mills, & Remus, 2009).

Competence with technology use does not necessarily imply high levels of self-efficacy either. In a study of pre-service teacher education, students that had high grades in technology courses, which implied technology competence in their teacher education programs, reported low levels of confidence with using the technologies for curriculum integration (Teclehaimanot, Mentzer, & Hickman, 2011). The researchers also found that self-reports of high levels of lesson planning that included a technology component were not supported when predictor evaluations of lesson plans took place in the pre-service students teaching portfolios.

Self-efficacy is about the judgments that a person makes regarding their abilities to successfully pursue and accomplish an activity (Bandura, 1982). According to Bandura, simply because a person has knowledge about something it does not necessarily mean that they will act on that information and use it when needed. The transfer of knowledge into action is constantly interrupted by a person's thoughts or perceived self-efficacy and beliefs about their capabilities towards the situation under consideration. The judgments that are made based on self-efficacy, whether real or not, are paramount in decision making as to whether or not to take on specific situations. Perceived self-efficacy affects motivation, behavior, effort and persistence. Generally the more self-efficacy a person exhibits the more willing they are to continue something difficult or start something new. When self-efficacy is low, effort lessens, doubts creep in and people tend to give up easily. However, high self-efficacy does not necessarily mean that an individual will be successful in their endeavors. Over-confidence can also result in lessened efforts resulting in poor performance on pursued activities (Bandura, 1982).

There are four sources that influence a person's self-efficacy: performance, vicarious observations of others performance, social influence and verbal persuasion, and physiological states (Bandura, 1977; Bandura, 1982). Mastery performance influences a person's self-efficacy by raising it if successful and lowering it if unsuccessful, and provides the most influence on efficacy because it can be based in authentic environments. Observations of others with similar likeness to oneself who exhibit successes or failures can also influence self-efficacy both positively and negatively. Verbal persuasion can increase self-efficacy if it is applied realistically, yet as a source for creating long-term increases in self-efficacy, it has limits. Physiological states of arousal, i.e., high or aversive arousal such as agitation, stress or being tense, can be viewed as being inefficient and can negatively impact self-efficacy. The four sources above are key factors in creating behavioral change and, if administered appropriately, can raise personal self-efficacy.

Teacher self-efficacy has been shown to have significant impacts on technology use and student learning. Teachers with high self-efficacy towards their ability to influence student outcomes regardless of environmental factors showed a larger interest in how technology affects the learners academically (Dunn & Rakes, 2010). Technological self-efficacy can be defined as "the belief in one's ability to successfully perform a technologically sophisticated new task" (McDonald & Siegall, 1992, p. 467). Most research on technology self-efficacy in K-12 environments has historically focused on computer use. Computer self-efficacy has been defined as personal judgments on capabilities of how to use a computer in broader terms like report writing and data analysis rather than simple sub-skill tasks like saving or printing files (Compeau & Higgins, 1995). A teacher's beliefs about his or her capabilities with computers can impact their students in positive and negative ways. Changes in teachers' computer self-efficacy have been shown to have significant positive effects on students' computer self-efficacy (Ross, Hogaboam-Gray, & Hannay, 2001). Interest in integrating computers into future practice has been found with student teachers that have strong computer self-efficacy (Sang et al., 2010). Even though teachers realize the importance of using technology in the classroom those with low self-efficacy for teaching new literacy media are less likely to implement those technologies in the classroom (McDougall, 2010).

Teacher self-efficacy can be increased by manipulating experiences in perceptions of mastery, observations of successful teaching, social persuasion, and stress reduction (Ross, McKeiver, & Hogaboam-Gray, 1997). Providing sustained long-term mastery professional development that provides collaboration and training for the implementation of interactive white board use increased self-efficacy significantly with that technology (DeSantis, 2013). Vicarious learning experience models and social persuasion provided by colleagues, cooperating teachers and supervisors have been shown to benefit pre-service teachers' self-efficacy with technology integration (Al-Awidi & Alghazo, 2012). Gentry, Denton, and Kurz (2008) found that technology based mentoring (social persuasion) can impact teachers' attitudes and beliefs for professional development support. Stress reduction using coping techniques by teachers such as self-monitoring and emphasizing positive change were able to increase teaching self-efficacy for math courses (Ross et al., 1997).

Development of teacher technology self-efficacy has not historically been a focus of PDAs (Ross et al., 2001; Ross & Bruce, 2007). Self-efficacy with learning a new innovation increases with the duration of PDAs: the longer the exposure and training the higher the self-efficacy (Stevens, To, Harris, & Dwyer, 2008). It has been suggested that the design of professional development activities for technology integration should be differentiated based on the level and skill that the teacher currently has with technology, and training should be customized to the needs of the teacher (Ertmer, Johnson, & Lane, 2001). During their VisionQuest© research, teachers were provided professional development software, which used goal setting, reflection and modeling as tools to develop self-efficacy skills to move through the change process of technology integration. Professional development activities that focus on differentiating goals for the individual teacher and distributing the learning across implementation periods have also been found to be more successful on student achievement (Ross et al., 2001).

Knowledge about how to use technology alone will not be sufficient for technology integration if teachers do not possess the belief in their skills to use a technology (Ertmer & Ottenbreit-Leftwich, 2010). “In fact, evidence suggests that self-efficacy may be more important than skills and knowledge in teachers who implement technology in their classrooms” (p. 261). However, the relationship between self-efficacy and performance cannot be ignored either. “Simply put, without skill, performance isn't possible; yet without self-efficacy, performance may not be attempted” (Ertmer et al., 2001, p. 834).

Basic technology tools have shown promise for increasing teacher characteristics and student learning. Pre-service teachers’ self-efficacy, and attitudes and openness to change towards educational technologies showed significant increases when exposed to using digital story-telling tools (Heo, 2009). Additionally, teaching with databases has been found to lessen cognitive load (the amount of mental effort needed for working memory) as well as improve performance for student learning (Li & Liu, 2007).

Which is a predictor of the importance of technology attributes: technology self-efficacy or perceptions about basic technology competence? Professional development with technology typically has been limited in scope focusing on technical aspects of the technology or proficiency of use, yet it has been demonstrated that it could be much more. This research study will investigate whether technology self-efficacy or technology competency can be more predictive of perceptions of using a new technology.

## Chapter Three: Methods

The purpose of this study is to determine which constructs predict intentions to adopt and use a new innovation by pre-service teachers (educational applications on iPads for classroom use): basic technology competencies or technology self-efficacy. Technology competence is assessed by nine sub-domains (basic computer operation skills, setup/maintenance and troubleshooting equipment skills, word processing skills, spreadsheet skills, database skills, networking skills, telecommunication skills, media communication skills, and social/legal/ethical knowledge skills) with technology self-efficacy as potential predictors of using educational applications on iPads.

### Research Questions and Hypotheses

Question 1: Which is a predictor of intention to adopt educational applications on iPads by pre-service teachers: Overall basic technology competencies or technology self-efficacy? Hypothesis 1: Prior literature in the area of technology competence as predictors of innovation adoption has not been found. There will be no significant differences between technology self-efficacy and technology competence as predictors of adopting educational applications on iPads. It is expected that there will be a positive relationship between PCI score and the technology competence and technology self-efficacy variables. Higher levels of technology competence scores and technology self-efficacy scores will be related to higher PCI scores which indicate the participants' willingness to adopt educational applications on iPads for classroom use.

Question 2: Between technology self-efficacy and the nine sub-domains of technology competence (basic computer, setup/maintenance/troubleshooting equipment, word processing, spreadsheets, databases, networking, telecommunications, media communications, and social/legal/ethical issues knowledge skills), which variables are predictors of intention to adopt educational applications on iPads by pre-service teachers? Hypothesis 2: Prior literature in the area of technology competence as a predictor of innovation adoption has not been found. There will be no significant differences between technology self-efficacy and the nine sub-domains of technology competence as predictors of adopting educational applications on. It is expected that there will be a positive relationship between PCI score and these variables. Higher levels of scores on technology self-efficacy and the nine sub-domains of technology competence will result in higher PCI scores.

**Research Design**

To determine which factors are predictors of innovation adoption by pre-service teachers (basic technology competencies or technology self-efficacy) a multiple regression technique was used to understand the relationship between basic technology competencies, technology self-efficacy, and perceptions of innovation attributes, which predict whether a person will adopt or reject a new innovation.

**Participants**

The participants for this study were students from pre-service education courses in the department of curriculum and instruction at the University of Arkansas College of Education and Health Professions. The courses were 3000 and 4000 level courses, which consisted of students in their $3^{rd}$ and $4^{th}$ years of the program. Course topics included Early Child Education, Classroom Learning Theory, Emergent and Developmental Literacy, Math Methods in the K-6 Classroom, Integrated Social Studies for the K-6 Classroom, Teaching Science in the Elementary Grades, Language Development for the Educator, Integrated Communication Skills in the K-6 Classroom, Measurement and Research in the K-6 Classroom, Classroom Management in the Elementary Grades, and Acquiring a Second Language. The surveys were conducted using pencil and paper.

**Models**

The research model tested in this study was developed with reference to Diffusion of Innovations research. Diffusion research was used because components of the theory can assist with understand how innovation characteristics influence adoption. Because teachers are being trained for technology integration primarily in the area of skills development instead of developing their beliefs in being able to use their current skills to integrate technology, this model was created to test the effects of these two constructs on intentions to adopt a new technology, educational applications on iPads. Research Question 1 addressed which is a predictor of innovation adoption by pre-service teachers: Overall basic technology competencies or technology self-efficacy?

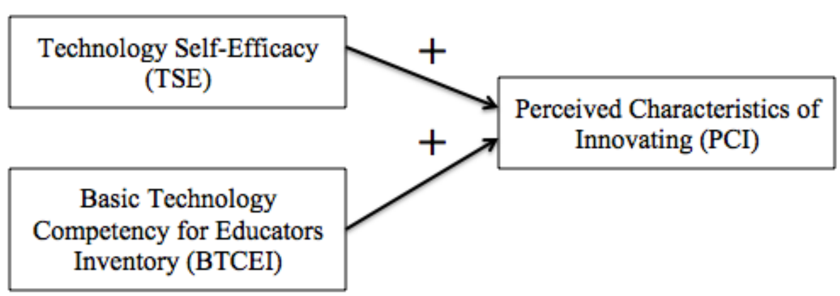


*Figure 1.* Proposed research model of the predictors of innovation adoption

Research Question 2 addressed whether there were domain specific competencies that were predictors of innovation adoption by pre-service teachers. This study also sought to determine if there were any domains within the basic technology competencies that were more important in predicting innovation attribute adoption and how those interacted with self-efficacy. A multiple regression analysis was completed including the addition of uniqueness indexes to measure the importance of each variable in determining its individual contribution to the PCI score variable.

