2012

Technology Use in Higher Education Instruction

Sammy Elzarka
Claremont Graduate University

DOI: 10.5642/cguetd/39

Technology Use in Higher Education Instruction

By

Sammy Elzarka

Claremont Graduate University

2012

APPROVAL OF THE REVIEW COMMITTEE

This dissertation has been duly read, reviewed, and critiqued by the Committee listed below, which hereby approves the manuscript of Sammy Elzarka as fulfilling the scope and quality requirements for meriting the degree of PhD.

Dr. David Drew, Chair
Claremont Graduate University
Professor

Dr. Mary Poplin
Claremont Graduate University
Professor

Dr. Carl Cohn
Claremont Graduate University
Professor

Abstract

Technology Use in Higher Education Instruction

by

Sammy Elzarka

Claremont Graduate University: 2012

The significance of integrating technology use in higher education instruction is undeniable. The benefits include those related to access to instruction by underserved populations, adequately preparing students for future careers, capitalizing on best instructional practices, developing higher order thinking activities, and engaging students whose relationships with technology are increasingly native, among others. The significance of the current study is based on the fact that few prior studies focused on the factors that support, or inhibit, the use of educational technology by faculty in schools of education. The data collection instrument was a survey designed by the principal investigator based on review of the literature and professional experience. Five constructs were addressed by the survey: institutional policies, belief in the learning benefits, efficacy with integrating technology with content, barriers to technology use, and personal uses of technology. The survey was administered online and targeted 379 full and part time faculty in schools of education throughout the U.S. A total of 203 faculty members responded which was a response rate of 53%. Several path analyses were conducted to determine the variables that most related with the dependent variable, rate of technology adoption for professional instructional purposes. The variable that had the strongest relationship with the adoption rate for professional use was the adoption rate for personal use. This held true for all subgroups except part-time and older faculty. Suggestions for future research include the use of additional data sources to measure the variables described here. Study of the role of institutional policies in technology

adoption should consider administrator perspectives in addition to those of faculty. Study of learning benefits should consider students' views in addition to those of faculty. Finally, efficacy variables should consider perspectives of college leaders and administrators.

Acknowledgement

I would like to acknowledge my dissertation committee for the great contributions each member has made in my professional and educational growth. Dr. Drew, as my committee chair, provided me with patient guidance and wisdom throughout the research and data collection and analysis portions of the dissertation effort. His witty sense of humor provided much color to an otherwise stress-ridden experience. Dr. Poplin provided much needed insights into the operations of teacher education programs and school management. Her personable demeanor made her a joy to work with. Dr. Cohn provided lessons that only a seasoned leader could, both during class discussions and one to one advisement. I can only hope to aspire to the greatness exemplified by these education leaders.

Table of Contents

List of Tables

List of Figures

Chapter 1

Introduction

"Online alternatives to language classrooms open up to students" -- *The Guardian Weekly* 7/5/11

"Private schools unite to share courses online" -- *The Philadelphia Inquirer* 7/4/11

"Project lets K-12 students archive websites: Students create 'digital time capsule' reflecting internet in kids' daily lives" – *eSchool News* 7/4/11

"Homework Help Site Has a Social Networking Twist" -- *The New York Times* 7/3/11

"N.C. district cuts summer school budget with online-only approach" -- *The News & Record (Greensboro, N.C.)* 7/3/11

"Expert: A tech-savvy teacher can grab students' attention" -- *Duluth News Tribune (Minn.)* 6/29/11

"ISTE take-home message #2: The flipped classroom makes sense" -- *ZNET.com* 7/7/11

Education technology is an ever-growing area in education policy-making, professional development, and daily practices. As indicated by the headlines above, most published within a one-month period, technological innovations in education are dynamic. While advancements like these are not new to education, the speed, reach and implication of current innovations are. The abilities to interact, collaborate, challenge, engage and connect have reached new heights and continue to branch to even more unusual possibilities.

According to the most recent data published by the Pew Research Center (2011), use of technology in education has reached staggering levels. The following are relevant data points:

- 89% of four-year public universities offer online courses; the rate is 60% for four-year private universities;
- 50% of college presidents predict that in 10 years, most students will have taken courses online;
- 62% of college presidents predict that in 10 years, more than half of the textbooks used will be digital;

- 57% of college graduates have used a smartphone, laptop or tablet to some degree during class; most institutions do not have clear policies regarding use of such gadgets; for most institutions, it is up to the individual instructors to manage such uses. (Taylor, Parker, Lenhart, & Patten, 2011, pp. 1-2)

As new generations of people are exposed to advanced technologies, their applications in educational settings also grow. This diffusion of technology requires well-trained and technologically versatile faculty and school staffs to support this growing demand. This study will examine such methods of communication, training, professional development with the goal of encouraging the effective use of technology for instructional purposes. The research question is: What are the variables that most impact the use of education technologies for instructional purposes in higher education? The research question has been dissected into sub-elements, described in chapter three. This research question was applied to the entire sample as well as subgroups based on gender, full/part – time status, tenure status, and age.

Statement of Problem

Salman Khan has refined an innovation that has been practiced for decades. Known as "classroom flipping", this innovation uses advanced technology to deliver classroom lectures at home and allows for classroom time to be used for application and information processing (Thompson, 2011). The challenge, however, is determining strategies to permeate the use of such technologies into mainstream education to improve engagement and learning. An additional challenge is that the current uses of such technologies are far from student-centered.

Shana (2009) examined the experiences students have with online distance learning programs and use of educational technologies. Of special import was measuring student attitudes toward online teaching. Many of their participants were unfamiliar with constructivist learning which was key in the research design. Shana (2009) found that discussion board activities must be learner-centered and linear type learning must be carefully designed and implemented for high engagement. Additionally, Shana (2009) observed the need for complete resource offerings online. For example, course syllabi, study guides, activity expectations, among others, should be well-organized and accessible to the *digital native* students. Similarly, Razzeq and Heffernan (2009) examined the differences in learning using educational technology compared with traditional methods. The emphasis here, however, was on treatment of homework assignments. Using a counterbalance experimental design, Razzeq and Heffernan (2009) found that the online homework group showed higher gains in learning than the paper-pencil homework group. Additionally, engagement was also higher with the online group. Since the online program used in this study was designed to be tutor-based and aligned with learning theories, it would be instructive to explore these tutor designs further.

Chuang and Chen (2009) also studied the use of computer technology for instructional purposes. Using an experimental design, they examined the merits of computer-assisted instruction (CAI) as compared with computer-based video games designed to promote learning. They found that the video game activities produced better results than the CAI activities in the areas of recall, strategic skills, problem-solving and higher level cognitive processes. No significant difference was found with judgment-related tasks such as identifying similarities and differences. Similar to the study by Razzeq and Heffernan (2009), deeper exploration of the designs of online instruction programs and the merits of their individual characteristics would be instructive.

An emphatic case for using and teaching educational technologies has been made by both Aworuwa, Worrell, and Smaldino (2005) and Smith and Robinson (2003). While varying reasons were described, both studies identified the need for teacher preparatory programs to work harder to meet minimum technology standards. Several technology-based strategies were found to be effective as an alternative to field experience placements as well as in tapping into students' strengths and learning styles (Aworuwa et al., 2005). Smith and Robinson (2003) discussed the risks assumed by teacher preparatory program of not deeply integrating technology uses. Technology competent and eager teachers and teacher candidates who do not find support and encouragement may leave teaching altogether for more technology─supportive fields. For other teacher candidates, it was found that they became frustrated with their lack of technology skills and the faculty's. Successful integration of technology requires collaboration, rapport building and development of self-efficacy (Smith & Robinson, 2003). Additionally, partnerships among teacher preparatory programs and K-12 schools should be cognizant of these characteristics (Aworuwa et al., 2005).

Bybee and Starkweather (2006) argue for the imperative need to address future workforce needs. Similar to Manning and Carpenter (2008), they identify global competitiveness as a major impetus for improving technology use and training for grade school students. Similar arguments can be made about those in higher education. Teacher preparatory programs have an integral role in facilitating such innovation application. Bybee and Starkweather (2006) indicate that quality teaching will rely more heavily on advancements of technology proficiency. Additionally, Manning and Carpenter (2008) describe the need for teacher preparatory programs to integrate technology use and instruction deeply throughout, rather than isolate them in one or two courses. Higher education accreditation also holds high standards in technology instruction (National Council for Accreditation of Teacher Education, 2001). Competencies such as problem-solving, ability to reason, and critical evaluation are especially important for technology use and instruction (Bybee & Starkweather, 2006).

Statement of Significance

The study of educational technology is significant for several reasons. It has been well-established, as described in the next chapter, that use of current technologies for instructional purposes has great impact on the following: student engagement, learning styles, student-faculty interactions, faculty satisfaction, demands for technology use as well as learning outcomes. These themes as well as the conceptual framework are discussed below.

The significance of Diffusion of Innovation (DOI) in higher education instruction has been established by many studies examining a variety of dependent variables. These variables include academic performance, cost, satisfaction, among others. Two such studies are described here and both used the meta-analysis methodology. The first, by Means, Toyama, Murphy, Bakia and Jones (2009), was published by the U.S. Department of Education. The purpose of this study was to determine the extent to which online or technology-based methods were used to deliver classroom instruction. While the intent of this meta-analysis was to focus on K-12 instruction, too few studies met the criteria for inclusion. Therefore, several studies examining higher education instruction were included. The findings of this study clearly indicate the importance of this type of research. Instruction that combined online with face-to-face methods produced better academic performance than that which was purely online or purely face-to-face. While this was the most important finding in this study, other findings added value. For example, Means et al. (2009) also found that the specific tools used as part of online instruction did not produce variations in outcomes. While the inclusion criteria included studies that examined web-based tools, the specific characteristics or manufacturers of these tools had little impact. Means et al. (2009) described the need to improve our understanding of education technologies and how to promote their use.

Projections for demand of technology-competent instructors at all levels are staggering. The authors suggest that web-based forms of instruction will grow at rates far beyond all other technology advancements of the past (televisions, audio recording, among others). Birch, Greenfield, Janke, Schaeffer, and Woods (2008) describe the importance of technology-based information literacy with reference to national accreditation standards. Among the six National Council on Accreditation of Teacher Education standards, four delineate technology competencies (NCATE, 2002). These include locating, evaluating and using technology─derived information, the integration in planning and delivery of meaningful technology in instruction, and use of technology-based professional development. Birch et al. (2008) identified the requisite technology instruction in teacher preparation programs to elicit such meaningful technology in K-12 classrooms. Additionally, when shifting to a technology-intense preparation program, teacher candidates' skills evolved from retrieve and read to sophisticated uses of technology and information literacy (Birch et al., 2008).

Shoffner (2009) describes the imperative for teacher preparation programs to provide training in uses of education technologies. This must be achieved at multiple levels, including academic, personal and pedogagic levels of technology use. The benefits include opportunities for reflective thinking and expression, as well as engagement with peers (Shoffner, 2009).

The academic challenges of using education technologies include assessment and advising. The strengths are training, support, instructional designs, student satisfaction, student completion, and student retention. Regarding training, 53% of higher education institutions (HEI's) mandate technology training. The average duration of such trainings is 27 hours (Green, 2009). Recent growth in uses of educational technology indicates a 37% to 65% rise in recent years (Means et al., 2009). Zhao, Alexander, Perreault, Waldman, and Truell (2009) have indicated that 52% of public universities and colleges use two-way audio and video technologies as part of their instructional programs. In their study, it was clear that students found such technologies as productivity enhancers.

Archambault and Crippen (2009) have profiled the differences between those who teach through online means and traditional means. Among the many benefits identified by online teachers, student honesty was primary. These teachers described the lack of face-to-face interaction as lending to more openeness by students. Similar to Razzeq and Heffernan (2009), Archambault and Crippen (2009) also observed that teachers who had strong grasps of their instructional content made an easier transition to use of online technologies for teaching.

Projections of demand for online teaching are staggering. By 2019, it is expected that 50% of all high school courses will be offered online (Archambault & Crippen, 2009). Additionally, Means et al. (2009) have found that particular types of knowledge are better learned through online delivery methods. For example, declarative knowledge outcomes were better with online learning methods. Also, the authors described asynchronous discourse as more conducive to self-reflection and deeper thinking.