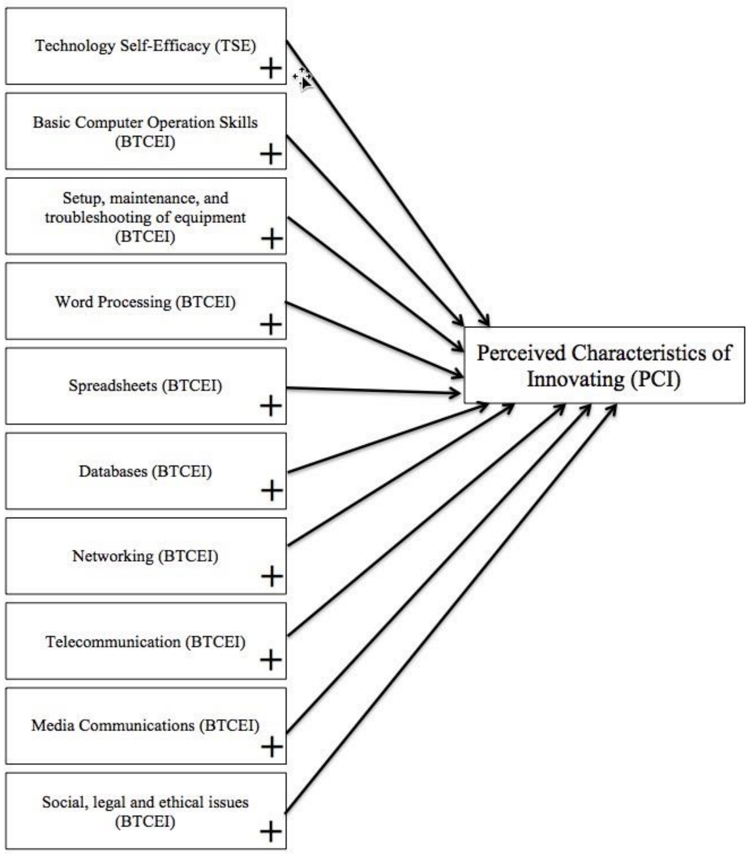


*Figure 2*. Research model of the predictors of innovation adoption by domain

**Instruments**

The 83-item survey instrument utilized closed Likert scale items, which were collected for data analysis. These items were modified versions of three instruments that measured technology self-efficacy, technology competence and intention to adopt a new technology, all of which have been created and deemed both reliable and valid. The intention to use and technology competence scales were interval measures, and the technology self-efficacy scale was ratio because it has a true zero point.

The researcher used a combination of three survey instruments: (a) a modified *Perceived Characteristics of Innovating Survey (PCI)* (Moore & Benbasat, 1991), (b) *Basic Technology Competencies for Educators Inventory* (Flowers & Algozzine, 2000), and (c) a modified *Computer Self-Efficacy Survey* (Compeau & Higgins, 1995).

**Perceived characteristics of innovating (PCI) instrument.** The first instrument (PCI) was chosen because it has been deemed valid and reliable through factor and discriminant analysis. The instrument also focuses on the perceptions of the characteristics of using an innovation as opposed to characteristics of the innovation itself (Moore & Benbasat, 1991). The PCI instrument requires that the survey have a specific innovation focus. A current trend in technology procurement is on educational applications on iPads for use in education. Schools and districts are making major investments of capital to incorporate these tablet devices into education. For example: the Los Angeles Unified School District invested $1-billion in an effort to put an iPad in the hands of every student (Blume, 2013). According to a U.S. News article over 600 high school districts in the United States have launched iPad initiatives (Koebler, 2011). The focus for this instrument was on “educational applications on iPads” instead of generic tablets to provide more specificity in the technology to be integrated. The full PCI instrument was a 38-item instrument. However, Moore and Benbasat (1991) created a 25-item shorter survey that could be used in lieu of the larger item instrument. The 24-item questionnaire was used for this study. One item was eliminated because the authors removed it as a result of a factor analysis and was eliminated from this study as well. The instrument itself covers the nine sub-domains of innovation attributes outlined in the literature review. The questions were reworded to have a future tense because the participants were not current teachers and the scenario reflected future job service. A 5-point Likert scale was used for the questions ranging from "strongly disagree" to "strongly agree" and used a 7-point Likert scale. Questions for this portion of the survey included:

- **Voluntariness**
    1. My boss will not require me to use educational apps on iPads.
    2. Although it might be helpful, using educational apps on iPads will certainly not be compulsory in my job.
- **Relative Advantage**
    1. Using educational apps on iPads will enable me to accomplish tasks more quickly.
    2. Using educational apps on iPads will improve the quality of work that I do.
    3. Using educational apps on iPads will make it easier to do my job.
    4. Using educational apps on iPads will enhance my effectiveness on the job.
    5. Using educational apps on iPads will increase my productivity.
- **Compatibility**
    1. Using educational apps on iPads will be compatible with all aspects of my work.
    2. Using educational apps on iPads will fit well with the way I like to work.
    3. Using educational apps on iPads will fit into my work style.
- **Image**
    1. People in my organization who use educational apps on iPads will have more prestige than those who do not.
    2. People in my organization who use educational apps on iPads will have a high profile.
    3. Having educational apps on iPads will be a status symbol in my organization.
- **Ease of Use**
    1. I believe that it will be easy to get educational apps on iPads to do what I want them to do.
    2. Overall, I believe that educational apps on iPads will be easy to use.
    3. Learning to operate educational apps on iPads will be easy for me.
- **Result Demonstrability**
    1. I would have no difficulty telling others about the results of using educational apps on iPads.
    2. I believe I could communicate to others the consequences of using educational apps on iPads.
    3. The results of using educational apps on iPads will be apparent to me.
    4. I would have difficulty explaining why using educational apps on iPads may or may not be beneficial.
- **Visibility**
    1. In my organization, one will see educational apps on iPads in many classrooms.
    2. Educational apps on iPads will not be very visible in my organization.
- **Trialability**
    1. Before deciding whether to use educational apps on iPads, I will be able to properly try them out.
    2. I will be permitted to use educational apps on iPads on a trial basis long enough to see what I could do.

**Basic technology competencies for educators instrument (BTCEI).** The second instrument used was the Basic Technology Competencies for Educators Instrument (BTCEI) developed by Flowers and Algozzine (2001). The instrument tests for competency in nine domains:

1. Basic computer operation skills
2. Setup, maintenance and troubleshooting of equipment
3. Word processing
4. Spreadsheets
5. Database
6. Networking
7. Telecommunications
8. Media communication
9. Social, legal and ethical issues.

The instrument uses a 4-point Likert scale including (a) not competent, (b) somewhat competent, (c) competent, and (d) very competent. The definitions are stated as "*Very competent* individuals can teach others how to perform the task, *competent* individuals can complete the task without assistance, *somewhat competent* individuals can perform the task with some assistance, and *not competent* individuals cannot complete the task" (p. 414). The BTCEI survey was also found to have "high internal consistency reliability (.87-.96) and adequate stability reliability (.77-.90)" (p. 411). The researchers also looked at concurrent validity by correlating the scores on the instrument with performance based competency tests that measured items on the instrument. They found the instrument to be positively correlated with a coefficient of .62.

The BTCEI has 45 questions with questions in each domain chosen because they progressively move from lower to higher skills. Each domain offers a final question for the participant to provide an overall rating of their abilities in each domain (Flowers & Algozzine, 2001). This instrument assesses 8 basic technology skills that teachers use in the classroom (basic computer operation skills, setup maintenance and troubleshooting equipment, word processing, spreadsheets, database, networking, telecommunications, and media communications) and one knowledge domain skill set (social, legal and ethical issues). Below are the modified questions for this survey:

1. **Basic computer operations skills**
   - Insert and eject external USB drive (changed from **floppy diskette** because that technology is not current)
   - Store files in a folder or subdirectory
   - Access information on CD-ROM, external USB drive (changed from **floppy drive**), and hard drives.
   - Create and delete folders or subdirectories
   - Overall rating of basic computer operation skills
2. **Setup, maintenance, and troubleshooting equipment**
   - Protection of USB drives (changed from **floppy diskette**)
   - Virus protection
   - Connecting peripheral devices
   - Managing memory
   - Overall rating of ability to setup, maintain, and troubleshoot equipment
3. **Word Processing**
   - Set margins
   - Change font size and type
   - Cut, copy, and paste in and between documents
   - Insert files, graphics, and tables in a document
   - Overall rating of word processing ability
4. **Spreadsheets**
   - Enter data in cells
   - Move data within a spreadsheet
   - Use formulas
   - Create charts
   - Overall rating of spreadsheet management ability
5. **Database**
   - Enter data in a database
   - Sort and search in a database
   - Produce a report in a database
   - Queries using *and* and *or*
   - Overall rating of competencies using a database
6. **Networking**

- Logging on a network
- Working in a network environment
- Electronic file sharing
- Knowledge of advantages of a server
- Overall rating of networking skills

7. **Telecommunications**
   - Send and receive eMail
   - Navigate the World Wide Web
   - Subscribe to a list-serve
   - Develop programs using an authoring system or language (example: html is an authoring language for developing websites)
   - Overall rating of telecommunication
8. **Media Communication**
   - Use an overhead
   - Develop an electronic slideshow
   - Develop an interactive electronic slideshow
   - Develop a presentation using graphics and sound
   - Overall rating of media communication skills
9. **Social, legal and ethical issues**
   - Knowledge of copyright laws
   - Knowledge concerning shareware
   - Knowledge of software piracy
   - Knowledge of intellectual property rights
   - Overall rating of social, legal and ethical issues

**Technology self-efficacy instrument (TSE).** The instrument used to assess technology self-efficacy was a modified computer self-efficacy measure that was adapted from Compeau and Higgins (1995). This instrument was developed because previous computer self-efficacy instruments focused more on skills related tasks (technology competence) instead of measuring a person's assessment of whether or not they can perform tasks or use their current knowledge and skills to apply to different scenarios. All of the questions in this instrument were focused on measuring the performance of a task and understanding the magnitude of the self-efficacy.

This instrument includes 10 questions using a 10-point scale ranging from "not at all confident" above the left side of the scale at position 1 to "moderately confident" above the 5 position on the scale, and finally to "totally confident" above the 10 position on the scale. First the participants will circle “Yes” or “No” as to whether they initially feel that they could use the technology to complete a job. If they answer, “Yes” they go on to indicate on a scale from 1-10 how confident they feel about the question being asked. The researchers indicated that when scoring this instrument the addition of a zero on the scale can eliminate the need for counting of “Yes” or “No” responses to measure the magnitude of the participants’ self-efficacy. This study followed that recommendation, and eliminated the “Yes”/“No” response with a scale from 0-10 for simplicity.

The participants were given a scenario, which was modified (see Table 2 below for original and modified instrument changes).