Over 60% of HEI's have reorganized, or plan to reorganize, IT units within two years. While the demand for innovative, instruction-focused technologies continues to rise, the demand for computer labs is declining. Use of e-portfolios has increased from 22% in 2004 to 43% in 2009 of higher education institutions. Additionally, 70% of HEI's believe e-textbooks will be an important part of technology planning within five years. Use of learning management systems is approaching 60% of HEI's. The availability of wireless classrooms approaches 80% (Green, 2009). Lee and Rha (2009) describe the educational technology movement as an important paradigm shift.

Often, use of educational technology tools involves distance between instructor and learner. This spatial separation is a difficult concept for those trained to use traditional pedagogy. Lee and Rha (2009) advance the concept that a well-structured and cohesive online program can compensate for this spatial distance. This is especially true with skills based on understanding, memorization, and recall of ideas without analysis. With critical thinking challenges, however, such compensation has not been observed (Lee & Rha, 2009). They suggest deeper research on the nature of the interaction structure as related to achievement.

An additional study examining the significance of DOI was conducted by Shacher and Neumann (2010). This was a meta analysis of studies published between 1991 and 2009. The focus was on distance education (DE) in higher education. The authors attempted to measure students' attitudes toward DE, student-instructor interactions, student learning outcomes, and faculty satisfaction. Their findings were based on comparisons between DE students and those in face-to-face settings. DE students were found to outperform those in face-to-face classrooms on learning outcome measures. The authors predict this gap in performance will widen over time. The basis for this prediction is the evaluation of the innovations currently available. DE strategies of the past were more limiting, pedagogically, than those based on the interactive and collaborative capabilities of current technology advancements. Shacher and Neumann (2010) suggest that future research focus on the various delivery models (synchronous vs. asynchronous) and whether differences exist among particular disciplines.

The top two most important issues in IT are network upgrades and financing. The next three issues include distance education instructional integration and user support. Distance education is a priority because of rising enrollments and the new role of IT in the infrastructure of online instructional programs (Green, 2009). Paechter, Maier, and Macher (2009) explored the views of students toward e-learning with instruments measuring attitudes and achievement. While achievement was self-reported, they did find a correlation of r=0.6 between self perceived achievement and actual achievement. Success factors regarding e-learning were more pedagogy─related than technology driven. Also important were the needs for autonomy, mastery and purpose of e-learning activities. Paechter et al. (2009) suggest that highly structured technology training for instructors will allow the benefits to manifest.

The trend toward globalization of all industries, including higher education, warrants thought and planning in the area of technology-driven, distance education. Competition among higher education institutions, revenue sources, and relevance for digital natives are all factors that demand education technologies. Cultural characteristics, at the macro, societal level, as well as the micro, institution level also place demand on faculty to adapt to current methods for communication and relating with others. Among the micro adaptations is the need to match the advancements in the administrative services with curriculum delivery at an institution (Sadykova & Dautermann, 2006). While Martinez, Liu, Watson and Bichelmeyer (2006) agree with Sadykova and Dautermann (2006) regarding the significant factors of use of education technologies, they make one addition. The reputation of the institution was identified as important and defined as providing innovative research and development opportunities for both faculty and students.

The availability of computers in classrooms has increased four-fold within the past decade. Classroom technologies have been focused on easing teacher workload such as through use of online assessments and record-keeping. To capitalize on the positive impact such technologies can have on student achievement, they must be authentically integrated into daily instruction (Kopcha, 2010). In 2005, nearly all large higher education institutions offered some online course delivery. Enrollment in online courses has been on a sharp incline since. It is suspected that institution size is an important factor in the effective use of education technology (Chen, 2005). While Saeed, Yang, and Sinnappan (2009) examined the role of learning styles in achievement, they found technology preferences as having a much greater impact. They suggest that current students are far more flexible with learning styles than those of the past. Since the focus of their study was students in IT fields, they suggest examining similar variables in non-science-based disciplines.

Foulger and Williams (2007) have been critical of teacher preparation programs for addressing technology standards in a single, stand-alone course. Rather, they advocate a more integrated design where technology has an integral role in delivering core content. They also identified the importance of collaboration in maintaining effective use of new technology practices. Similarly, Nicholas and Ng (2009) examined engagement, collaboration and learning within online environments. They used a mixed methods design and found that the relationship with the instructor was pivotal in successful online learning experiences. As facilitators, instructors can create a spotlight venue for students which increases motivation and engagement. This involves the expectation that student artifacts will be made, at least partially, public. Nichols and Ng (2009) suggest that students be given opportunities to explore education technology tools to make transitions in learning methods more successful. Santilli and Beck (2005) have found that faculty who have embraced use of education technologies laud their abilities to create student communities and opportunities to provide meaningful feedback. They suggest examining similar variables within all sub-disciplines of education. Peluchette and Rust (2005) indicate the need to further study the technology preferences of faculty and how those lead to more effective adoption.

It is clear through these studies that DOI is a critical component of education reform and the future trends of education culture in the U.S. This research endeavor will attempt to contribute to the DOI body of knowledge by examining strategies that are most successful in recruiting faculty participation in innovative instructional models. This will provide clear strategies for training, compliance, and professional growth in DOI. A faculty engaged in DOI will enhance students' engagement, thus better preparing them for future professional demands. The research question for the current study is: What are the variables that most impact the use of education technologies for instructional purposes in higher education?

To assist in understanding the terminology and reference to the conceptual models, a list of definitions has been provide:

Glossary

The current study examined the use of terminology specific to the conceptual framework as well as to technology tools used for educational purposes. To enhance clarity, below are definitions of key terms referenced throughout this study:

personal use of technology – use of any technology tools for personal reasons; such tools might include personal uses of email, social media, sharing of photos and videos with friends and family, etc.

learning benefits – the benefits of using education technology tools regarding student learning; measurement of these variables are based on faculty's self-reported beliefs

efficacy – the self-reported competency of faculty members regarding teaching of discipline content and the use of technology for instructional purposes

institutional policy – policies of institutions related to the use of education technologies; examples include training, professional development, rewards, workload management, among others

barriers – factors that inhibit the use of education technologies

education technology – the instructional uses of technology tools; these can include software, hardware, web-based resources; examples are podcasts, laptops, netbooks, smartphones, tablet computers, course management systems, learning management systems, among others *exogenous variable* – in path analysis, these variables have impacts on other variables but are not impacts by any; these variables send arrows while not receiving any

endogenous variable – in path analysis, these variables are impacted by other variables in the path model; these variables receive arrows;

intermediate endogenous variable – these variables help measure indirect relationships in path analysis; they are both impacted by some variables in the model while impacting others in the model; these variables receive and send arrows

mobile technology – any technology tool that is portable; examples are laptops, tablets, smartphones, among others

LMS – learning management system

CMS – course management system

adopter rate – the rate at which a user adopts newly released technologies;

DOI – diffusion of innovation; this is the theoretical framework in the current study

blog – a website on which an individual or group of users record opinions, information, etc. on a regular basis

wiki – a website developed collaboratively by a community of users, allowing any user to add and edit content

Chapter two will examine in more depth the body of knowledge on this topic. Specifically, research studies addressing the following factors will be analyzed: origins of the DOI framework, history of education technology use and development, training factors, technology adopter qualities, learning and teaching elements, and technology implementation strategies. Chapter three will describe the methodology used for the current study, including an overview of the conceptual model. Chapter four provides the results of the data collection and analysis efforts. Included are descriptive and inferential statistical analyses. The conceptual model described in chapter three is applied to the entire sample of the study as well as to various subgroups. Chapter five describes the implications of the findings from chapter four in accordance with the constructs of the study. The appendix includes the data collection instrument.

Chapter 2

Literature Review

Introduction

A review of prior studies and literature was conducted to help identify the emergent themes regarding the integration of technology use in higher education. The areas covered include the origins of the DOI framework, the history of technology use in education, training requirements and implicatrions, adopter qualities, learning benefits and teaching style, and implementation environments and strategies.

Origins of the Diffusion of Innovation Framework

Technological advancements in education have been vast, innovative and customer-oriented. While most education professionals would agree with this statement, virtually none would agree that the field has seen unanimous adoption of an innovation upon its release. This DOI has many elements and requirements. This paper will explore this DOI theoretical framework as well as its uses and advancement in many education contexts.

Everett Rogers founded the DOI concept five decades ago. While he founded this concept in an agricultural setting, the theory has been infused into many fields, including medicine, political science and education. There are four elements to the diffusion of Innovation (DOI) theoretical framework. These are the innovation, communication channels, time passage and the social system. The term innovation has been defined as an idea, practice or object that is perceived as new to a member or members of a social system. This term is often used synonymously with technology which is described as the design for an instrumental action that clarifies the relationship between cause and effect regarding a desired goal. Technology often has two components, hardware and software, and can often consist of clusters where multiple components are seen as closely related (Rogers, 2003).

Living on a midwestern farm, Rogers was interested in agricultural studies. He earned his bachelor's, master's, and PhD degrees from Iowa State University where there was an emphasis on rural sociology. Because there had been diffusion studies conducted by leaders there, Rogers was able to explore this framework with expert guidance. A primary research question examined the reasons that some farmers adopted innovations while others lagged, even if the advantages were indisputable. Studying this resistance was the crux of his graduate work (Baker & Singhal, 2005).

As Rogers' diffusion interests broadened, he delved into the dynamics of adoption in fields other than agriculture. Medical practices and education were included in this interest list. His work culminated in the 1962 version of the book Diffusion of Innovation. This text helped promote action research and broad improvements in many disciplines. It was immediately popular on the international stage. It is currently the second most cited text in social science (Baker & Singhal, 2005). This research work was accepted as authoritative in technology adoption studies. The current version of the text includes the massive impact by the internet on communication (Rogers, 2003).

Rogers held faculty positions in six large universities, earning several coveted awards for his pioneering research (Baker & Singhal, 2005).

Innovations have been described by Rogers (2003) as having five key characteristics. These are:

- Relative advantage – the degree to which an innovation is perceived as being superior to one that it replaced;

- Compatibility – the degree to which an innovation is perceived as being consistent with the existing values, experiences and needs of potential users;
- Complexity – the degree to which an innovation is perceived as being difficult to understand or use;
- Trialability – the degree to which an innovation may be experimented with; and
- Observability – the degree to which the results of an innovation are visible to others.

Understanding the factors that influence the rate of innovation adoption is critical to the DOI. Relative advantage and compatibility are viewed as being the most important of the characteristics to the rate of innovation adoption (Rogers, 2003).

Communication channels are used for the transmission of information about an innovation's value and use. Early adopters tend to be more explorative with innovations and therefore rely more on objective, scientific information about them. Late adopters however rely more on others and their subjective evaluations who have adopted an innovation. Potential adopters are more likely to trust such evaluations from those they see as similar to themselves, known as homophilous groups. However, in a social system, heterophily is required since those who are alike tend to have the same level of exposure and relationships with innovations (Rogers, 2003).

Time passage is required for DOI. The innovation-decision process is the process through which an individual passes from knowledge to the decision of whether to adopt or reject an innovation. The steps involved with this innovation-decision process are knowledge, persuasion, decision, implementation and confirmation. The process is driven by information-seeking and processing. These steps must happen in the sequence described for an adoption to remain

(Rogers, 2003). Without sufficient time passage, this process will be disrupted and is not sustainable. The ideal duration of time depends on a variety of factors.

The social system is the context within which innovation-decisions are made. Change agents are critical in this process since they promote such innovations and use many techniques to achieve DOI. There are three type of decisions that can be made:

- Optional innovation-decisions – innovation adoption choices made by an individual independent of others in the social system;
- Collective innovation decision – innovation adoption choices made by consensus where all in the social system conform; and
- Authority innovation-decisions – innovation adoption choices made by a few who have power or technical prowess to enforce and others in the social system cannot do much to change such a decision.

A fourth type of decision is called contingent and is an amalgam of two or three of the other types. As far as rate of adoption, authority-based decisions produce the fastest (Rogers, 2003).

The social system is also concerned with the consequences of innovation decisions. The following three type of consequences have been identified:

- Desirable-undesirable – dependent on functionality of innovation;
- Direct-indirect – dependent on whether the innovation's effect is first order or beyond; and
- Anticipated-unanticipated – dependent on whether the innovation's effect is intended.

These DOI elements have been studied and the theory advanced as a whole through research in a diversity of settings.

History of Technology Use in Education Practices

While some revolutions can be abrupt and pivotal, others are gradual and evolutionary. Technological advances in the field of education have roots thousands of years in history. Communication was primarily oral 2,500 years ago, wherein memorization was the only way to pass along knowledge and skills. The advent of written records caused concerns, even then, among scholars. A troubling question was whether the written record would diminish the need for human memory (Fahmy, 2004).

A second revolution within the education discipline was the formation of campus life where students and scholars share space and resources. This new education community led to campus infrastructure which supports scholarship in a variety of ways (Fahmy, 2004). This support has likely led to adoption of practices from other disciplines. For example, the use of hypertext technology in 1940 military training helped the advent of presentation technologies used in the 1950's. Through the 1970's and 1980's, telecourses have gained popularity as part of the distance learning movement. The new demands for higher education training and the diversification of the student population have been primary factors in this movement. Telecourses added television to the print media materials already used in correspondence courses. The populations served with this technological advancement include adult learners who cannot commit to campus life as well as those seeking enrichment as opposed to comprehensive degree programs.

While popular, these advancements had critics. Those who believe in the traditional classroom environment insisted that learning and scholarship would be compromised. Those espousing such critiques were overwhelmed by the students and other market demands for alternatives to the traditional learning system. An important challenge to higher education service providers posed as a question was (this question remains relevant today), "Will we use and control it, or will we ignore and lose it to other providers?" (Voegel, 1986, p.59). Also in the 1970's, computer-based instruction had started its journey. Again, with roots in military innovation, those computer-driven devices were used for instructional diagnoses and engagement (Educational Technology, 2011). Additional benefits of computer-driven instruction include test preparation, computer-adaptive testing for accurate diagnosis, and providing immediate learning feedback to students (Rounds, Kanter, & Blumin, 1987). Further, computer technology advancements have also allowed virtual conferencing where much collaboration work can be accomplished among people in different parts of the world (Southworth, Knezek & Flanigan, 2003). By the 1990's, the World Wide Web (WWW) had allowed for yet further advancements in technology use in education practices. In addition to computer-driven instruction, the WWW has allowed for computer-mediated instruction, as well. This allows the relationship between instructors and learners to remain direct while making use of the latest technologies to augment the learning experience (Educational Technology, 2011).

Additionally, the open-source information movement has been an integral aspect of DOI in education practices. This movement began in the 1970's when Richard Stallman, a researcher with MIT, requested the programming code to a printer from Xerox to fix a persistent paper jam problem. When Xerox firmly refused, Stallman became infuriated and began a free-open-source movement with his GNU Project, an open operating system. Mimicking the cultures of the scientific and higher education communities, he insisted on creating a transparent and collaborative environment in information technology. David Wiley built on the work of Stallman in the late 1990's by creating a system of learning objects. This allowed the integration of open-source capabilities into education scholarship (Wiley & Gurrell, 2009).

With such deep history, education technology is ever-evolving. It is difficult to identify a starting point of this innovation and it is clear we remain in the midst of further growth and possibilities. The next challenges in the use of education technologies include the need to maintain communities among people separated by large distances, minimizing cultural and generational gaps in knowledge and resources as well as ensuring scholarship quality and accountability.

Training Requirements and Implications

Samarawickerma and Stacey (2007) examined the adoption of learning management systems in a multi-campus university in Australia. Several elements of the diffusion of innovation (DOI) theoretical framework were explored. Also referenced was the actor-network theory. Six campuses were included with 22 participants chosen based on use of web-based approaches for on and off campus learners. While some participants had used web-based teaching tools prior to the study, the innovation was the tool used at this institution following a university-designed training protocol. Data sources included in-person interviews with participants, examination of teaching artifacts and field notes describing participants and their teaching materials. Of particular interest were university technology policies and the maintenance and support of technology resources.

The findings produced a profile of the impact of the university environment on faculty behavior. This profile included management of faculty time and workload, funding for the additional technology-related tasks and the propensity for learning new things. Within this framework, the authors concluded that university policies regarding technology use impacted faculty action. To facilitate technology adoption, such policies need to be adaptive, must address on-going needs for professional development, training and mentoring and must be driven by clear visions and expectations. Santilli and Beck (2005) set out to help identify creative reward systems to encourage the adoption of technology by graduate level faculty. Their participants were doctoral study faculty members using a common learning management system. A survey including both quantitative and qualitative items was used with all participants. They found that much of online course faculty's time was spent on question and answer sessions as well as on mediating online discussions among students. Among the benefits of online instruction identified by these faculty were student-to student interactions and the venue for providing feedback to students. The discussions boards built learning communities comprised and led by students. Santilli and Beck (2005) determined that the use of learning management system technologies help to focus on individual student needs. They suggest that future studies on this topic devote energy on matters of student work authenticity, learning assessment as well as examining faculty with more diverse backgrounds. Successful implementation of technology must be holistic, addressing issues regarding pedagogy, copyright, formative evaluation and learning approaches. Peer pressure was found to be important. Robust training increases user confidence which increases technology adoption (Samarawickerma and Stacey, 2007).

Bennett and Bennett (2003) explored characteristics of educational technology that impact faculty adoption. This was done through the design and deployment of a faculty training program aimed at encouraging use of the course management software (CMS). With this focus on improving DOI, the authors used surveys to collect data on several constructs. The findings suggest that the training program enhanced each of the constructs of interest including faculty's sense of technology efficacy, positive attitudes towards computers and plans to use computers to facilitate student learning.

As with Santilli and Beck (2005), Jones and Laffey (2000) identified the importance of training support and a rewards system to encourage the use of education technology. Their study included 16 MBA students and data were collected through observation and a series of surveys. The foci of this study were on the impact of collaborative technologies on student learning and factors promoting DOI. The authors suggest that collaborative technologies may help counter the individualistic environments that permeate higher education. Such tools might enhance organizational power as opposed to the abundant individual power. The authors also identify key requirements for DOI based on collaboration goals. These include a cooperative organizational culture, clear value and benefit of the new system, adequate training, system must be user-centered, support from users and top management, time for experimentation and adaptation as well as a reward system (Jones and Laffey, 2000).

Jones and Laffey (2000) produced a formulaic approach to measuring DOI, considering all key variables. These variables centered around Rogers' five characteristics of innovation. The authors also suggest that future researchers examine DOI differences among colleges within institution, majors and regions of the US. Also, future focus should delve more deeply into the impact of technology use on student learning.

Russell, Kleiman, Carey, and Douglas (2009) researched the impact of various support levels on the use and engagement by users. The focus of the content was on professional development of teachers in the area of math instruction. The participants were 231 middle school teachers of math. There were four groups; one was supported with a math instructor, online facilitator and peer interactions; a second group with only an online facilitator and peer interactions; a third with a math instructor and online facilitator and the fourth with no support. Data were collected through several surveys (background, pedagogy, and student), a math assessment, and teacher log and course evaluation. The core research question focused on whether the various supported levels affected teachers' mathematical understanding, pedagogical beliefs and instructional practices.

The findings were revealing. Pedagogical beliefs were significantly different in multiple areas between the pre and post conditions for all four groups. There were no differences among the four groups. The same was true for student survey responses and teacher logs. Zhoa, Alexander, Perreault, Waldman and Truell (2009) described the importance of technology adoption for distance learning programs. Their research goals were to provide guidance to administrators and instructors of distance learning programs on cost and effectiveness measures. They found that most faculty in the business department believe that use of the internet, online discussions, and voicemail services helped increased faculty productivity. The results from the student were largely in alignment with those of Russell et al. (2009), except for use of voicemail. Zhao et al. (2009) describe the need to treat current and emerging technologies differently from those of the past. The capabilities now possible are unprecedented and should be examined fully for effectiveness and efficiency measures. Russell et al. (2009) suggest that the participant recruitment strategy explains some of these results. Recruitment was based on volunteerism and the authors posit that only the highly motivated and skilled teachers stepped forward. Suggestions for future research include employing various recruitment strategies to account for this. Also suggested was the examination of online and in-person comparisons (Russell et al., 2009).

Adopter Qualities

Tabata and Johnsrud (2008) examined faculty attitudes toward distance education and the technology that supports it. DOI was used as the theoretical framework. Full and part-time

(N=4,534) faculty members were included representing 10 college campuses. These institutions included research universities, baccalaureate and community colleges. Surveys were the source of data and they included the following constructs: technology use, attitude toward technology, attitude toward distance education, and the adoption of innovation. Factor analysis was the primary analysis technique. Also used was regression analysis with participation in distance education used as a dependent variable. Demographic variables examined included race, gender, tenure, age and title. The survey response rate was 46%.

The findings of this study advance the cause of technology adoption. Barriers to such adoption include learning time, technology support, and impact of workload, which are congruent with Rogers' (2003) time passage element. An important outcome was the emphatic need to reward innovators and incorporate DOI matters into the tenure and promotion process. Cited was a 1998 NCES finding that email users spent 10% more time working than non-users of email. With the advances and plethora of technology tools since then, this added workload is sure to be much greater. Suggestions for future research might examine this item as well as researching how early technology adopters acquire their interest and skills (Tabata and Johnsrud, 2008).

Woodell and Garofoli (2002) contributed to the DOI body of literature with an important piece on Rogers' (2003) concept of early versus late adopters. This is summarized in the following table of characteristics:

Early Adopter	Early Majority
Favor revolutionary change	Favor evolutionary change
Visionary	Pragmatic
Project oriented	Process oriented
Risk takers	Risk averse

Willing to experiment	Want proven applications
Generally self-sufficient	May need significant support
Horizontally connected	Vertically connected

Additionally, the authors make an important distinction between early adopters and early majority adopters. Since each of these groups has different reasons for adopting an innovation, the implementation ("marketing") techniques must cater to the respective needs. This alternative approach might include a transition space, allowing the various adopters to integrate and collaborate. This would allow adopters to enter the adoption cycle at any point during the collaborative practice. This supports Rogers' (2003) time passage requirement. A suggestion for future research is to clarify the basis for adopting an innovation to better understand, and serve, user motives (Woodell and Garofoli, 2002).

Hansen and Salter (2001) studied adoption of web technology into mainstream teaching. This was a descriptive study focused on the need to use adopter-centric approaches to technology rather than the developer-centric approaches. The authors suggest this "bottom-up" approach produces more successful technology adoption practices, although the upfront time and effort required is greater. The user-centered method of adoption entails five steps:

1. Identify the potential adopter;
2. Measure the relevant potential adopter perceptions;
3. Design and develop a user-friendly product;
4. Inform the potential adopter (of the user-friendliness); and
5. Provide post-adoption support.

This user-centric approach is presented as one of two prongs required for successful adoption by teaching staffs. The second is related to the innovation-decision-making process. There are four such decisions as presented by the authors and as congruent with Rogers' (2003) decision types:

1. Optional innovation decisions – the choices made by individuals are independent of others;
2. Collective innovation decisions – the choices are decided by consensus and then adopted by all in that consensus;
3. Authority innovation decisions – choices made by a few with power and are then adopted by the whole; and
4. Contingent innovation decisions – choices made by one or more of the above, but only after a prior innovation decision.

These organizational level decision-making processes must be integrated with the user-centric characteristics described earlier to produce effective adoption and reduce discontinuance (or rejection) soon after adoption (Hansen and Salter, 2001).

Hug and Reese (2006) explored the adoption aspect of the DOI theory with a case study. A maverick teacher was the participant since she was assertive in her research and use of a drawing software program. The research goal was to illuminate how to best encourage the adoption of innovation by teachers. The authors identified the need for this research given the lack of literature on the underlying characteristics of Rogers' (2003) various adopters. The early versus late adopters have been described but not explained. Since this is a case study design, only the matter of innovation adoptions can be explored as opposed to innovation diffusion. Data were collected through analysis of communication between the participant and various audiences. The framework for this analysis was Rogers' (2003) innovation-decision process. Hug and Reese (2006) described this framework as follows:

- Knowledge - In this stage the individual is first exposed to an innovation but lacks information about the innovation. During this stage of the process the individual has not been inspired to find more information about the innovation;
- Persuasion - In this stage the individual is interested in the innovation and actively seeks information/detail about the innovation;
- Decision - In this stage the individual takes the concept of the innovation and weighs the advantages/disadvantages of using the innovation and decides whether to adopt or reject the innovation. Due to the individualistic nature of this stage Rogers notes that it is the most difficult stage to acquire empirical evidence;
- Implementation - In this stage the individual employs the innovation to a varying degree depending on the situation. During this stage the individual determines the usefulness of the innovation and may search for further information about it; and
- Confirmation - Although the name of this stage may be misleading, in this stage the individual finalizes their decision to continue using the innovation and may use the innovation to its fullest potential.