Table 2

*Technology Self-Efficacy Scenarios*

| Original | Modified |
|---|---|
| Often in our jobs we are told about **software packages** that are available to make work easier. For the following questions, imagine that you were given a new **software package** for some aspect of your work. It doesn't matter specifically what this **software package** does, only that it is intended to make your job easier and that you have never used it before.<br><br>The following questions ask you to indicate whether you could use this unfamiliar **software package** under a variety of conditions. For each of the conditions, please indicate whether you think you would be able to complete the job using the **software package**. Then, for each condition that you answered "yes" please rate your confidence about your first judgment, by circling a number from 1 to 10, where 1 indicates "Not confident at all," 5 indicates "Moderately confident," and 10 indicates "Totally confident." | Often in our jobs we are told about **technologies** that are available to make work easier. For the following questions, imagine that you were given a new **technology** for some aspect of your work. It doesn't matter specifically what this **technology** does, only that it is intended to make your job easier and that you have never used it before.<br><br>The following questions ask you to indicate whether you could use this unfamiliar **technology** under a variety of conditions. For each of the conditions, please indicate whether you think you would be able to complete the job using the **technology**. Then, for each condition that you answered "yes" please rate your confidence about your first judgment, by circling a number from 1 to 10, where 1 indicates "Not confident at all," 5 indicates "Moderately confident," and 10 indicates "Totally confident." |

The primary question for the introduction to the questionnaire was stated as "I could complete the job using the software package…". Because this study dealt with future teachers the question was reworded to state "I would be able to complete my teaching job using the new technology…". The questions for this survey were listed as follows (the terms software or package have been replaced by technology):

I would be able to complete my teaching job using the new technology…

1. …If there was no one around to tell me what to do as I go.
2. …If I had never used a technology like it before.
3. …If I had only the technology manuals for reference.
4. …If I had seen someone else using it before trying myself.
5. …If I could call someone for help if I got stuck.
6. …If someone else had helped me get started.
7. …If I had a lot of time to complete the job for which the technology was provided.
8. …If I had just the built-in help facility for assistance.
9. …If someone showed me how to do it first.
10. …If I had used similar technologies before this one to do the same job.

**Demographic questions.** Additional demographic questions were include in the survey to facilitate analyses and provide information regarding the characteristics of the participants. Demographic questions were:

1. What is your current declared major (note: the acronyms are used in the college and it was assumed that students were familiar with their meaning).
   - AGED: Agricultural Education
   - ARED: Art Education
   - CATE: Career and Technical Education
   - CHED: Childhood Education
   - ELED: Elementary Education
   - MUED: Music Education
   - PHED: Physical Education
   - SPED: Special Education
   - VOED: Vocational Education
   - Other (open comment space)
2. Gender
   - Male
   - Female
3. Age – please provide your current age in years
   Write your age here >> ___________________

4. Ethnicity
    - Asian
    - African American
    - American Indian or Alaska Native
    - Caucasian
    - Hawaiian or Pacific Islander
    - Non-Resident Alien
    - Two or more races
    - Unknown

The combine survey of the instruments detailed above resulted in an 83-item survey.

**Sampling**

The sampling for this research was one of convenience. A request was sent to faculty in each 3000 and 4000 level class described previously to determine willingness to allow the researcher 15-20 minutes of class time for data collection via the survey (see Appendix B). For faculty that agreed, the researcher determined a time to visit the class and asked students to voluntarily participate in the study. The researcher did offer treats (small bite size candy bars) to the participants as a token of appreciation. All students were informed that they could have the treats regardless of participation. Students that did not wish to participate were allowed to leave the room for the duration of the survey administration. The survey was provided with paper and pencil with data being entered into electronic format for analysis after the fact by the researcher. This allowed for minimal disruption of the class and intrusion on the teacher's class time, and was instrumental in gaining a high response rate (99.6%) as opposed to distributing the survey electronically.

**Human Subjects Considerations**

An expedited IRB was submitted to the Office of Institutional Research and was reviewed and approved administratively. Participants were provided with a cover letter explaining the research protocol attached to the survey. The letter to participants can be found in the Appendix A, a letter to faculty to participate in the study can be found in Appendix B, and the IRB approval letter with modifications and an initial application stamp can be found in Appendix C.

# Chapter Four: Results

## Analysis Strategy

This research study was correlational and used multiple regression analysis procedures to assess the relationships between technology self-efficacy, and technology competence as predictors of Perceived Characteristics of Innovating (PCI), a measure of the perceptions of the participant towards integrating educational applications on an iPad for future classroom use. A standard multiple regression analysis was performed between the PCI score as the criterion variable with technology competence, including nine sub-domain scores[1], and technology self-efficacy as predictor variables. Analyses were performed using SAS PROC REG and PROC CORR for the evaluation of assumptions.

## Response Rates

There were 273 observations collected from 17 course sections for this research study: one student out of 273 opted-out of participating resulting in a response rate of 99.6%. The high response rate can be attributed to the researcher physically going to classes with permission from the instructors and explaining the research objectives to the participants. The explanations of the study were not scripted, however, one researcher provided the same information, and consistency was maintained in the explanations of the research. In addition participants were provided treats in the form of candy as a "thanks" for participating. Students were informed that they could partake in the treats regardless of their participation in the study. The front of the survey form included an implied informed consent with information about the project as well as three opt-in/out check boxes: 1) I agree to take part in this research study, 2) I have already participated in

[1] The nine sub-domains are basic computer operation skills, skills in setup, maintenance and troubleshooting of equipment, word processing skills, spreadsheet skills, database skills, networking skills, telecommunication skills, media communication skills, and social/legal/ethical knowledge.

this research study in another class (to ensure uniqueness in participation) and 3) I am choosing to not participate by opting-out of this research study (see Appendix A).

Fifty-one observations were removed from the sample due to incomplete data, resulting in a final *N* of 222 for analysis. Missing data were scattered without apparent pattern throughout the observations. Because the survey was provided via pencil and paper it was found that participants would skip or overlook questions leaving some surveys incomplete. With 222 responses and 9 predictor variables being tested in one analysis and two predictor variables being tested in another, the cases were sufficient for conducting standard multiple regression analyses (Tabachnick & Fidell, 2013).

**Demographics**

Of the 222 observations used for analysis the observations used in the study included 197 (88.74%) female, 23 (10.36%) male, and 2 unreported gender (less than 1%). Ethnicity of the students (based on the federal definitions for ethnicity) were Asian 2 (less than 1%), African American 4 (1.8%), Hispanic and any other race 14 (6.31%), American Indian or Alaska Native 7 (3.15%), Caucasian 183 (82.43%), Two or More Races 8 (3.6%), and Unknown 4 (1.8%). The participant ages ranged from 18-40 with 92.79% falling between 18-25 years of age (3 were unreported – 1.35%). The declared majors for the students consisted of Secondary Education 56 (25.23%) (which included Art Education, Career and Technical Education, Music Education, Physical Education, Special Education, Other), Childhood Education 89 (40.09%), and Elementary Education 74 (33.33%). There were 3 (1.35%) non-responders for the ethnicity question.

## Instrument Reliability

Reliability estimates were computed for the three survey instruments used in this study: *Perceived Characteristics of Innovating Survey (PCI*; Moore & Benbasat, 1991), (b) *Basic Technology Competencies for Educators Inventory* (Flowers & Algozzine, 2000) and (c) a modified *Computer Self-Efficacy Survey* (Compeau & Higgins, 1995). Estimates of internal consistency for instrument variables were measured using Cronbach's alpha and exceeded .79 (see Table 3).

## Normality, Linearity, and Residuals

Preliminary screening for normality, linearity, and independence of residuals was conducted via the SAS PROC REG procedure using untransformed variables to produce scatterplots of residuals against the criterion variable PCI score. Evaluation of the scatterplots revealed a normal distribution of the data.

**Outliers.** To examine for the presence of influential data, the SAS PROC Univariate procedure was used to determine if any single cases had standardized z scores in excess of 3.29 as potential outliers; only two observations fell outside of the accepted levels. Because a few observations with standardized scores above 3.29 are to be expected in a very large sample (Tabachnick & Fidell, 2013) these two observations were left in the analysis. A Mahalanobis distance analysis was calculated (Tabachnick & Fidell, 2013) using a PROC ROBUSTREG procedure in SAS and, no multivariate outliers were detected among the cases using a $p < .001$ criterion.

There were no violations of the assumptions for multivariate normal distribution, independence of errors, equality of variance or outlier influence for this data.

**Question 1**

Which is a predictor of intention to adopt educational applications on iPads by pre-service teachers: overall basic technology competencies or technology self-efficacy?

**Bivariate results.** Results for research question one were analyzed using multiple regression and simple bivariate correlations. Means, standard deviations, intercorrelations, and Cronbach's coefficient alpha estimates appear in Table 3.

Table 3

*Means, Standard Deviations, Intercorrelations, and Coefficient Alpha Estimates for PCI Score, Technology Competence and Technology Self-Efficacy variables*

| | | | Intercorrelations | | |
|---|---|---|---|---|---|
| Variables | Mean | SD | 1 | 2 | 3 |
| 1. PCI Score | 106.32 | 12.19 | (.79) | | |
| 2. Technology Competence Score | 142.57 | 21.18 | .26** | (.96) | |
| 3. Technology Self-Efficacy Score | 75.08 | 14.00 | .15* | .58** | (.91) |

*Note*. $N = 222$. Reliability estimates appear on the diagonal above correlation coefficients.

$*p < .05$, $**p < .001$

The bivariate correlation revealed that the two predictor variables of overall technology competence score and technology self-efficacy score were positively related to PCI. The technology competence score was significant at $p < .001$, while the technology self-efficacy score was significant at $p < .05$. Although the predictors are positively related to the criterion variable, the strength of the association to the PCI variable was low: technology competence ($r = .26$); technology self-efficacy ($r = .15$). The two predictor variables had a moderate correlation with each another ($r = .58$).

**Multiple regression results.** A standard multiple regression analysis was performed on PCI score as the criterion variable with technology competence and the technology self-efficacy score as the predictor variables (Table 4).

Table 4

*Standard Multiple Regression Analyses of Technology Competence Score and Modified Technology Self-Efficacy Score on PCI Score (intention to adopt educational applications on iPads for classroom use).*

| Variable | B | SE B | β | *t* | $R^2$ |
|---|---|---|---|---|---|
| Initial model | | | | | .0654 |
| Technology Competence Score | .15 | .05 | .26 | 3.19** | |
| Technology Self-Efficacy Score | .00 | .07 | .00 | .01 | |
| Final model | | | | | .0654 |
| Technology Competence Score | .15 | .04 | .26 | 3.92** | |

** $p < .001$,

$R^2$ for the original model regression was significantly different from zero, $F$ (2, 219) = .0654, $p < .001$, adjusted $R^2$ = .0568 and 95% confidence limits from 74.26 to 96.37. The $R^2$ indicated that approximately 7% of the variability in the PCI score was predicted by the combination of technology competence and technology self-efficacy. The variance jointly contributed to the variability in PCI score with both technology competence and technology competence was 6%, while the technology self-efficacy score uniquely contributed less than 2 tenths of 1% of the variability in PCI score.

The size and direction of the relationships of technology self-efficacy and technology competence to PCI score suggested that these variables had a small relationship to the criterion variable. Between these two variables, technology competence was more predictive than technology self-efficacy. Because the technology self-efficacy and the technology competence scores had moderately high bivariate correlations at .58, there was not sufficient reason to think that multicollinearity or singularity as a factor for consideration. According to Tabachnick and Fidell (2013) only bivariate correlations higher than .90 should be considered to cause multicollinearity or singularity. However, because the semi-partial type II correlation for the technology self-efficacy score was so close to zero it appears that multicollinearity could be an issue between the variables. A final model was ran excluding the technology self-efficacy variable the result was also significant, $F$ (1, 220) = 15.39, $p < .0001$, $R^2 = .0654$, adjusted $R^2 = .0611$ and 95% confidence limits from 74.67 to 95.99. Although the bivariate correlation between technology self-efficacy to PCI score was statistically different from zero, $r = .0275$, technology self-efficacy did not contribute significantly to the regression analysis. For this reason technology self-efficacy was also eliminated as a variable in the analysis for the second research question. Apparently, from this analysis there were other unexplained variables outside of technology competence and technology self-efficacy that accounted for variability of the PCI score.

**Question 2**

Of the nine sub-domains of technology competence (basic computer, setup/maintenance/troubleshooting equipment, word processing, spreadsheets, databases, networking, telecommunications, media communications, and social/legal/ethical issues knowledge skills) what variables were predictors of intention to adopt educational applications on iPads by pre-service teachers?

**Bivariate results.** In order to better understand the relationship of technology competence to PCI score, simple bivariate correlational coefficients were calculated using the technology competence sub-domain scores. The nine sub-domains included: basic computer operation skills, setup/maintenance and troubleshooting equipment skills, word processing skills, spreadsheet skills, database skills, networking skills, telecommunication skills, media communication skills, and social/legal/ethical knowledge skills. Table 5 outlines the means, standard deviations, intercorrelations, and Cronbach's coefficient alpha estimates for the PCI score and nine technology sub-domains.

Table 5

*Means, Standard Deviations, Intercorrelations, and Coefficient Alpha Estimates for PCI Score, and Nine Technology Competence Sub-Domains*

| | | | Intercorrelations | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1. PCI Score | 106.32 | 12.19 | (.79) | | | | | | | | | |
| 2. Basic Computer Oper. Skill | 18.48 | 2.13 | .07 | (.86) | | | | | | | | |
| 3. Setup, Maint-Equip Skills | 12.85 | 4.15 | .25* | .49* | (.93) | | | | | | | |
| 4. Word Processing Skills | 19.28 | 1.53 | .05 | .58* | .26* | (.83) | | | | | | |
| 5. Spreadsheet Skills | 15.56 | 3.88 | .24* | .49* | .55* | .47* | (.92) | | | | | |
| 6. Database Skills | 13.12 | 4.68 | .17* | .34* | .58* | .24* | .62* | (.96) | | | | |
| 7. Networking Skills | 15.55 | 3.76 | .24* | .39* | .59* | .28* | .46* | .51* | (.91) | | | |
| 8. Telecommunications Skills | 16.95 | 2.48 | .27* | .39* | .45* | .34* | .47* | .47* | .55* | (.68) | | |
| 9. Media Comm. Skills | 18.27 | 2.48 | .10 | .45* | .23* | .52* | .47* | .30* | .38* | .42* | (.88) | |
| 10. Social Legal Ethic Issues | 12.53 | 4.52 | .13 | .26* | .57* | .17* | .41* | .47* | .48* | .45* | .32* | (.93) |

*Note:* $N = 222$. Reliability estimates (Cronbach's alpha) appear on the diagonal above the correlation coefficients.
$^*p < .001$

**Multiple regression results.** A standard multiple regression analysis was performed between the nine technology competence sub-domains variables in predicting the PCI score. Analysis was performed using SAS PROC REG and PROC CORR for evaluation of assumptions. All predictor variables were normally distributed. Table 6 displays the beta weights and uniqueness indices for the nine technology competence sub-domain variables on PCI score.

Table 6

*Beta Weights and Uniqueness Indices for Multiple Regression Analyses Predicting PCI Score*

| Predictor – PCI Score | B | SE B | β | *t* | $sr^2$ (unique) |
|---|---|---|---|---|---|
| Basic Computer Operation Skill | -.89 | .52 | -.16 | -1.72 | |
| Setup-Maint-Troubleshoot Equip. Skills | .60 | .30 | .20 | 2.00* | .0003 |
| Word Processing Skills | -.43 | .69 | -.05 | -.62 | |
| Spreadsheet Skills | .60 | .30 | .19 | 2.00* | .0003 |
| Database Skills | -.23 | .24 | -.09 | -.99 | |
| Networking Skills | .29 | .29 | .09 | 1.02 | |
| Telecommunications Skills | 1.05 | .41 | .21 | 2.52* | .0007 |
| Media Communication Skills | -.01 | .42 | -.00 | -.01 | |
| Social, Legal and Ethical Issues | -.30 | .23 | -.11 | -1.33 | |

*Note.* $R^2$ = .1343 ($F$ (9, 212) = 3.65). *$p$ < .05

$R$ for the model regression was significantly different from zero, $F$ (9, 212) = 3.65, $p$ < .001, adjusted $R^2$ = .0975 and 95% confidence limits from 77.95 to 119.51. The adjusted $R^2$ indicated that approximately 10% of the variability in the PCI score was predicted by the combination of all nine technology competence sub-domains. Three sub-domain variables were significantly different from zero in predicting PCI score: basic computer operation skills, spreadsheets skills, and telecommunications skills. All other variables (setup/maintenance and troubleshooting equipment skills, word processing skills, database skills, networking skills, media communication skills, and social/legal/ethical knowledge skills) were not statistically significant in predicting or explaining the variability of the PCI score. As with question one, results of this analysis indicated that there were other unmeasured variables outside of technology competence that accounted for variability of the PCI score that were not factored into this study.

The above analysis used standard multiple regression techniques in which all of the variable entered into the equation at one time. This method was chosen to simply assess the relationship among the variables. According to Tabachnick and Fidell (2013) using a stepwise (statistical) regression technique can "tighten up future research" (p.143). With statistical regression techniques only the independent variables that are useful in predicting the dependent variable will remain in the analysis. Those independent variables that are not statistically relevant will be eliminated. Stepwise regression starts with an empty equation and adds the independent variables based on statistical criteria for entry into the model. If they criterion are met they stay in the model. However, as other independent variables are added to the model previously added variables could be eliminated because they no longer meet the entry criterion. This procedure steps through all variables until only statistically relevant variables remain. The order of importance of each variable can be determined using stepwise regression procedures. "IVs with bigger correlations or higher standardized regression coefficients are more important to the solution than those with lower (absolute) values" (p.144). Bendel and Afifi (1977) recommends a .15 probability level for forward regression in an effort to be more liberal so that important variables are not eliminated. This is the same criterion that is defaulted to in the SAS stepwise regression procedure. The results of the stepwise regression are listed in Table 7 below:

Table 7

*Summary of Stepwise Multiple Regression Analyses Predicting PCI Score*

| Predictor – PCI Score | B | SE B | β | *t* | Partial $R^2$ | Model $R^2$ |
|---|---|---|---|---|---|---|
| Telecommunications Skills | .96 | .37 | .20 | 2.58* | .0739 | .0739 |
| Setup-Maint-TrShoot Eqip. Skills | .50 | .24 | .17 | 2.07* | .0216 | .0955 |
| Basic Computer Operation Skill | -.92 | .44 | -.16 | -2.06* | .0116 | .1072 |
| Spreadsheet Skills | .43 | .26 | .14 | 1.64 | .0109 | .1181 |

*Note.* Model $R^2$ = .1181 ($F$ (4, 217) = 7.26). *$p$ < .05

The stepwise analysis revealed in order of importance that telecommunication, setup-maintenance-troubleshooting equipment, basic computer operations and spreadsheet skills scores were the model variables best at predicting PCI score. This model for prediction was significant at $p < .001$ level. Collectively these four independent variables account for approximately 12% of the variance in the regression model. Telecommunication skills had the highest partial $R^2$ value at 7% in predicting PCI score. Independent variables that were eliminated included word processing, database, networking, media communication, and social, legal and ethical skills.

## Chapter Five: Discussion

### Summary

The purpose of this study was to examine how pre-service teachers perceived themselves on basic classroom technology competence skills (basic computer operation skills, setup-maintenance-troubleshooting equipment, word processing, spreadsheets, databases, networking, telecommunication, media communications and social-legal-ethical issues), and technology self-efficacy, and how these two constructs related to perceived characteristics of innovating scores for adopting educational applications on iPads for classroom use.

The results of this study extend our understanding of first order barriers or tangible items (technology competence) and second order barriers or intangibles such as beliefs (technology self-efficacy) and how these variables relate to perceptions about using educational applications on iPads for the classroom, which is the innovation attribute component of Diffusion of Innovations Theory. Moore and Benbasat (1991) extended these innovation attributes with the development of the Perceived Characteristics of Innovating (PCI) instrument as a prediction tool to measure perceptions of characteristics about using a new innovation. According to the developers of the instrument higher scores on the overall instrument can be used to predict adoption of a newly introduced innovation.

Past research using the PCI instrument has focused on how the sub-domains of innovation attributes (voluntariness, relative advantage, compatibility, image, ease of use, result demonstrability, visibility and trialability) influence adoption of different innovations such as teaching strategies, eLearning adoption, and e-Government initiatives (Carter & Belanger, 2014; Phillips & Vinton, 2010; Zhang, Wen, Li, Fu & Cui, 2010). This study focused on variables that might act as influencers on scores on the overall PCI instrument designed to focus on integrating educational applications on iPads for classroom use.

The first research question sought to evaluate the influence of technology self-efficacy and technology competence scores on pre-service teacher's intention to adopt educational applications on iPads - PCI score. This question related to understanding whether one of these variables was more important when adopting a new technology, which can assist in determining if current methods for teaching technology integration education should focus on technology competence, technology self-efficacy development, or both. The second research question extended the first question to determine whether any specific technology competence sub-domains were related to the PCI score.