The authors found that the early adopter experienced stages of the above model in a compressed fashion. The participant in this study found relevant uses for the tool quickly and, therefore, did not hesitate to explore and eventually adopt it. A reason for this successful adoption experience is the participant's willingness to invest time into learning and using the new tool. The authors suggest that future research should focus on the methods for encouraging such engagement into new technologies.

Learning Benefits and Teaching Styles

Liao (2005) explored the impact of technology use on student learning and communication using the DOI model. The learning management system (LMS) program Angel was used and the data were collected through surveys. Survey items were clustered to address each of Rogers' (2003) five characteristics of innovation (relative advantage, compatibility, complexity, trialability and observability). The study participants were 196 graduate and undergraduate students majoring in communication in Western New York. Factor analysis was used to determine the most impactful of the innovation characteristics. Path analysis was used to determine important technology variables in the use of the LMS and technology-based interactions.

Liao (2005) found that student motivation was more related to LMS usage than learning styles. Similarly, Saeed et al. (2009) conducted an action research study to determine students' preferences for technology tools as well as learning styles. They hypothesized that learning style impacts preferred technology tools which then impacts achievement. The research problem they helped address with their study is the scant studies relating learning preferences and achievement. Since they explored a variety of technology tools, they were able to determine that there was little correlation between emerging technologies such as blog's, wikis, and podcasts and conventional technologies such as email and learning management systems. While many of the findings by Saeed et al. (2009) support those of Butler (2006), Saeed et al. (2009) found that students preferred both synchronous and asynchronous communication whereas Butler (2006) found preference for asynchronous only. Saeed et al. (2009) used students enrolled in a web programming course, therefore, they suggest the use of students in non-science-based courses or majors to further the knowledge of technology preferences. Of the five innovation characteristics, Liao (2005) found that simplicity (complexity) predicted usage best. When examining demographic variables, the author found years in school to be a better predictor of LMS use than age or technology competence. When treating student learning as the dependent variable, the author found that compatibility to be the strongest predictor. It was also found that learning was facilitated by interactions between students and content as well as instructors which the LMS promulgated (Liao, 2005).

Kilmon and Fagan (2007) examined the consequences that result from a decision to adopt an innovation. The design was a case study based on the DOI framework. This was appropriate given that the research questions were “why” in nature. The focus was on the use of course management software and this study used only adopters. Data were collected through semi-structured interviews with the adopting faculty members. These faculty members primarily used the hybrid teaching model, integrating in-person with online instruction. The findings suggest diverse reasoning for adoption. Most did so for practical and/or logistical reasons, citing the need to teach to students off-site or extend additional instructional support. Also, while the initial investment of time and effort was difficult, the pay-off was great. Three themes emerged through these interviews: 1) the course management system facilitates course organization, 2) the course management system improves communication when used as a supplement to classroom instruction and 3) the course management system is easy to use with minimal training and minimal need for technical support. While most adopters did not have to change their teaching styles, all had to be organized, including attention to detail and good written communication. Many adopters cited, as a benefit, the ability to engage students online in a way less possible in class. Passive learning is much easier in a classroom setting.

Since one of the goals of this study was to further the understanding of desirable and undesirable effects of innovation adoption, the authors focused on this with suggestions for future research. These are one of the consequence types included in Rogers' (2003) DOI model. The other types of consequences include direct vs. indirect, and anticipated vs. unanticipated. A follow-up suggestion was to examine the consequence of adoption in environments less favorable than that of this study (Kilmon and Fagan, 2007). For example, use of non-adopting faculty or a technology tool that is more complex might provide an important contrast to these findings.

Freeman, Bell, Comerton-Forde, Pickering, and Blayney (2007) looked at DOI using electronic response systems (ERS's). This was a case study examining the use of ERS's after a series of pilots on the devices. Data were collected through a combination of written exercises and interviews. Rogers' (2003) five characteristics of innovation were the basis of the data organization and participants were divided into academic and non-academic (administrative) user groups. Academic users reported increased job satisfaction when using the ERS's for the following reasons: more student engagement, better formative capabilities, and use of aggregated data to inform improvement of future courses. The authors also found that cultural compatability, complexity and relative advantage to be most important in the adoption decision. Additionally, teaching style must be considered to improve adoption rate. The example cited in this study was the comparison of a constructivist teacher versus the "sage on the stage", authoritative, style teacher. Each would have differing motives for and needs of instructional technology. The authors have deemed this to be such an important variable that it is the basis for the suggestion for future study.

Kebritchi (2008) conducted a case study on the factors that affect teachers' use of computer games. The author is addressing a research problem given the dearth of published studies on the use of computer games in the classroom setting. The sample used was purposeful including three math teachers with seven or more years of experience. Data were collected through interviews and the questions were based on Rogers' (2003) five characteristics of innovation.

The findings point to two critical elements required for successful adoption of computer game technology for instructional purposes. These are fun and alignment with the teachers' instructional methodologies. Fun is important for student engagement while integration is crucial for smooth transitions into and out of computer game activities. These critical elements will help users overcome the following cited problems with such educational technology: curriculum issues, time and purpose of game implementation, outcome issues, and technical issues.

Foulger and Williams (2007) identified a lack of deep integration of technology into teacher preparation programs. Rather than embedded throughout all instructional portions of such programs, they rely on a single course to teach the requisite knowledge and skills. To help address this gap, Foulger and Williams (2007) strove to pair instructors of technology with those teaching content areas. They describe the significance of organizational support in the adoption and integration of technology. For example, organization members can provide support, encouragement, challenges, and growth unavailable when working individually. The study by Foulger and Williams (2007) required collaboration between the paired instructors. Gaps in technology curriculum were identified and filled, jointly. A seven stage redevelopment process was used along with corresponding surveys for all participants. A repeated measure analysis system was used with these pre-post survey data. They found that collaboration was key in the effective integration of technology. In alignment with Roger's (2002) concepts of communication channels, Foulger and Williams (2007) found that the more open the communications among faculty, the higher the likelihood of effective integration. Since the primary focus of the adoption study by Kebritchi (2008) was on the teaching personnel, a suggestion for future research is to examine these matters with the administrative and support staffs (Kebritchi, 2008).

Matthew, Felvegi and Callaway (2009) studied the use of wikis as a collaborative tool with students of teacher education. Their research questions were relevant to previously described DOI challenges and interests. These included the study of student perceptions regarding the use of wikis, the relationship between wikis and learning and technology related concerns. The method was a case study to examine these items as well as other benefits and challenges. There were 37 pre-service teachers and their tasks were to contribute to the wikis at regular intervals. There was no instructor participation in these wiki discussions. Data were collected through interviews and analysis of the online content produced by students using the constant comparative method. The results indicated that the wiki discussion process led to exposure to learning material because posting comments required that students become familiar with the posting of classmates. There was peer pressure to take initiative and contribute in a meaningful way. This also led to students reaching beyond the confines of their class assignments to make important learning connections. While the amount of learning was self-reported, many students reported that this was an important source of information and collaboration. The authors suggest that future research examine the role of contributors in ensuring quality content.

Implementation Environments and Strategies

Murray (2009) examined ways to facilitate diffusion on innovations. While the focus of this study was on the gap between research and practices in counseling, the DOI principles presented are instructive. Several postulates were described, all based on Rogers' (2003) DOI framework. The first addresses the five characteristics of innovation that impact its adoption. Since most of these characteristics are perception-driven, the author suggests that researchers should reach out to clinicians to address perception-related conflict regarding adoption. Chen (2009) examined the factors that contribute to the adoption of distance learning services by higher education institutions. Primary foci were program costs and faculty participation. Berge (2002) has indicated that barriers to adoption can include technical expertise, faculty compensation, as well as time and attitudes toward technology (as cited by Chen, 2009). Chen (2009) found that institution type was an important factor. The highest likelihood of adoption was with public four-year institutions and private institutions had the lowest likelihood of adoption. Additionally, faculty workload was found to be an important factor. For each unit increase of concerns about workload, adoption likelihood increased over three units (Chen, 2009). Chen (2009) recommends replicating this study using data more current than the 2001-2002 set used here. A second, and related, postulate by Murray (2009) refers to the homophilous-heterophilous difference. Potential adopters are more likely to be persuaded to adopt an innovation by someone they see as similar to them. The last postulate presented is the adopter categories based on the rate of adoption. In this context, the author suggests that researchers must deeply understand the practitioners' motives and concerns regarding the adoption rate. The author concludes with a six-step procedure to improve DOI:

1. Innovations should be relevant to potential adopters;
2. Innovators should use the appropriate communication channels to convey their solutions effectively;
3. Innovators should carefully consider the consequences of their solutions;

4. Innovators should allow for implementation flexibility so adopters can make the solution their own;
5. Innovators must deeply understand the decision-making process used by their target audiences; and
6. Innovators should seek input from potential adopters.

Nichols (2008) has published a descriptive study on the challenges faced by institutions when implementing e-learning solutions. He has identified the importance of such solutions by citing prior studies indicating improved student retention and learning effectiveness when using such tools. Data in this study were collected through interviews with e-learning managers from 14 institutions. The design assumed the benefits of instructional technology and focused on the methods of successful diffusion. Some of the important findings that contribute to sustainable diffusion include large-scale centralization of instructional technology matters and incremental, staff-based change. These ingredients must include a clear vision and open communication, similar to the social context and communication ideas by Rogers (2003). Additionally, sufficient resources, detailed professional development and an institutional approach (strategic planning rather than mere policy compliance) are essential for this effort. Peluchette and Rust (2005) examined technology preferences of faculty in a management program. Surveys were used as the primary method of data collection. Among the technology tools included were PowerPoint presentations, computer simulations, email and web pages, online chat rooms, as well as lower technology tools such as transparencies and video recordings. While Peluchette and Rust (2005) found that class size did not impact preferred tools, they indicated a possible problem with selection bias. They also found that the tools most preferred were of the low tech variety: transparencies, chalkboards, and PowerPoint presentations. The authors attribute this to the fact that the content required more experiential learning and student demonstrations. While most faculty members indicated issues with limited time with regard to technology adoption, this was more pronounced among female faculty. The authors conclude that release time and smaller class sizes should be part of a successful technology adoption plan. Of interest for further research should be the role of learning styles and use of faculty from other disciplines (Peluchette & Rust, 2005). Nichols (2008) suggests that future research focus on factors that hinder innovations and their sustainability.

Keller (2005) has published a descriptive examination of three implementation perspectives regarding virtual learning environments (VLE's). The author contends that student perceptions are not deeply impacted by demographic variables; therefore, the research problem here is the lack of attention on implementation styles. Implementation is treated as having many phases, depending on the user. These include initiation, development, adoption, adaptation, acceptance, freezing, unfreezing, among others. These indirectly influence the implementation perspectives which include implementation as technology acceptance, implementation as diffusion of innovation and implementation as a learning process (Keller, 2005).

The technology acceptance model (TAM) postulates that user perceptions are paramount. These include perceived usefulness and ease of use. Also included is subjective norm which is the perception of what is expected from close members of society (Keller, 2005) supporting Rogers' (2003) homophilous concept.

Implementation as DOI includes the decision-making process which consists of the knowledge, persuasion, decision, implementation and confirmation phases. Within the persuasion phase are Rogers' (2003) five characteristics of innovation: relative advantage, comparability, complexity, trialability and observability. These qualities have deep meaning for organizations since they are animated when there are gaps between performance and expectations. When innovations experience initiation and implementation, careful calculations of this gap are made to ensure implementation effectiveness (Keller, 2005).

Implementation as a process of learning requires an understanding of interactions between communities of practice (people) and technology (boundary objects). Communities of practice must identify the extent to which change is supported and with whom knowledge is willingly shared. Clarity with these items will promote the advancement of innovations which then may produce one of several effects. These include creating new communities, strengthening or threatening existing communities, and changing knowledge distribution. While there are clearly distinct qualities to each of these theoretical approaches to technology use, there remains overlap among all three which can advance effective implementation of technology (Keller, 2005).