Many educational training programs for technology integration are short term in nature focusing on technology competence skills when perhaps they should be focusing on more long-term training that supports self-efficacy with technology. Prior research has demonstrated that self-efficacy may be more important than technology skills for those who use technologies in the classroom (Ertmer & Ottenbreit-Leftwitch, 2010). Others have found that the time invested in the learning task is related to the development of self-efficacy (Stevens, To, Harris, & Dwyer, 2008). Similarly technology competence has been found to be instrumental in whether or not administrators support and champion technology efforts in schools as well as predicting teachers use of eLearning technologies (Baylor & Ritchie, 2002; Stuart, Mills & Remus, 2009). Therefore, understanding how technology self-efficacy and technology competence skills influence whether or not a pre-service teacher might adopt an innovation such as educational applications on iPads for classroom use was an important contribution of this study.

## Findings

**Research question one.** Is there a relationship between technology competence and technology self-efficacy toward intentions to adopt educational applications on iPads for classroom use? The results of this study indicate that technology self-efficacy was not a significant factor in predicting scores on the PCI instrument which measured a pre-service teacher's willingness to adopt educational applications on iPads for classroom use when included in a model that held constant the technology competence variable. These findings aligned with recent research that found that self-efficacy was not a significant predictor of computer use (Zogheib, 2015). Similarly, recent research by Anderson & Groulx (2015) concluded that self-efficacy beliefs were not the best predictor of intention to integrate a technology into classroom use when combined with other variables such as ease of use, value beliefs, and subjective norms. The present research adds to the evidence showing self-efficacy beliefs may be a poor measure of intention to integrate technology. In contrast Sang, Valcke, VanBraak and Tondeur (2010) found computer self-efficacy was a strong indicator of a teacher's future computer use. Although not related to predicting education technology adoption, Ellen, Bearden, & Sharma (1991) found that self-efficacy can impact resistance to technological change: those with higher self-efficacy showed less resistance to change while those with less showed more resistance. The literature seems to be divided in terms of the importance of self-efficacy towards technology integration. According to Bandura (1977), perceived self-efficacy can positively or negatively influence performance on a task, depending on the incentives and skills of the individual. Skills and incentives are key to building self-efficacy, which determines effort expended, choosing what activities to engage in, and the amount of effort sustained for performance in light of stressful situations. Bandura (1977) stated that most measures of expectancy are "concerned with people's hopes for favorable outcomes rather than with their sense of personal mastery" (p. 194). The four major sources of information required for self-efficacy theory from a social learning perspective are performance accomplishments, vicarious experience, verbal persuasion and physiological states. Future studies for technology adoption where self-efficacy measures are involved should attempt to include gathering data on all four sources of information regarding self-efficacy. Because hope for favorable outcomes would probably not always translate into action, collecting more data deemed important to the sources of information required for self-efficacy could provide insight into technology adoption. Finding ways to measure performance in light of these constructs would also strengthen the results of further study.

Technology competence was determined in this study to have significance in predicting whether pre-service teachers would adopt educational applications on iPads for classroom use. The current results are consistent with Agyei & Voogt's (2011) study that found teacher's technology competence skills (specifically computer skills) were strong predictors of technology integration. Similarly, MacCallum & Jeffery (2013) found that students who were competent in basic information and computing technologies (ICT) skills were more likely to adopt mobile learning. However, the MacCallum study also revealed that advanced ICT skills were not significant in predicting adoption of learning on mobile devices. Past experiences with information and communication technologies (ICT) were determined not to be a strong predictor of future technology use (So, Choi, Lim & Xiong, 2012). No literature was located that did support technology competence as a predictor for technology integration. Question two of this research further explored sub-domains of technology competence in predicting PCI scores.

**Research question two.** Do any of the nine sub-domains of technology competence predict scores on the PCI instrument for adopting educational applications on iPads for classroom use? Results showed that a model including four variables of telecommunication skills, basic computer skills, setup, maintenance and troubleshooting equipment skills, and spreadsheets, skills were predictive of PCI score. An extensive literature search was conducted to locate studies that included the technology sub-domain areas specifically in the area of technology integration. Very few studies have been published that focused on specific sub-domain competence as evidence of technology integration practices. However, a few studies did provide information for consideration. Similar to the findings in this study Rastogi & Mahlotra (2013) reported that information and communication technology skills (ICT) were found to be significant predictors of future ICT integration. Their ICT skills were similar to the nine technology sub-domain skills in this study. The effects of technology competencies similar to this study on computer self-efficacy (CSE) revealed 42% of the variance in CSE was accounted for by the technology competencies (Hasan, 2003). In opposition to the current findings Hasan's (2003) research found that computer programming and graphics skills were stronger predictors of CSE than other technology competencies (word processing, spreadsheets, databases, operating system, computer games, and telecommunications experiences). Technology competence was found to be a mediating variable in ICT integration by literacy teachers (Hutchison & Reinking, 2011). However, the authors discussed the need for further research in exploring the relationship between the variables under consideration (acquisition of competence, obstacles to integration and access to technologies) in terms of understanding technology integration for literacy instruction. This study revealed that four technology competence variables were the best predictive model for PCI score. Further exploration of the relationship between telecommunication, basic computer, equipment setup-maintenance-troubleshooting and spreadsheet skills should take place in terms of understanding technology adoption specific to educational applications on iPads.

Literature in the area of technology sub-domains as predictors for technology integration is difficult to find in education. The present research helps address that deficit by showing that specific competency sub-domains are predictive of technology adoption, specifically educational applications on iPads for classroom use. Opportunities exist for future exploration on how and why skills related to the basic technologies can positively or negatively impact technology integration. Because programs of education and professional development focus on skills training understanding the relationship to technology integration would benefit in the development of teacher training programs.

**Recommendations**

This study revealed that only 7% of the overall variance in PCI score was attributed jointly by technology competence and technology self-efficacy. Therefore, it is important to think about what other types of variables account for the remaining variability of the analysis. Attitudes and beliefs of the pre-service teachers were not a consideration in this study. These could have been critical or mediating variables between the criterion and predictor variables that could have accounted for some of the variability in PCI score. Bai & Ertmer (2008) identified the importance of introductory technology courses as important in predicting pre-service teachers' technology use attitudes. Other research studies have also supported the importance of attitudes and beliefs as integral to technology adoption (Belland, 2009; Crompton, 2012; Straub, 2009). Rogers (2003) stated that values, beliefs and past experiences are important factors regarding adoption rates of innovation to the individual. Including other measures of attitudes and beliefs into a future study would be a consideration extending the current research.

**Conclusion**

This study had two main goals. The first was to determine the relationship between the criterion variable (pre-service teacher's intention to adopt educational apps on iPads - PCI score) and the set of predictor variables: Technology self-efficacy and technology competence. The second goal was to understand the relationship to the PCI score of the nine sub-domain technology competence scores (basic computer operation skills, setup-maintenance-troubleshooting equipment, word processing, spreadsheets, databases, networking, telecommunication, media communications and social-legal-ethical issues).

The results of this study did not support technology self-efficacy as a significant predictor of pre-service teacher's intentions to adopt educational applications on iPads for classroom use. Technology competence was found to support the adoption of educational applications on iPads for classroom use. Specifically, setup, maintenance and troubleshooting equipment skills, basic computer skills, spreadsheets skills, and telecommunications skills were significant in predicting scores on the PCI instrument. This study's findings support continuing to teach technology skills in pre-service teacher education courses in support of technology integration. Specifically, training and education to ensure that basic computer skills, general equipment maintenance and troubleshooting, spreadsheets and telecommunication skills are taught.

This study is a starting point for further research in the area of technology competence sub-domains as predictors of technology integration. Further investigation into how technologies skills are related to technology adoption are needed to gain a better understanding of how to prepare future teachers for technology integration for classroom use.

## Limitations of the Study

There were limitations within the current study. The study sample was one of convenience and limited to university students that were studying in one pre-service education program. The sample was not randomly selected from all possible pre-service education programs, which limits external validity of the study making it difficult to generalize the findings to other pre-service teacher populations. The survey information depended on self-reported data of participants' technology competence skills, which may not be an accurate measure of actual competence with the skills being reported. As well, the technology self-efficacy instrument used was assessing generalized perceptions of ability to use a new technology. Pajares (1996) discusses that in academic settings research often does not use self-efficacy instruments that are designed to correspond with the criteria tasks under investigation. It is possible that the research instrument used in this study was generic to technology use and not sufficiently specific to the use of educational applications on iPads.

## Implications for Practice

This study revealed three significant indications of intention to adopt educational applications on iPads for classroom use: Setup, maintenance and troubleshooting equipment, spreadsheets, and telecommunications skills. Programs that support the education of pre-service teachers could use this information to increase the skills in these three areas of technical competence. An aspect of diffusion theory focuses on members of the social system that are instrumental in getting the new innovation into the community. Innovators, early adopters, and early majority persons are instrumental in adopting new innovations (Rogers, 2003). School administrators that need to determine personnel who would be successful at integrating educational applications on iPads could single out teachers to assist with diffusion of this particular innovation into their school environments that have high scores on the setup, maintenance and troubleshooting equipment, spreadsheets, and telecommunications skill sets, and who are also innovators, early adopters, or the early majority.

**Future Research**

This research serves as a beginning for other adoption research regarding integration of classroom technologies. It is clear that other variables of interest need to be included in understanding the innovation adoption decisions by participants in this study. Other researchers have recently included variables from theories including the theory of reasoned action, and social cognitive theory into prediction models for explaining technology integration (Anderson & Groulx, 2015). Investigating and adding to this research from other theories that focus on causes of personal action or change theories would be a next logical step in extending this research.

Gathering technology competence data that accurately measures skill in each specific technology sub-domain could extend the current research study. Using actual measurements of data on technology competence may be better predictors than self-reported data. The survey instrument in this study asked five questions related to each technology competence domain, which represents a subjective perception of the participant's skills, as opposed to an objective measurement of overall technology competence in each specific domain. A more comprehensive tool that could determine actual overall scores on using word processing or spreadsheet software for example could indicate true proficiency in terms of being a beginner, intermediate or advanced user. It would be interesting to see if the same results are achieved if this study were conducted using true assessment scores.

In terms of technology self-efficacy this research could also be extended. There are four sources that influence self-efficacy: Performance, vicarious observations of others performance, social influence and verbal persuasion and physiological states (Bandura, 1986). Research supports that these four sources are key factors in creating behavioral change, and if administered appropriately can raise personal self-efficacy (Ross et.al, 1997). Future research could include the four influential sources of self-efficacy as measures to determine whether or not pre-service teachers would adopt educational applications on iPads for classroom use.

## References


Agarwal, R., & Prasad, J. (1998). A conceptual and operational definition of personal innovativeness in the domain of information technology. *Information Systems Research, 9*(2), 204-215.

Agyei, D. D., & Voogt, J. M. (2011). Exploring the potential of the will, skill, tool model in Ghana: Predicting prospective and practicing teachers' use of technology. *Computers & Education*, *56*(1), 91-100.