Morin (1975) has expanded on Rogers' five characteristics of innovation as well as requirement for an effective change agent. The author presents facilitators and prohibitors to each of Rogers' (2003) five innovation characteristics. Since most of the prohibitors reflect the opposite of a facilitator, only facilitators are presented per characteristic:

- Relative advantage - availability of money, needs of people, health, welfare, and appeal to a better life;
- Compatibility - values of people, needs of people, lack of habits in people involved;
- Complexity - availability of technology, supporting material and institutions, lack of habits of people;
- Divisability - information, consultants, cost in divided units; and

- Communicability - leadership, openness, needs of people, political pressure, spirit of the time (for example, change for change sake) (Morin, 1975).

Careful application of Rogers' (2003) theory will result in effective and efficient uses of innovations.

The effective change agent must:

- Enjoy high professional esteem;
- Be a stimulator, an inspiring person;
- Be open to changing point of view, prudent and well aware of social implications;
- Be capable of working with others; and
- Have leadership qualities (Rogers, 2003).

Weiner (2003) has examined the use of technology in library settings. The "life" problem addressed here is the discontinuous adoption of technologies by libraries given the pace of innovation. Three relevant theories are reviewed: structuration, DOI and contingency.

Structuration suggests that the organizational structure of a unit has a significant impact on its operation. It is the process by which systems are produced and reproduced through its members' use of rules and resources. Variations in resource allocation create hierarchies which impact unit operations. In the library setting, history, staffing, the surrounding environment and budget matters directly relate to such matters as technology adoption. Structuration involves tension management which is always present between people involved, between people and rules as well as between people and established norms. Structuration suggests the need to break routines in process and procedures to allow for change agents to infuse innovation as needed.

DOI, conversely, requires an alternate viewpoint. With a focus on the users, DOI examines the rate of adoption and the requirements to support change in technology use and acceptance.

The author highlights the differences between innovators and users. The former tend to be visionary, looking at possibilities for the future, while the latter tend to take direction from the former and use the past as a point of reference. The author also highlights the difference between methodical and tool-based innovation. Hardware-driven changes require much less change investment and are less abstract than those that are procedure-oriented. This points to the need for ample training and communication (Weiner, 2003). Kopcha (2008) identified predispositions that prevent faculty from adopting education technology tools. These include time, beliefs, access, professional development and culture. He set out to examine system-based model of technology intrgration. This included communication and mentoring strategies. Their implementation matrix included four stages and accounted for mechanics of technology use, system for training and support, culture adaptations, and curricular adjustments. His finding was that such a teacher-centered approach was effective with encouraging adoption, providing just-in-time support to maintain momentum and addressing the other barriers to adoption. Kopcha (2008) suggests examining a similar model for faculty in a variety of disciplines as well as with students. DOI requires a client-centered focus rather than one that is change-centered. There are several reasons users have to resist technology-based change including fear of job termination, loss of status and deeply ingrained habits. However, the author also suggests that once a first innovation is adopted, there seems to be a seal that is broken allowing for subsequent adoptions to occur with more ease (Weiner, 2003).

Contingency theory is concerned with organizational decentralization while also creating much integration. Seemingly paradoxical, this balance is achieved through healthy and cooperative tensions between groups in an organization. The author suggests that libraries that are organized in this way should be responsive to environmental needs for technology adoption.

This is greatly impacted by the type of transactional leadership and directs this growth. Low transactional leadership is focused on rewards and compliance while high level transactional leadership is focused on vision and growth. Libraries with this type of structure should be nimble and priority-focused (Weiner, 2003).

Weiner (2003) provides a summarized list of requirements for the adoption of innovation:

- Provide clear, detailed vision of the change;
- Be a model for expecting and incorporating change;
- Involve all stakeholders;
- Give people time to adjust;
- Divide a big change into manageable, familiar steps;
- Make standards and requirement clear;
- Offer positive reinforcement;
- Allow expressions of nostalgia for the past, then create excitement for the future;
- Maintain a sense of humor; and
- Continuously access change and effect quality improvement.

Literature Review Summary

Several themes have emerged among the studies and perspectives presented here. With DOI as a goal and point of interest, these researchers addressed the successful uses of educational technologies by students, faculty, the larger system as well as the managers and deliverers of such tools. The themes include:

- Effective training;
- Role of institutional policies;
- Self efficacy;

- Implications for learning;
- Resource availability (financial incentives and on-going technical support);
- User-centric approaches to DOI;
- Peer pressure (on students and faculty);
- Alignment with teaching styles;
- Best predictors of innovation adoption;
- Need for ample time passage;
- Clear vision;
- Enjoyment; and
- Interactions between students and instructional content.

The resounding need for supportive and user-centric training is borne from the many past experiences users have with failed technology uses. The empty vessel fallacy occurs when trainers, or change agents, treat potential adopters as though they are without preconceived ideas and attitudes about technology. Change agents must also be sensitive to the previous methods and procedures and resist the urge to dismiss them for the superior replacement technology. This innovation negativism can also be countered by financial incentives (Rogers, 2003). Bennett and Bennett (2003), like Samarawickerma and Stacey (2007), suggest that comprehensive training programs enhance faculty’s sense of efficacy, positive attitudes toward computers and plans to use computers to facilitate student learning. With regard to the decision process, mass media channels are primarily knowledge creators whereas interpersonal networks are important for persuasion (Rogers, 2003). Training facilitates this at the user level.

As far as predictors of DOI, Liao (2005) identified complexity as the best of the five characteristics of innovation. When treating student learning as the dependent variable, compatibility was found to be the best. Freeman et al. (2007) identified compatibility, complexity, and relative advantage as the most important for this prediction. Innovation-decisions are experienced more rapidly with an individual compared with an organization (Rogers, 2003), which impacts the role of the five characteristics in the prediction of adoption. This is, in part, due to the fact that threshold is required at the individual level whereas critical mass is required at the system level for adoption to take hold. Strategies for moving towards critical mass include:

1. Respected change agent;
2. Enhancing perception of innovation;
3. Target groups more likely to adopt if early adopters help spread the adoption; and
4. Incentives.

The researchers' suggestions for future research are based on their findings and persistent gaps between technology availability and use. These include identifying the sources of motivation for early adopters, assessing the impact of teaching style and pedagogical beliefs in use of education technology, as well as obstacles to DOI. Since innovation adoption requires behavioral change, not merely cognitive or attitudinal change, a suggestion for future research is to examine the network influences on individual (and organizational) innovation (Rogers, 2003). Additionally, these researchers are not in agreement about the best predictor of innovation adoption. Since each of their studies was comprised of varying populations, technology instruments, and fields, future work should disaggregate and analyze data on each of these variables.

Using these prior studies as a basis, the current study will examine the factors most related with the adoption of technology in higher education instruction. The five constructs used will be personal uses of technology, institutional policies, efficacy with the instructional content and technology use, belief in the learning benefits of technology use, and general barriers to technology use.

Chapter 3
Methodology

Introduction

Statistical techniques must be appropriate for the research design and data limitations. Much of the research in education is deemed non-experimental, meaning there's an absence of control groups, and of randomized assignment of participants and treatment..

Statistical techniques must address this. Path analysis is one such technique. This technique requires the justification of use of variables and how a researcher connects them with one another. Often, this justification is based on the findings of prior studies and experiences of the researchers. Additionally, this technique has the advantage of not only measuring direct relationships between variables, but also indirect relationships. The path coefficients produced by this technique represent the variability of one variable given variability in another (Keith, 1988).

Research Question

The research question in this study was as follows: What are the variables that most impact the use of education technologies for instructional purposes in higher education? Use of education technologies has been defined by the variable *adopter rate for professional uses of technologies.*

The list of question elements below is intended to provide specificity to address some of the possible factors.

Elements of the Research Question:

1. What are the personal use of technology factors leading to professional adoption?
2. What learning benefits (as believed by faculty) predict technology adoption?

3. What are the self perceptions of performance quality as an instructor (efficacy) and their impacts on technology use?
4. What are the impacts of institution policies regarding reward and workload reduction on technology use?
5. What is the relationship between technology use and barriers such as training provider and technical problem-solving?

Hypotheses:

1. Faculty uses of technology-based solutions in their professional arenas are aligned with their personal uses.
2. Faculty who perceive learning benefits of use of technology will be more likely to adopt technology use for instruction.
3. Faculty who have high self-efficacies are more likely to learn and integrate technology-based solutions into their craft.
4. University policies regarding reward and workload management have a clear and direct impact on faculty uses of technology for the purposes of instruction.
5. Barriers such as training needs and technical challenges greatly impact the adoption of technology use for instruction.

Instrument

The primary method for collecting data in the present study was through the use of an online survey. The target population was higher education faculty members working in education colleges or departments. The survey was devised by the principal investigator based on the emergent themes identified from a review of prior studies. Items were created based on the technology adoption factors described in prior studies, the experiences of the principal investigator, and on the elements of the DOI theoretical framework. An initial draft of the survey was distributed to four reviewers for clarity of survey items and directions. Once these modifications were made to the survey, it was distributed to a group of 43 faculty members. This distribution was based on convenience sampling, including those working at a local university. Additional feedback on survey item and direction clarity was received and used to further refine the survey. The survey addressed the following constructs:

- Current professional technology use (P)
- Barrier to use of education tech (B)
- Institutional policies – rewards and workload management (I)
- Faculty teaching efficacy (E)
- Learning benefits of technology use (L)

Single letter prefixes were used for each survey item as listed above to identify the construct to which it belongs. Table 1 lists each survey item categorized by the constructs. These constructs emerged through reviews of prior studies.

Samarawickerma and Stacey (2007) referenced the institutional policy construct by describing the importance of workload management for faculty regarding courses taught and administrative duties. This profile included management of faculty time and workload, funding for the additional technology-related tasks and the propensity for learning new things. Within this framework, the authors concluded that university policies regarding technology use impacted faculty action. To facilitate technology adoption, such policies need to be adaptive, must address on-going needs for professional development, training and mentoring, and must be driven by clear visions and expectations.

The efficacy, learning impact and personal use constructs were addressed by Bennett and Bennett (2003). They explored characteristics of educational technology that impact faculty adoption. This was done through the design and deployment of a faculty training program aimed at encouraging use of the course management software (CMS). With this focus on improving DOI, the authors used surveys to collect data on several constructs. The findings suggested that the training program enhanced each of the constructs of interest including faculty's sense of technology efficacy, positive attitudes towards computers and plans to use computers to facilitate student learning.

The barrier construct, and items, were based on the DOI principle of change agent qualities. These should be relatable to the potential adopter of technology. While highly skilled, technical experts might have the knowledge in using technology tools effectively, it will mean little if this trainer type does not speak to challenges faced by faculty. Therefore, the barrier item dealing with training by a similar colleague is proposed to impact the adoption rate. Other barrier items relate to general technical know-how. Based on experiences of and observations by the principal investigator, there is an intimidation factor regarding the use of a new technology tool. Much of this is caused by fear of being left unable to work through the many technical glitches and breakdowns that are inevitable.

Table 1. List of Each Survey Item (variables) Organized by Construct

Demographic Items
What is your job title or rank?
Area of your specialization based on current research/teaching interests (check all that apply):
Degree or certificate earned in any branch of education technology; if more than one, list them all
If you are certified or have a degree in education technology, indicate the number of hours of training or course unit equivalent you completed.
Name of higher education institution where you are currently employed; if more than one, list them all
Number of years teaching at the college level (including all levels of post-secondary education)
With which race/ethnicity do you identify (check all that apply)?:

Your e-mail address
Do you have tenure?
Are you a full-time faculty member?
Barriers to Use of Education Technology Items
B[I have the technical skills I need to use education technology.]
B[I keep up with important new education technologies.]
B[I know how to solve my own education technology problems.]
B[I would use technology tools more if I could receive training from someone who has worked in my area of specialty;]
B[I would use technology tools more if the tools were simpler to use;]
Efficacy with Discipline Content and the Use of Education Teachnology Items
E[I am familiar with common student understandings and misconceptions.]
E[I can adapt my teaching based upon what students currently understand or do not understand.]
E[I can adapt the use of the technologies that I am learning about to different teaching activities.]
E[I can assess student learning in multiple ways.]
E[I can choose technologies that enhance students' learning for a lesson.]
E[I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches in my college/department.]
E[I can teach lessons that appropriately combine analysis, technologies, and my teaching approaches.]
E[I can teach lessons that appropriately combine writing, technologies, and my teaching approaches.]
E[I can use a wide range of teaching approaches in a classroom setting (collaborative learning, direct instruction, inquiry learning, problem/project based learning, etc.).]
E[I know how to organize and maintain classroom management.]
E[I know how to select effective teaching approaches to guide student learning in analytical tasks.]
E[I know how to select effective teaching approaches to guide student learning in writing tasks.]
E[The experiences I have had teaching in my current program have caused me to think more deeply about how technology could influence the teaching approaches I use in my instruction.]
Institutional Policies related with Use of Education Technology Items
I[A university/college technology plan, in which skills needing to be achieved are clearly spelled out, would help me to integrate technology.]
I[I could be among the following adopter type if my university/college provided more support.]
I[I would attend technology-based professional development activities if my university/college offered them.]
I[I would use technology if I had more of a voice in the decision-making process (i.e., purchases, creation of the technology plan, etc.).]
I[I would use technology tools more if I could receive on-demand training support in addition to the initial training session;]
I[I would use technology tools more if I could reduce my project list/administrative duties.]
I[I would use technology tools more if I could reduce my teaching load.]
I[I would use technology tools more if I would receive a stipend for the added workload;]
I[I would use technology tools more if I would receive recognition for the effort from my supervisor;]
I[I would use technology tools more if I would receive recognition from my peers;]

I[I would use technology tools more if my university (or college) would invest in updating the technology equipment;]
I[I would use technology tools more if my university (or college) would provide more academically relevant training.]
I[I would use technology tools more if my university's (or college's) policies allowed for flex time to work with technologies;]
I[If I collaborated with others to examine the use of computers in educational practice, it would increase the likelihood of my technology adoption.]
Learning Benefits of Using Education Technology Items
L[A teacher who plans lessons that are learner-centered uses education technology.]
L[Automating or managing grades;]
L[Capturing lectures with video equipment;]
L[Collaboration tools for students;]
L[Creating and using effective presentation technologies;]
L[Instructional simulations or games;]
L[Live online meetings/classes/seminars;]
L[Managing assignments;]
L[Offering broader access to course materials;]
L[Putting course and/or lecture content online;]
L[Student-created content (i.e. video, audio, web pages);]
L[Supplementing a course with online resources;]
L[Teaching and managing courses delivered entirely online;]
L[Teaching and managing courses with large enrollment;]
L[Technology can help accommodate different learning styles.]
L[Technology-equipped classrooms;]
L[Understanding and using best practices of teaching with technology.]
L[Using alternative assessment strategies;]
L[Using digital audio and video;]
L[Virtual classroom space (i.e. Learning Management Systems such as Blackboard or Moodle);]
L[Web page design and development;]
Personal Use of Technology Items
P.How many computers, laptops, and/or tablets do you actively use (at least once monthly)?
P.How many email accounts do you use regularly (at least once monthly)?
P[I have a Facebook account and log onto it.]
P[I manage a blog and/or wiki.]
P[I post videos/photos to a sharing service (Flickr, YouTube, Google Docs, etc.).]
P[I receive regular news feeds about education technology (newsletters, email listservs, reviews of web news).]
P[I use video conferencing programs.]
P[Using a "trial and error" approach has increased my knowledge on use of education technologies.]
P[When new technologies are released, I am typically among the following group of adopters for personal use (cell phones, computers, laptops for personal use).]

Additional Items
Please answer all of the following items using the scale provided. [A teacher should be at ease using education technology.]
Please answer all of the following items using the scale provided. [A teacher should use education technology, whether he/she is rewarded or not.]
Please answer all of the following items using the scale provided. [My experience using technology to learn has been successful.]
Please answer all of the following items using the scale provided. [My role as the teacher will be dramatically changed because of the education technology within five years.]
Please answer all of the following items using the scale provided. [Textbooks will be replaced by electronic media within five years.]
Describe a specific episode where a peer effectively demonstrated or modeled combining content, technologies and teaching approaches in a classroom lesson. Please include in your description what content was being taught, what technology was used, and what teaching approach(es) was implemented.
Expand on the barriers to the use of education technology by describing how these barriers can be mitigated for you. List the top three barriers and describe remedies for each.
Describe a specific episode where you effectively demonstrated or modeled combining content, technologies and teaching approaches in a classroom lesson. Please include in your description what content you taught, what technology you used, and what teaching approach(es) you implemented. If you have not had the opportunity to teach such a lesson, please indicate that you have not and describe why.
Describe any additional information you would like to share regarding your use of education technology for instructional purposes.
UoT[I effectively use a learning management system (such as Blackboard, Moodle, etc.) to teach and organize instructional content.]
UoT[I effectively use mobile devices (including smartphones, tablets, laptops, etc.) to teach and organize instructional content.]
UoT[I effectively use videos to teach and organize instructional content.]
DV[When new technologies are released, I am typically among the following group of adopters for professional use (cell phones, computers, laptops for instructional use or with my students).]
For the following two items, use the scale provided for your responses. [In general, approximately what percentage of your peers outside your college/department, but within your university, have provided an effective model for combining content, technologies and teaching approaches in their teaching?]
For the following two items, use the scale provided for your responses. [In general, approximately what percentage of your peers within your department have provided an effective model for combining content, technologies and teaching approaches in their teaching?]

Of all these variables, 20 that were cited repeatedly in the literature were central to the current study. These include the following:

Barrier Variables
B[I know how to solve my own education technology problems.]
B[I would use technology tools more if I could receive training from someone who has worked in my area of specialty;]
Learning Benefits Variable
L[Student-created content (i.e. video, audio, web pages);]
L[Understanding and using best practices of teaching with technology.]
L[A teacher who plans lessons that are learner-centered uses education technology.]
L[Collaboration tools for students;]
Efficacy with Content and Technology
E[I can teach lessons that appropriately combine analysis, technologies, and my teaching approaches.]
E[I can teach lessons that appropriately combine writing, technologies, and my teaching approaches.]
E[I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches in my college/department.]
E[I am familiar with common student understandings and misconceptions.]
E[I can choose technologies that enhance students' learning for a lesson.]
E[I can adapt the use of the technologies that I am learning about to different teaching activities.]
Institutional Policies related with use of Education Technology
I[I would use technology tools more if I could reduce my teaching load.]
I[I would use technology tools more if I could reduce my project list/administrative duties.]
I[A university/college technology plan, in which skills needing to be achieved are clearly spelled out, would help me to integrate technology.]
Personal uses of Technology
P[Using a “trial and error” approach has increased my knowledge on use of education technologies.]
P[When new technologies are released, I am typically among the following group of adopters for personal use (cell phones, computers, laptops for personal use).]
Uses of Specific Technology Tools
DV[When new technologies are released, I am typically among the following group of adopters for professional use (cell phones, computers, laptops for instructional use or with my students).]
UoT[I effectively use a learning management system (such as Blackboard, Moodle, etc.) to teach and organize instructional content.]
UoT[I effectively use mobile devices (including smartphones, tablets, laptops, etc.) to teach and organize instructional content.]

Sampling

To sample from a diverse group of higher education faculty working in education colleges or departments, the membership list from a large, nation-wide professional organization was used to identify the participant pool. Included in the messages to them were the purpose of this study, directions on how to take the survey, contact information for any IRB or other methodological concerns, and the link to the online survey. The desired number of participants was a minimum of 200.

The number of members in this organization was determined to be 22,540. Using an online random number generator, www.random.org, 379 numbers were pulled from the range between one and 22,540. The member names that corresponded to each of the 379 numbers based on alphabetical ranking were sent the request for participation in this study. A limit of two faculty was set per institution. After two reminder messages, a total of 203 members completed the survey in the fall of 2011.

Conceptual Model Based on Constructs

Using prior research, the Diffusion of Innovation theoretical framework, survey participant responses to the open-ended survey items, and the principal investigator's observations, the constructs in the model below were chosen (Figure 1). Each of the five constructs introduced in this chapter are represented. The list of constructs included and their proposed relationships to the adoption of technology follow:

- Personal uses of technology - the greater the personal use of technologies, the greater the professional uses of them;
- Learning impact - the more faculty believe in the learning benefits for student of technology use, the more likely they are to adopt its use;
- Efficacy - the more comfortable faculty are with teaching their content, the more likely they are to adopt technology uses;
- Institutional policies - the more institution policies support reduced course and project loads, the more likely faculty are to adopt technology use;

- Barriers - the more faculty are trained by peers, the more likely they are to respond with greater adoption; the more self-sufficient faculty are regarding technical problems, the more likely they are to adopt.

Figure 1 displays the direct and indirect relationships among all constructs and the ultimate endogendous variable. In addition to the five constructs and one ultimate endogendous variable, a sixth category was included. This is called use of specific technology tools and serves to identify the role those tools play. Given that the goal of the current study is to identify the factors that foster technology adoption, it is proposed that the use of these specific tools (mobile devices and learning management systems) might yield predictor variables. The survey item regarding mobile devices asked the degree to which the participant used them for their own learning. Conversely, the LMS item references the use of this tool for classroom instruction. Figure 2 displays the independent variables and their proposed relationships with the ultimate endogenous variable. These proposed relationships are compatible with the conceptual model in Figure 1.

Analysis

Data were analyzed using descriptive and inferential statistical techniques. Regression coefficients were used in path analysis to identify variables that impact adoption most. Descriptive statistics from the current study were compared with national norms. Additionally, means and standard deviations of each of the 20 path variables were computed for all faculty participants as well as the subgroups based on age, gender, full/part-time status, and tenure status. Resulting path diagrams were produced for all faculty participants as well as for subgroups based on age, tenure, full/part-time status and gender.