Al-Awidi, H. M., & Alghazo, I. M. (2012). The effect of student teaching experience on preservice elementary teachers' self-efficacy beliefs for technology integration in the UAE. *Educational Technology Research and Development*, *60*(5), 923-941.

Anderson, S. E., & Groulx, J. G. (2015). Predicting elementary student teachers' technology acceptance. *The International Journal of Information and Learning Technology*, *32*(4).

Aust, R., Newberry, B., O'Brien, J., & Thomas, J. (2005). Learning generation: Innovations with tomorrow's teachers and technology. *Journal of Technology and Teacher Education*, *13*(2), 167-195.

Bai, H., & Ertmer, P. (2008). Teacher educators' beliefs and technology uses as predictors of preservice teachers' beliefs and technology attitudes. *Journal of Technology and Teacher Education*, *16*(1), 93-112.

Bakia, M., Means, B., Gallagher, L., Chen, E., & Jones, K. (2009). *Evaluation of the Enhancing Education Through Technology program: Final report.* Alexandria, VA: US Department of Education. Retrieved from http://files.eric.ed.gov/fulltext/ED527143.pdf

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review*, *84*(2), 191-215.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, *37*(2), 122-147.

Barshay, J. (2014, July 29). Why a New Jersey school district decided giving laptops to students is a terrible idea. *Washington Monthly: College Guide*. Retrieved from http://www.washingtonmonthly.com/college_guide/blog/.

Baylor, L., & Ritchie, D. (2002). What factors facilitate teacher skill, teacher morale, and perceived student learning in technology-using classrooms? *Computers & Education*, *39*(4), 395-414.

Becker, H. J. (1994). How exemplary computer-using teachers differ from other teachers: Implications for realizing the potential of computers in schools. *Journal of Research on Computing in Education, 26*(3), 291-321.

Belland, B. R. (2009). Using the theory of habitus to move beyond the study of barriers to technology integration. *Computers & Education*, *52*(2), 353-364.

Bendel, R.B., & Afifi, A.A. (1977). Comparison of stopping rule sin forward regression. *Journal of the American Statistical Association. 72,* 46-53.

Berliner, D. C. (2004). Describing the behavior and documenting the accomplishments of expert teachers. *Bulletin of Science, Technology & Society*, *24*(3), 200-212.

Blume, H., (August 27, 2013). First L.A. unified school gets iPads in $1-billion effort. *The Los Angeles Times.* Retrieved from http://articles.latimes.com/

Bourgonjon, J., Grove, F. D., Smet, C. D., Looy, J. V., Soetaert, R., & Valcke, M. (2013). Acceptance of game-based learning by secondary school teachers. *Computers & Education*, *67*, 21-35.

Browne, J. (2011). An IRT analysis of preservice teacher self-efficacy in technology integration. *Journal of Technology and Teacher Education*, *19*(2), 123-140.

Bullock, C., & Schomberg, S. (2002). Technology in the classroom: Lessons learned through professional development. *Education*, *122*(2), 248-256.

Bureau, L. S. (n.d.). *Occupational outlook handbook, 2010-11*. Labor Statistics Bureau Bulletin, 2800.

Carter, L., & Belanger, F. (2004). The influence of perceived characteristics of innovating on e-government adoption. *Electronic Journal of E-government*, *2*(1), 11-20.

Compeau, D. R., & Higgins, C. A. (1995). Computer self-efficacy: Development of a measure and initial test. *MIS quarterly*, *19*(2), 189-211.

Clarke, J., Dede, C., Ketelhut, D. J., Nelson, B., & Bowman, C. (2006). A design-based research strategy to promote scalability for educational innovations. *Educational Technology*, *46*(3), 27.

Crompton, H. (2012). Implementation of a one-to-one iPod Touch program in a middle school. *Journal of Interactive Online Learning*, *11*(1), 1-18.

Culp, K. M., Honey, M., & Mandinach, E. (2005). A retrospective on twenty years of education technology policy. *Journal of Educational Computing Research*, *32*(3), 279-307.

Davis, H., Hartshorne, R., & Ring, G. (2010). Being an innovative teacher: Preservice teachers' conceptions of technology and innovation. *International Journal of Education*, *2*(1), 1-28.

DeSantis, J. D. (2013). Exploring the effects of professional development for the interactive whiteboard on teacher's technology self-efficacy. *Journal of Information Technology Education*: *Research, 12*, 343-362.

Diaz, D. P., & Bontenbal, K. F. (2000). Pedagogy-based technology training. *Teaching and Learning in a Network World*, 50-54.

Dingfelder, H. E., & Mandell, D. S. (2011). Bridging the research-to-practice gap in autism intervention: An application of diffusion of innovation theory. *Journal of Autism and Developmental Disorders*, *41*(5), 597-609.

Dunn, E., & Rakes, C. (2010). Learner-centeredness and teacher efficacy: Predicting teachers' consequence concerns regarding the use of technology in the classroom. *Journal of Technology and Teacher Education*, *18*(1), 57-81.

Ellen, P. S., Bearden, W. O., & Sharma, S. (1991). Resistance to technological innovations: an examination of the role of self-efficacy and performance satisfaction. *Journal of the Academy of Marketing Science*, *19*(4), 297-307.

Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development*, *47*(4), 47-61.

Ertmer, P. A. (2001). VisionQuest©: Teacher development model for scaffolding technology integration. In J. Price, D. Willis, N. Davis & J. Willis (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2001* (pp. 833-839).

Ertmer, P. A., & Ottenbreit-Leftwich, T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education*, *42*(3), 255-284.

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education*, *59*(2), 423-435.

Flowers, C. P., & Algozzine, R. F. (2000). Development and validation of scores on the Basic Technology Competencies for Educators Inventory. *Educational and Psychological Measurement*, *60*(3), 411-18.

Gaytan, J. A., & McEwen, B. C. (2010). Instructional technology professional development evaluation: Developing a high quality model. *Delta Pi Epsilon Journal*, *52*(2), 77-94.

Gentry, B., Denton, A., & Kurz, T. (2008). Technologically-based mentoring provided to teachers: A synthesis of the literature. *Journal of Technology and Teacher Education*, *16*(3), 339-373.

Gibson, D., Aldrich, C., & Prensky, M. (2007). *Games and simulations in online learning: Research and development frameworks.* Hershey, PA: Information Science Publishing

Goldring, R., Gray, L., & Bitterman, A. (2013). Characteristics of public and private elementary and secondary school teachers in the United States: Results from the 2011-12 Schools and Staffing Survey. First Look. NCES 2013-314. *National Center for Education Statistics*.

Gray, L., Thomas, N., Lewis, L., & Tice, P. (2010, May). *Educational technology in U.S. public schools: Fall 2009*. (NCES 2010-040). Retrieved from National Center for Education Statistics website: https://nces.ed.gov/pubs2010/2010040.pdf

Groff, J., & Mouza, C. (2008). A framework for addressing challenges to classroom technology use. *AACE Journal*, *16*(1), 21-46.

Hasan, B. (2003). The influence of specific computer experiences on computer self-efficacy beliefs. *Computers in Human Behavior*, *19*(4), 443-450.

Heo, M. (2009). Digital storytelling: An empirical study of the impact of digital storytelling on pre-service teachers' self-efficacy and dispositions towards educational technology. *Journal of Educational Multimedia and Hypermedia*, *18*(4), 405-428.

Hutchison, A., & Reinking, D. (2011). Teachers' perceptions of integrating information and communication technologies into literacy instruction: A national survey in the United States. *Reading Research Quarterly*, *46*(4), 312-333.

Inan, F. A., & Lowther, D. L. (2010). Factors affecting technology integration in K-12 classrooms: A path model. *Educational Technology Research and Development*, *58*(2), 137-154.

Keengwe, J., & Onchwari. (2009). Technology and early childhood education: A technology integration professional development model for practicing teachers. *Early Childhood Education*, *37*, 209-218.

Kent, T. W., & McNergney, R. F. (1999). *Critical issues in teacher education.* Thousand Oaks, CA: Corwin Press, Inc.

Kimmel, H., Deek, F. P., Farrell, M. L., & O'Shea, M. (1999). Meeting the needs of diverse student populations: Comprehensive professional development in science, math, and technology for teachers of students with disabilities. *School Science and Mathematics*, *99*(5), 241-249.

Koebler, J. (2011, September 7). More high schools implement iPad programs. *U.S. News and World Report: Education.* Retrieved from http://www.usnews.com

Lai, H.-M., & Chen, C.-P. (2011). Factors influencing secondary school teachers' adoption of teaching blogs. *Computers & Education*, *56*(4), 948-960.

Lawless, K. A., & Pellegrino, J. W. (2007). Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. *Review of Educational Research*, *77*(4), 575-614.

Li, R., & Liu, M. (2007). Understanding the effects of databases as cognitive tools in a problem-based multimedia learning environment. *Journal of Interactive Learning Research*, *18*(3), 345-363.

Loeb, S., Miller, L. C., & Strunk, K. O. (2009). The state role in teacher professional development and education throughout teachers' careers. *Education Finance and Policy, 4*(2), 212-228.

Loogma, K., Kruusvall, J., & Ümarik, M. (2012). E-learning as innovation: Exploring innovativeness of the {VET} teachers' community in Estonia. *Computers & Education*, *58*(2), 808-817.

Matzen, N. J., & Edmunds, J. A. (2007). Technology as a catalyst for change: The role of professional development. *Journal of Research on Technology in Education*, *39*(4), 417-430.

MacCallum, K., & Jeffrey, L. (2013). The influence of students' ICT skills and their adoption of mobile learning. *Australasian Journal of Educational Technology*, *29*(3), 303-313.

McDonald, & Siegall, M. (1992). The effects of technological self-efficacy and job focus on job performance, attitudes and withdrawal behaviors. *The Journal of Psychology*, *126*(5), 465-475.

McDougall, J. (2010). A crisis of professional identity: How primary teachers are coming to terms with changing views of literacy. *Teaching and Teacher Education*, *26*(3), 679-687.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017-1054.

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, *2*(3), 192-222.

Overbaugh, R., & Lu, R. (2008). The impact of a NCLB-EETT funded professional development program on teacher self-efficacy and resultant implementation. *Journal of Research on Technology in Education*, *41*(1), 43-61.

Pajares, F. (1996). Self-efficacy beliefs in academic settings. *Review of Educational Research*, *66*(4), 543-578.

Pegler, K., Kollewyn, J., & Crichton, S. (2010). Generational attitudes and teacher ICT use. *Journal of Technology and Teacher Education*, *18*(3), 443-458.

Phillips, J. M., & Vinten, S. A. (2010). Why clinical nurse educators adopt innovative teaching strategies: A pilot study. *Nursing Education Perspectives*, *31*(4), 226-229.

Plair, S. K. (2008). Revamping professional development for technology integration and fluency. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *82*(2), 70-74.