Figure 1. Proposed Path Model using Constructs

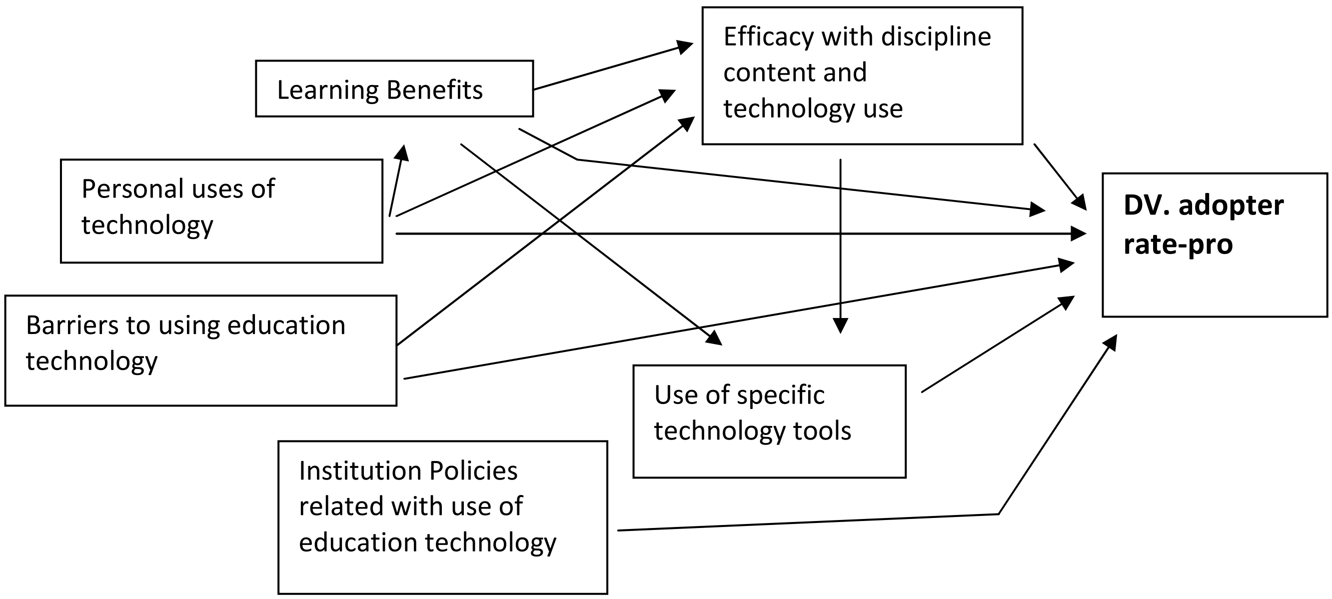
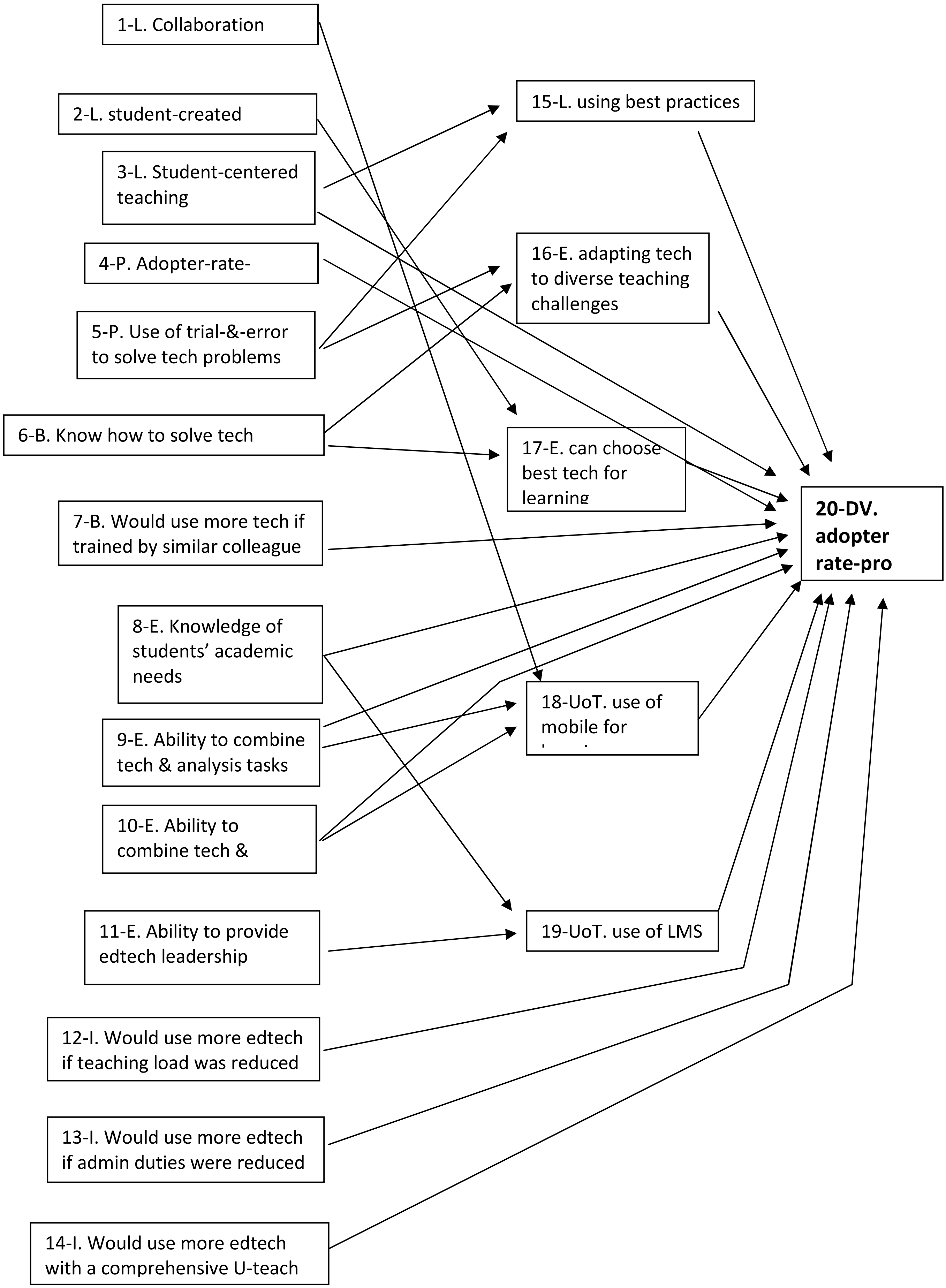


Figure 2. Path Model – Proposed



Chapter 4
Results

Descriptive Statistics

Table 2 displays the demographic data for the participants in this study. Where possible, these breakdowns were compared with trends at the national level using the results of the National Study of Post Secondary Faculty published by the National Center on Education Statistics. These tables are titled with the question/label as it appeared on the survey. Table 2 shows a predominance of white/Caucasian faculty. This is aligned with the national percentage of white/Caucasian faculty members. There is, however, a slant in the current study toward female faculty. In the current study, 69% of participants were female whereas only 43% of faculty nation-wide are female. Sixty eight percent of this study's participants indicated fulltime employment as faculty; this is compared with 56% nation-wide. The tenure status breakdown was more aligned with 32% in the current study and 28% nation-wide indicating tenure status. Table 2 also displays alignment with age measures with the average age in the current study being 46 years and nationally, 49 years.

Table 2. Demographic Breakdown of Survey Participants with Comparisons to National Figures

	% of participants	National Comparison Figures(%)*
Race/Ethnicity		
White/Caucasian	89.1	82.5
Hispanic/Latino/Latina	6.4	3.4
African American/Black	2	5.8
Asian/Asian American	2.5	6.9
American Indian	0	1.4
Total Race/Ethnicity	100	100
Gender		
Male	30.0	57

Female	69.9	43
Total Gender	100	100
Full vs Part Time Status		
Fulltime	69.8	56
Part-time	30.2	44
Total F/P Status	100	100
Tenure		
Yes	32.2	28
No	67.8	72
Total Tenure	100	100
Age		
Mean	46.6	49.4
Standard Deviation	11.4	11.1
Range	25-82=57	19-89=70

*based on the National Study of Post Secondary Faculty published by the National Center on Educational Statistics

The means and standard deviations for each of the path model variables are listed for all faculty participants as well as for each subgroup including gender, tenure, full/part time, and age factors (Table 3). The item that consistently scored the lowest average was an efficacy variable: faculty know students' common misunderstanding and misconceptions. The item that scored consistently high was the adopter rate for personal use of technology.

Table 3: Descriptive Measures for All Path Model Variables

Descriptive Statistics on Key Variables						Gender Subgroups					
	All Faculty Participants					Males			Females		
	N	Min	Max	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Barrier Variables		1.000	4.000	2.032	0.817		2.000	0.785		2.045	0.809
B[I know how to solve my own education technology problems.]	203	1	4	1.93	.735	60	1.65	.709	143	2.05	.715
B[I would use technology tools more if I could receive training from someone who has worked in my area of specialty;]	203	1	4	2.13	.899	60	2.35	.860	143	2.04	.903
Learning Benefits Variable		1.000	4.000	1.818	0.787		2.004	0.831		1.740	0.756
L[Student-created content (i.e. video, audio, web pages);]	203	1	4	1.84	.787	60	2.07	.821	143	1.75	.755
L[Understanding and using best practices of teaching with technology.]	203	1	4	1.56	.717	60	1.77	.810	143	1.48	.659
L[A teacher who plans lessons that are learner-centered uses education technology.]	203	1	4	2.25	.907	60	2.42	.926	143	2.18	.893
L[Collaboration tools for students;]	203	1	4	1.62	.738	60	1.77	.767	143	1.55	.719
Efficacy with Content and Technology		1.000	4.000	1.755	0.696		1.794	0.707		1.739	0.692
E[I can teach lessons that appropriately combine analysis, technologies, and my teaching approaches.]	203	1	4	1.79	.694	60	1.82	.701	143	1.78	.693
E[I can teach lessons that appropriately combine writing, technologies, and my teaching approaches.]	203	1	4	1.83	.719	60	1.87	.747	143	1.82	.708

	All Faculty Participants					Males			Females		
	N	Min	Max	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.
E[I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches in my college/department.]	203	1	4	2.08	.916	60	2.07	.936	143	2.09	.911
E[I am familiar with common student understandings and misconceptions.]	203	1	4	1.44	.554	60	1.55	.534	143	1.40	.558
E[I can choose technologies that enhance students' learning for a lesson.]	203	1	4	1.69	.627	60	1.73	.660	143	1.67	.614
E[I can adapt the use of the technologies that I am learning about to different teaching activities.]	203	1	4	1.69	.665	60	1.73	.660	143	1.67	.669
Institutional Policies related with use of Education Technology		1.000	4.000	2.332	0.929		2.372	1.006		2.315	0.897
I[I would use technology tools more if I could reduce my teaching load.]	203	1	4	2.38	.985	60	2.47	1.096	143	2.35	.936
I[I would use technology tools more if I could reduce my project list/administrative duties.]	203	1	4	2.30	.971	60	2.28	1.059	143	2.30	.935
I[A university/college technology plan, in which skills needing to be achieved are clearly spelled out, would help me to integrate technology.]	203	1	4	2.32	.832	60	2.37	.863	143	2.29	.821
Personal uses of Technology		1.000	4.500	2.214	0.808		2.267	0.882		2.192	0.776
P[Using a “trial and error” approach has increased my knowledge on use of education technologies.]	203	1	4	1.66	.688	60	1.72	.715	143	1.64	.677

	All Faculty Participants					Males			Females		
	N	Min	Max	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.
P[When new technologies are released, I am typically among the following group of adopters for personal use (cell phones, computers, laptops for personal use).]	203	1	5	2.77	.928	60	2.82	1.049	143	2.75	.876
Uses of Specific Technology Tools		1.000	4.333	2.230	0.850		2.444	0.950		2.140	0.786
UoT[When new technologies are released, I am typically among the following group of adopters for professional use (cell phones, computers, laptops for instructional use or with my students).]	203	1	5	2.62	.896	60	2.70	1.046	143	2.58	.826
UoT[I effectively use a learning management system (such as Blackboard, Moodle, etc.) to teach and organize instructional content.]	203	1	4	1.59	.741	60	1.82	.873	143	1.50	.659
UoT[I effectively use mobile devices (including smartphones, tablets, laptops, etc.) to teach and organize instructional content.]	203	1	4	2.48	.914	60	2.82	.930	143	2.34	.873
Means	203	1.000	4.113	2.013	0.799	60	2.106	0.846	143	1.974	0.772

	Full/Part Time Subgroups						Age Subgroups					
	Full-Time			Part-Time			Below Median			Above Median		
	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Barrier Variables		2.057	0.81		1.97	0.831		1.965	0.828		2.10	0.796
B[I know how to solve my own education technology problems.]	141	1.92	.728	62	1.95	.756	100	1.80	.696	103	2.06	.752
B[I would use technology tools more if I could receive training from someone who has worked in my area of specialty;]	141	2.19	.894	62	2.00	.905	100	2.13	.960	103	2.14	.841
Learning Benefits Variable		1.840	0.78		1.76	0.791		1.853	0.797		1.78	0.776
L[Student-created content (i.e. video, audio, web pages);]	141	1.87	.773	62	1.77	.818	100	1.83	.805	103	1.85	.772
L[Understanding and using best practices of teaching with technology.]	141	1.55	.712	62	1.60	.735	100	1.56	.715	103	1.56	.723
L[A teacher who plans lessons that are learner-centered uses education technology.]	141	2.33	.937	62	2.08	.816	100	2.38	.896	103	2.13	.904
L[Collaboration tools for students;]	141	1.62	.714	62	1.61	.797	100	1.64	.772	103	1.59	.706
Efficacy with Content and Technology		1.757	0.69		1.75	0.712		1.757	0.663		1.75	0.729
E[I can teach lessons that appropriately combine analysis, technologies, and my teaching approaches.]	141	1.80	.678	62	1.77	.734	100	1.78	.675	103	1.81	.715
E[I can teach lessons that appropriately combine writing, technologies, and my teaching approaches.]	141	1.82	.700	62	1.85	.765	100	1.83	.711	103	1.83	.729
E[I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches in my college/department.]	141	2.11	.954	62	2.03	.829	100	2.11	.886	103	2.06	.948
E[I am familiar with common student understandings and misconceptions.]	141	1.41	.522	62	1.52	.620	100	1.46	.521	103	1.43	.587
E[I can choose technologies that enhance students' learning for a lesson.]	141	1.70	.620	62	1.68	.647	100	1.67	.570	103	1.71	.681
E[I can adapt the use of the technologies that I am learning about to different teaching activities.]	141	1.70	.663	62	1.66	.676	100	1.69	.615	103	1.69	.714
Institutional Policies related with use of Education Technology		2.314	0.94		2.37	0.900		2.323	0.946		2.34	0.917
I[I would use technology tools more if I could reduce my teaching load.]	141	2.35	.993	62	2.47	.970	100	2.34	1.007	103	2.43	.966