Polly, D., & Hannafin, M. J. (2010). Reexamining technology's role in learner-centered professional development. *Educational Technology Research and Development*, *58*(5), 557-571.

Praxis: For Test Takers: Test Centers and Dates. (2015). Retrieved from http://www.ets.org/praxis/register/centers_dates

Rastogi, A., & Malhotra, S. (2013). ICT skills and attitude as determinants of ICT pedagogy integration. *European Academic Research*, *1*(3), 3012-318.

Reiser, R. A. (2001). A history of instructional design and technology: Part I: A history of instructional media. *Educational technology research and development*, *49*(1), 53-64.

Rheem, S. P., Long, S., & Dickey, J. (2001). A comparison of preservice, inservice, and non teacher education majors on technology confidence, ability, and use. *Proceedings of SITE 2001 Conference*, *2001*(1), 2414-2419.

Rogers, E. M. (2003). *Diffusion of innovations* (5 ed.) [Kindle version]. New York, NY: Free Press. Retrieved from Amazon.com

Ross, A., Hogaboam-Gray, A., & Hannay, L. (2001). Effects of teacher efficacy on computer skills and computer cognitions of Canadian students in grades K-3. *The Elementary School Journal*, *102*(2), 141-156.

Ross, J., & Bruce, C. (2007). Professional development effects on teacher efficacy: Results of randomized field trial. *Journal of Educational Research*, *101*(1), 50-60.

Ross, J. A., McKeiver, S., & Hogaboam-Gray, A. (1997). Fluctuations in teacher efficacy during implementation of destreaming. *Canadian Journal of Education*, *22*(3), 283-296.

Sang, G., Valcke, M., Braak, J. V., & Tondeur, J. (2010). Student teachers' thinking processes and ICT integration: Predictors of prospective teaching behaviors with educational technology. *Computers & Education*, *54*(1), 103-112.

Sheingold, K., & Hadley, M. (1990). *Accomplished teachers: Integrating computers into classroom practice*. New York, NY: Center for Technology in Education.

Slavit, D., Sawyer, R., & Curley, J. (2003). Filling your PLATE: A professional development model for teaching with technology. *TechTrends*, *47*(4), 35-38.

So, H. J., Choi, H., Lim, W. Y., & Xiong, Y. (2012). Little experience with ICT: Are they really the Net Generation student-teachers? *Computers & Education*, *59*(4), 1234-1245.

Stevens, T., To, Y., Harris, G., & Dwyer, J. (2008). The LOGO project: Designing an effective continuing education program for teachers. *Journal of Computers in* Mathematics and Science Teaching, 27(2), 195-219.

Straub, E. T. (2009). Understanding technology adoption: Theory and future directions for informal learning. *Review of Educational Research*, *79*(2), 625-649.

Stuart, L. H., Mills, A. M., & Remus, U. (2009). School leaders, ICT competence and championing innovations. *Computers & Education*, *53*(3), 733-741.

Sugar, W. (2005). Instructional technologist as a coach: Impact of a situated professional development program on teachers' technology use. *Journal of Technology and Teacher Education*, *13*(4), 547-571.

Tabachnick, B. G., & Fidel, L. S. (2013). *Using multivariate statistics* (6th ed.). Boston, MA: Pearson.

Teclehaimanot, B., Mentzer, G., & Hickman, T. (2011). A mixed methods comparison of teacher education faculty perceptions of the integration of technology into their courses and student feedback on technology proficiency. *Journal of Technology and Teacher Education*, *19*(1), 5-21.

U.S. Bureau of Labor Statistics, U.S. Department of Labor. (2010). *Occupational Outlook Handbook, 2010-11 Library Edition,* Bulletin 2800. Retrieved from http://www.credentialwatch.org/occ/2010-11OOH.pdf

U.S. Department of Education, Office of Educational Technology. (2010). *Transforming American education: Learning powered by technology*. Retrieved from http://tech.ed.gov/wp-content/uploads/2013/10/netp2010.pdf

U.S. Department of Education (2015). *Funds for State Formula-Allocated and Selected Student Aid Programs.* Retrieved from http://www2.ed.gov/about/overview/budget/statetables/11stbystate.pdf

Voogt, J., Almekinders, M., van den Akker, J., & Moonen, B. (2005). A 'blended' in-service arrangement for classroom technology integration: Impacts on teachers and students. *Computers in Human Behavior*, *21*(3), 523-539.

Ward, L., & Parr, J. M. (2010). Revisiting and reframing use: Implications for the integration of ICT. *Computers & Education*, *54*(1), 113-122.

Wells, J. (2007). Key design factors in durable instructional technology professional development. *Journal of Technology and Teacher Education*, *15*(1), 101-122.

Wesley, S., Klem, L., & Reynolds, A. (1992). *A knowledge base for teacher licensure: A comparison of state requirements, professional association recommendations and teacher, teacher educator, and administrator opinions of teacher preparation on the principles of learning and teaching.* Princeton, NJ: Educational Testing Service.

Wright, V. H. (2010). Professional development and the master technology teacher: The evolution of one partnership. *Education*, *131*(1), 139-146.

Yamagata-Lynch, L. C. (2003). How a technology professional development program fits into teachers' work life. *Teaching and Teacher Education*, *19*(6), 591-607.

Youngs, P., Odden, A., & Porter, A. C. (2003). State policy related to teacher licensure. *Educational Policy*, *17*(2), 217-236.

Zhang, L., Wen, H., Li, D., Fu, Z., & Cui, S. (2010). E-learning adoption intention and its key influence factors based on innovation adoption theory. *Mathematical and Computer Modeling*, *51*(11), 1428-1432.

Zhao, Y., Pugh, K., Sheldon, S., & Byers, J. (2002). Conditions for classroom technology innovations. *The Teachers College Record*, *104*(3), 482-515.

Zogheib, S. (2015). Preservice teachers' computer use in single computer training courses; Relationships and predictions. *International Journal of Information and Communication Technology Education*, *11*(3), 77-89.

**Appendices**

**Appendix A – Implied Informed Consent Form for Educational Research**

Implied Informed Consent Form for Educational Research – Exempt Study
University of Arkansas
Title of Project: The Relationship Between Teacher Basic Technology Competence, Technology Self-Efficacy and Perceived Characteristics of Using iPads and Educational Applications for Classrooms

**Principal Investigator:** Rebecca A. Martindale
[redacted]

**Advisor:** Barbara Gartin
[redacted]

1. **Purpose of the Study:** The purpose of this research is to understand factors related to adopting iPads and educational applications with per-service teachers.
2. **Procedures to be followed:** You will be asked to fill out the following questionnaire about your perceived feelings, abilities and attitudes towards various technologies.
3. **Duration/Time:** This survey will take approximately 10-15 minutes to complete.
4. **Statement of Confidentiality:** Your participation in this research is confidential. Data collection methods do not ask for any information that would identify who the responses belong to. The University of Arkansas Institutional Review Board may review records related to this research study In the event of any publication or presentation resulting from the research, no personally identifiable information will be collected and your name is in no way linked to your responses.
5. **Right to Ask Questions:** Please contact Rebecca Martindale at ([redacted]) [redacted]-[redacted] with questions or concerns about this study. If you have questions about your rights as a participant in this research, please contact [redacted], IRB Compliance Officer, at ([redacted]) [redacted]-[redacted] or [redacted].
6. **Voluntary Participation:** Your decision to be in this research is voluntary. You can stop at any time.

By completing this survey you imply that you have read the information in this form and consent to take part in the research. Please keep this form for your records or future reference. To begin the surveys please turn the page.

**Appendix B – Sample request to faculty to participate in dissertation research**

Sample request to faculty to participate in dissertation research e-Mail request. Each request was customized to the professor and provided the class number and title.

Example Letter:

Dr. [redacted],

I know you may have worked with me as a colleague here in the College of Education and Health Professions in the past. However, I am writing you today as a student here at the U of A working on completing my dissertation in pursuit of a Ph.D. in Curriculum and Instruction.

I need to ask for your assistance with collecting data for my research. I need to collect survey data from 200 students for my analysis. I am wondering if you could assist me by allowing me to take 15 minutes of your class time to ask your students to participate in my study. I would like to take that time to briefly tell the students about the survey and allow them to fill it out in class if they are willing to participate. As a token of my appreciation to your students I will come bearing snacks.

I would like to come to one or both of your classes listed below with your permission. If time permits you to assist me with this request please indicate what date and time would be best. I'll be glad to come at any time during your class period. If your rooms and locations have changed please let me know.

I would like to collect my data by the end of April if that fits with your schedule. If this is something you do not feel you can accommodate due to resource constraints, etc. please know that I completely understand. However, I would be truly grateful if you could assist me with collecting data for my research.

CIED 3033 004 Classroom Learning Theory
Mon, Wed, Fri 8:35 AM - 9:25 AM

My research focuses on factors that influence technology integration with respect to adopting educational applications on iPads for future classroom use by pre-service teachers. If you would like to ask questions regarding my research please feel free to contact me or my committee members below:

Barbara Gartin [redacted]
Cheryl Murphy [redacted]
Felicia Lincoln [redacted]
Wen-Juo Lo [redacted]

Thanks for your consideration in this matter.
Rebecca

## Appendix C – IRB approval

UNIVERSITY OF ARKANSAS

Office of Research Compliance
Institutional Review Board

April 9, 2015

MEMORANDUM

| | |
|---|---|
| TO: | Rebecca Martindale<br>Barbara Gartin |
| FROM: | Ro Windwalker<br>IRB Coordinator |
| RE: | New Protocol Approval |
| IRB Protocol #: | 15-03-640 |
| Protocol Title: | *The Relationship between Pre-Service Teachers' Basic Technology Competence, Technology Self-Efficacy and Perceptions of Adoption Educational Apps on iPads for Classroom Use* |
| Review Type: | ☒ EXEMPT ☐ EXPEDITED ☐ FULL IRB |
| Approved Project Period: | Start Date: 04/09/2015 Expiration Date: 04/08/2016 |

Your protocol has been approved by the IRB. Protocols are approved for a maximum period of one year. If you wish to continue the project past the approved project period (see above), you must submit a request, using the form *Continuing Review for IRB Approved Projects*, prior to the expiration date. This form is available from the IRB Coordinator or on the Research Compliance website [redacted]). As a courtesy, you will be sent a reminder two months in advance of that date. However, failure to receive a reminder does not negate your obligation to make the request in sufficient time for review and approval. Federal regulations prohibit retroactive approval of continuation. Failure to receive approval to continue the project prior to the expiration date will result in Termination of the protocol approval. The IRB Coordinator can give you guidance on submission times.

**This protocol has been approved for 200 participants.** If you wish to make *any* modifications in the approved protocol, including enrolling more than this number, you must seek approval *prior to* implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

If you have questions or need any assistance from the IRB, please contact me at 109 MLKG [redacted]

109 MLKG • 1 University of Arkansas • Fayetteville, AR 72701-1201 • (479) 575-2208 • Fax (479) 575-6527 • Email irb@uark.edu

## IRB Official Stamp

**Implied Informed Consent Form for Educational Research – Exempt Study**

University of Arkansas

**Title of Project: The Relationship Between Teacher Basic Technology Competence, Technology Self-Efficacy and Perceived Characteristics of Using Educational Apps on iPads for Classrooms**

**Principal Investigator:** Rebecca A. Martindale
[redacted]

**Advisor:** Barbara Gartin
[redacted]

**1. Purpose of the Study:** The purpose of this research is to understand factors related to adopting educational applications on iPads with pre-service teachers.

**2. Procedures to be followed:** You will be asked to fill out the following questionnaire about your perceived feelings, abilities and attitudes towards various technologies.

**3. Duration/Time:** This survey will take approximately 10-15 minutes to complete.

**4. Statement of Confidentiality:** Your participation in this research is confidential. Data collection methods do not ask for any information that would identify who the responses belong to. The University of Arkansas Institutional Review Board may review records related to this research study In the event of any publication or presentation resulting from the research, no personally identifiable information will be collected and your name is in no way linked to your responses.

**5. Right to Ask Questions:** Please contact Rebecca Martindale a[redacted]4 with questions or concerns about this study. If you have questions about your rights as a participant in this research, please contact [redacted] Compliance Officer, at [redacted].

**6. Voluntary Participation:** Your decision to be in this research is voluntary. You can stop at any time.

By completing this survey you imply that you have read the information in this form and consent to take part in the research. Please keep this form for your records or future reference. To begin the surveys please turn the page.

- ☐ I agree to be a part of this research study.
- ☐ I have already participated in this research study in another class.
- ☐ I am choosing to not participate by opting-out of this research study.

IRB #15-03-640
Approved: 04/09/2015
Expires: 04/08/2016

**IRB Modification**

UNIVERSITY OF ARKANSAS

Office of Research Compliance

July 31, 2015

MEMORANDUM

TO: Rebecca Martindale
Barbara Gartin

FROM: Rosemary H. Ruff
Director, Research Compliance

RE: Protocol Modification Approval

IRB Protocol #: 15-03-640

Protocol Title: The Relationship between Pre-Service Teachers' Basic Technology Competence, Technology Self-Efficacy and Perceptions of Adopting Educational Apps on iPads for Classroom Use

Approved Project Period: Start Date: 04/09/2015 Expiration Date: 04/08/2016

Your protocol modification request has been approved by the IRB. You are now approved for a maximum of 300 participants. Because your project qualified for Exempt status, the requirement for prior approval has been waived for one time only. If you wish to enroll more than this number, or make any other changes to your protocol, please seek approval prior to initiating such changes.

If you have questions or need any assistance from the IRB, please contact [redacted]

109 MLKG • 1 University of Arkansas • Fayetteville, AR 72701-1201 • 479-575-4572 • Fax: 479-575-6527 • http://rscp.uark.edu

## Appendix D – Perceived Characteristics of Innovating Survey Instrument

Imagine that you are now a teacher working in your field and your school has decided to go to a 1-to-1 iPad and educational app initiative. For each of the statements below choose the answer that reflects your feelings about the newly introduced technologies to your classroom.

| | Extremely Disagree | Strongly Disagree | Disagree | Neither Agree or Disagree | Agree | Strongly Agree | Extremely Agree |
|---|---|---|---|---|---|---|---|
| My boss will *not* require me to use educational apps on iPads. | | | | | | | |
| Although it might be helpful, using educational apps on iPads will certainly not be compulsory/required in my job. | | | | | | | |
| Using educational apps on iPads will enable me to accomplish tasks more quickly. | | | | | | | |
| Using educational apps on iPads will improve the quality of the work I do. | | | | | | | |
| Using educational apps on iPads will make it easier to do my job. | | | | | | | |
| Using educational apps on iPads will enhance my effectiveness on the job. | | | | | | | |
| Using educational apps on iPads will give me greater control over my work. | | | | | | | |
| Using educational apps on iPads will be compatible with all aspects of my work. | | | | | | | |
| I think that using educational apps on iPads will fit well with the way I like to work. | | | | | | | |
| Using educational apps on iPads will fit into my work style. | | | | | | | |
| People in my organization who use educational apps on iPads will have more prestige than those who do not. | | | | | | | |
| People in my organization who use educational apps on iPads will have a high profile. | | | | | | | |
| Having educational apps on iPads will be a status symbol in my organization. | | | | | | | |
| I believe that it will be easy to get educational apps on iPads to do what I want them to do. | | | | | | | |
| Overall, I believe that educational apps on iPads will | | | | | | | |

| |
|---|
| be easy to use. |
| Learning to operate educational apps on iPads will be easy for me. |
| I would have no difficulty telling others about the results of using educational apps on iPads. |
| I believe I could communicate to others the consequences of using educational apps on iPads. |
| The results of using educational apps on iPads will be apparent to me. |
| I would have difficulty explaining why using educational apps on iPads may or may not be beneficial. |
| In my organization, on will see educational apps on iPads on many desks. |
| Educational apps on iPads will *not* be very visible in my organization. |
| Before deciding whether to use any educational apps on iPads, I will be able to properly try them out. |
| I will be permitted to use educational apps on iPads on a trial basis long enough to see what they can do. |

## Appendix E – Technology Self-Efficacy Survey Instrument

Often in our jobs we are told about technologies that are available to make work easier. For the following questions, imagine that you were given a new technology for some aspect of your work. It doesn't matter specifically what this technology does, only that it is intended to make your job easier and that you have never used it before.

The following questions ask you to indicate whether you could use this unfamiliar technology under a variety of conditions. For each condition, please indicate whether you think you would be able to complete the job using the technology. On each line make an X on a number from 0-10, where 0 indicates "Not confident at all", 5 indicates "Moderately Confident" and 10 indicates "Totally Confident".

| I would be able to complete my teaching job using the new technology… | Not Confident at All | | | | Moderately Confident | | | | Totally Confident | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| …If there was no one around to tell me what to do as I go. | | | | | | | | | | | |
| …If I had never used a technology like it before. | | | | | | | | | | | |
| … If I had only the technology manuals for reference. | | | | | | | | | | | |
| … If I had seen someone else using it before trying myself. | | | | | | | | | | | |
| … If I could call someone for help if I got stuck. | | | | | | | | | | | |
| … If someone else had helped me get started. | | | | | | | | | | | |
| … If I had a lot of time to complete the job for which the technology was provided. | | | | | | | | | | | |
| … If I had just the built-in help facility for assistance. | | | | | | | | | | | |
| … If someone showed me how to do it first. | | | | | | | | | | | |
| … If I had used similar technologies before this one to do the same job. | | | | | | | | | | | |

## Appendix F – Technology Competence Survey Instrument

Please choose the best answer for each statement below that you feel reflects your current level of technology competency. Competencies are defined as:

**Not Competent** individuals cannot complete the task
**Somewhat Competent** individuals can perform the task with some assistance
**Competent** individuals can complete the task without assistance
**Very Competent** individuals can teach others how to perform the task

| | Not Competent | Somewhat Competent | Competent | Very Competent |
|---|---|---|---|---|
| Basic Computer Operation Skills | | | | |
| Insert and eject external USB drive | | | | |
| Store files in a folder or sub-directory | | | | |
| Access information on a CD-ROM, external USB drive and hard drives | | | | |
| Create and delete folders or sub-directories | | | | |
| Overall rating of your basic computer operation skills | | | | |
| Setup, Maintenance, and Troubleshooting Equipment | | | | |
| Protection of USB drives | | | | |
| Virus Protection | | | | |
| Connecting peripheral devices | | | | |
| Managing memory | | | | |
| Overall rating of your setup, maintenance and troubleshooting equipment skills | | | | |
| Word Processing | | | | |
| Set margins | | | | |
| Change font size and type | | | | |
| Cut, copy, and paste in and between documents | | | | |
| Insert files, graphics, and tables in a document | | | | |
| Overall rating of your Word processing skills | | | | |
| Spreadsheets | | | | |
| Enter data in cells | | | | |
| Move data within a spreadsheet | | | | |
| Use formulas | | | | |
| Create Charts | | | | |
| Overall rating of your spreadsheet management ability | | | | |
| Databases | | | | |
| Enter data into a database | | | | |
| Sort and search in a database | | | | |
| Produce a report in a database | | | | |
| Create queries using “and” and “or” | | | | |
| Overall rating of your competencies using a database | | | | |

Please choose the best answer for each statement below that you feel reflects your current level of technology competency. Competencies are defined as:

**Not Competent** individuals cannot complete the task
**Somewhat Competent** individuals can perform the task with some assistance
**Competent** individuals can complete the task without assistance
**Very Competent** individuals can teach others how to perform the task

| | Not Competent | Somewhat Competent | Competent | Very Competent |
|---|---|---|---|---|
| Networking | | | | |
| Logging on a network | | | | |
| Working in a network environment | | | | |
| Electronic file sharing | | | | |
| Knowledge of advantages of a server | | | | |
| Overall rating of your networking skills | | | | |
| Telecommunications | | | | |
| Send and receive eMail | | | | |
| Navigate the World Wide Web/ Internet | | | | |
| Subscribe to a list-serve | | | | |
| Develop programs using authoring system or language (example: HTML is an authoring language for developing websites) | | | | |
| Overall rating of your telecommunication skills | | | | |
| Media Communication | | | | |
| Use an overhead projector | | | | |
| Develop an electronic slideshow | | | | |
| Develop an interactive electronic slideshow | | | | |
| Develop a presentation using graphics and sound | | | | |
| Overall rating of your media communication skills | | | | |
| Social, Legal and Ethical Issues | | | | |
| Knowledge of copyright laws | | | | |
| Knowledge concerning shareware | | | | |
| Knowledge of software privacy | | | | |
| Knowledge of intellectual property rights | | | | |
| Overall rating of your social, legal and ethical issues skills | | | | |

## Appendix G – Demographic Questions for Survey

The below questions are asked simply to identify the population taking this survey overall. None of the information asked below can be used to identify you as an individual.

What is your current declared major:
AGED: Agricultural Education
ARED: Art Education
CATE: Career and Technical Education
CHED: Childhood Education
ELED: Elementary Education
MUED: Music Education
PHED: Physical Education
SPED: Special Education
VOED: Vocational Education
Other: ________________________________________

Ethnicity:
Asian
African American
American Indian or Alaska Native
Caucasian
Hawaiian or Pacific Islander
Hispanic and any other race
Non-Resident Alien
Two or more races
Unknown

Gender:
Male
Female

Age:
Please provide your current age in years
**Write Your Age Here>>**__________________