	Full/Part Time Subgroups						Age Subgroups					
	Full-Time			Part-Time			Below Median			Above Median		
I[I would use technology tools more if I could reduce my project list/administrative duties.]	141	2.30	.971	62	2.27	.978	100	2.30	1.000	103	2.29	.946
I[A university/college technology plan, in which skills needing to be achieved are clearly spelled out, would help me to integrate technology.]	141	2.29	.866	62	2.37	.752	100	2.33	.829	103	2.30	.838
Personal uses of Technology		2.216	0.81		2.21	0.807		2.270	0.806		2.16	0.793
	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.
P[Using a "trial and error" approach has increased my knowledge on use of education technologies.]	141	1.67	.681	62	1.63	.707	100	1.60	.739	103	1.72	.633
P[When new technologies are released, I am typically among the following group of adopters for personal use (cell phones, computers, laptops for personal use).]	141	2.76	.940	62	2.79	.908	100	2.94	.874	103	2.60	.953
Uses of Specific Technology Tools		2.215	0.85		2.26	0.847		2.230	0.833		2.23	0.868
UoT[When new technologies are released, I am typically among the following group of adopters for professional use (cell phones, computers, laptops for instructional use or with my students).]	141	2.60	.926	62	2.66	.829	100	2.66	.890	103	2.57	.903
UoT[I effectively use a learning management system (such as Blackboard, Moodle, etc.) to teach and organize instructional content.]	141	1.54	.712	62	1.71	.797	100	1.55	.672	103	1.63	.804
UoT[I effectively use mobile devices (including smartphones, tablets, laptops, etc.) to teach and organize instructional content.]	141	2.51	.915	62	2.42	.915	100	2.48	.937	103	2.49	.895
Means	141	2.015	0.799	62	2.009	0.800	100	2.021	0.793	103	2.006	0.804

	Tenure Subgroups					
	Yes			No		
	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Barrier Variables		2.152	0.862		1.97	0.791
B[I know how to solve my own education technology problems.]	66	2.03	.803	137	1.88	.697
B[I would use technology tools more if I could receive training from someone who has worked in my area of specialty;]	66	2.27	.921	137	2.07	.885
Learning Benefits Variable		1.951	0.850		1.75	0.748
L[Student-created content (i.e. video, audio, web pages);]	66	2.05	.867	137	1.74	.728
L[Understanding and using best practices of teaching with technology.]	66	1.62	.799	137	1.53	.676
L[A teacher who plans lessons that are learner-centered uses education technology.]	66	2.35	1.000	137	2.20	.859
L[Collaboration tools for students;]	66	1.79	.734	137	1.53	.728
Efficacy with Content and Technology		1.785	0.732		1.74	0.679
E[I can teach lessons that appropriately combine analysis, technologies, and my teaching approaches.]	66	1.79	.734	137	1.80	.677
E[I can teach lessons that appropriately combine writing, technologies, and my teaching approaches.]	66	1.85	.707	137	1.82	.727
E[I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches in my college/department.]	66	2.15	.996	137	2.05	.877
E[I am familiar with common student understandings and misconceptions.]	66	1.45	.532	137	1.44	.567
E[I can choose technologies that enhance students' learning for a lesson.]	66	1.71	.696	137	1.68	.593
E[I can adapt the use of the technologies that I am learning about to different teaching activities.]	66	1.76	.725	137	1.66	.635
Institutional Policies related with use of Education Technology		2.404	1.014		2.30	0.885
I[I would use technology tools more if I could reduce my teaching load.]	66	2.50	1.027	137	2.33	.963
I[I would use technology tools more if I could reduce my project list/administrative duties.]	66	2.32	1.025	137	2.28	.947
I[A university/college technology plan, in which skills needing to be achieved are clearly spelled out, would help me to integrate technology.]	66	2.39	.990	137	2.28	.745
Personal uses of Technology		2.227	0.804		2.21	0.812

	Tenure Subgroups					
	Yes			No		
	N	Mean	Std. Dev.	N	Mean	Std. Dev.
P[Using a “trial and error” approach has increased my knowledge on use of education technologies.]	66	1.71	.674	137	1.64	.695
P[When new technologies are released, I am typically among the following group of adopters for personal use (cell phones, computers, laptops for personal use).]	66	2.74	.933	137	2.78	.929
Uses of Specific Technology Tools		2.298	0.950		2.20	0.798
UoT[When new technologies are released, I am typically among the following group of adopters for professional use (cell phones, computers, laptops for instructional use or with my students).]	66	2.64	.987	137	2.61	.852
UoT[I effectively use a learning management system (such as Blackboard, Moodle, etc.) to teach and organize instructional content.]	66	1.73	.851	137	1.53	.676
UoT[I effectively use mobile devices (including smartphones, tablets, laptops, etc.) to teach and organize instructional content.]	66	2.53	1.011	137	2.46	.866
Means	66	2.082	0.854	137	1.980	0.770

Path Analysis

The path model began with 14 exogenous variables, five intermediate endogenous variables, and one ultimate endogenous variable (Figure 2 below). Using the model summary and coefficient tables (Table 4-9), the resulting "after" diagram was created for all faculty participants (Figure 3 below). Of the five constructs represented in the proposed diagram (Figure 1), four remained in the resulting diagram. The construct that was excluded through the stepwise regression analysis was institutional policy. That is, institutional policies as, defined in the current study, were not deemed to impact the adoption of technology for instructional purposes using the current analysis. The four constructs that remained in the model were each represented by two variables. These were:

Learning impact –

Faculty believes that using technology helps to make the instruction student-centered

Faculty believes that using technology helps to identify best instructional practices

Personal use of technology –

Adopter type for personal uses of technology

Faculty uses trial and error approaches to solving technology-related problems

Barriers to technology use –

Faculty knows how to solve technical problems/glitches

Faculty would adopt more technology if he/she was trained by a colleague in the same discipline

Efficacy with use of technology in content area –

Faculty has the ability to combine technology use with writing tasks

Faculty knows how to adapt technology use to diverse teaching challenges

Correlations

Table 4 displays the correlation matrix for all 20 variables included in the proposed path model. The variables are numbered as they appear in the path model and are labeled according to the appropriate construct. One additional category was added along with the five constructs. This is called use of tools and is valuable to in determining the adoption of specific technology tools as related with the ultimate endogenous variable. The majority of the coefficients were significant at the $p<0.05$ or $p<0.01$ level.

Table 4. Correlation Table

Variables^	Learning Impact				Personal Use		Barriers		Efficacy						Inst Policy			Technology Use		
	1	15	3	2	4	5	7	6	8	17	16	9	10	11	12	13	14	18	19	20
1	1	.662**	.345**	.722**	.303**	.229**	.219**	.245**	.297**	.394**	.502**	.463**	.457**	.392**	.170*	.201**	.222**	.423**	.354**	.435**
2		1	.391**	.614**	.375**	.268**	.267**	.249**	.192**	.411**	.419**	.463**	.395**	.410**	.226**	.208**	.224**	.468**	.369**	.445**
3			1	.299**	.352**	.209**	.287**	.188**	-0.045	.251**	.302**	.295**	.262**	.362**	.312**	.354**	.236**	.402**	.242**	.327**
4				1	.302**	.285**	.212**	.251**	.297**	.362**	.398**	.402**	.417**	.362**	.142*	0.126	.160*	.478**	.313**	.434**
5					1	.155*	-0.099	.425**	0.085	.310**	.340**	.332**	.276**	.459**	0.13	.164*	.153*	.383**	.250**	.672**
6						1	0.097	.220**	.163*	.225**	.277**	.360**	.305**	.375**	0.099	0.107	.214**	.247**	.279**	.333**
7							1	-.307**	0.01	-0.03	0.07	0.076	0.058	0.028	.417**	.425**	.314**	0.102	0.09	-0.12
8								1	.165*	.452**	.482**	.434**	.397**	.522**	-0.09	-0.06	-.160*	.386**	.228**	.528**
9									1	.455**	.402**	.433**	.411**	.238**	0.013	-0.01	-0.025	.250**	.287**	.155*
10										1	.634**	.659**	.620**	.562**	0.058	0.054	0.065	.461**	.365**	.412**
11											1	.632**	.584**	.652**	0.115	0.097	0.07	.467**	.424**	.488**
12												1	.794**	.611**	0.095	0.091	0.054	.533**	.335**	.445**
13													1	.555**	0.056	0.043	0.105	.531**	.345**	.438**
14														1	.184**	.178*	.173*	.490**	.379**	.576**
15															1	.864**	.274**	.156*	.175*	0.12
16																1	.276**	0.112	.196**	0.11
17																	1	0.085	0.05	0.1
18																		1	.337**	.439**
19																			1	.321**
20																				1

****. Correlation is significant at the 0.01 level (2-tailed).**
***. Correlation is significant at the 0.05 level (2-tailed).**

^Variables listed aare numbered as they appear in the path diagram

Regressions

The tables below present the regressions specified in the path model.

Table 5. Model Summary Table Using “L using best practices” as the Dependent Variable

L.[Understanding and using best practices of teaching with technology.]	**β**	**t**	**Sig.**
L.[A teacher who plans lessons that are learner-centered uses education technology.]	.350	5.374	.000
P.[Using a “trial and error” approach has increased my knowledge on use of education technologies.]	.195	2.998	.003

R= .435 R^2 = .189 N= 203 F= 23.320 sig f = .003

Table 6. Model Summary Table Using “E adapting technology to diverse teaching challenges” as the Dependent Variable

E. [I can adapt the use of the technologies that I am learning about to different teaching activities.]	**β**	**t**	**Sig.**
B. [I know how to solve my own education technology problems.]	.325	4.932	.000
P. [Using a “trial and error” approach has increased my knowledge on use of education technologies.]	.203	3.077	.002

R= .420 R^2 = .177 N= 203 F= 21.469 sig f = .002

Table 7. Model Summary Table Using “E can choose best technology for learning” as the Dependent Variable

E. [I can choose technologies that enhance students' learning for a lesson.]	**β**	**t**	**Sig.**
L. [Student-created content (i.e. video, audio, web pages);]	.326	5.025	.000
B. [I know how to solve my own education technology problems.]	.223	3.439	.001

R= .424 R^2 = .180 N= 203 F= 21.884 sig f = .001

Table 8. Model Summary Table Using “UoT use of mobile devices for learning” as the Dependent Variable

UoT.[I effectively use mobile devices (including smartphones, tablets, laptops, etc.) to teach and organize instructional content.]	**β**	**t**	**Sig.**
E. [I can teach lessons that appropriately combine analysis, technologies, and my teaching approaches.]	.248	2.587	.010
L. [Collaboration tools for students;]	.197	3.002	.003
E. [I can teach lessons that appropriately combine writing, technologies, and my teaching approaches.]	.244	2.549	.012

R= .587 R^2 = .345 N= 203 F= 34.952 sig f = .012

Table 9. Model Summary Table Using “UoT use of LMS” as the Dependent Variable

UoT LMS. . [I effectively use a learning management system (such as Blackboard, Moodle, etc.) to teach and organize instructional content.]	**β**	**t**	**Sig.**
E. [I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches in my	.329	5.002	.000

college/department.]			
E. [I am familiar with common student understandings and misconceptions.]	.208	3.165	.002

R= .429 R^2 = .184 N= 203 F= 22.573 sig f = .002

Table 10. Model Summary Table Using "DV adopter type for professional use" as the Dependent Variable

DV. [When new technologies are released, I am typically among the following group of adopters for professional use (cell phones, computers, laptops for instructional use or with my students).]	**β**	**t**	**Sig.**
P. [When new technologies are released, I am typically among the following group of adopters for personal use (cell phones, computers, laptops for personal use).]	.498	9.440	.000
E. [I can adapt the use of the technologies that I am learning about to different teaching activities.]	.178	2.955	.004
E. [I can teach lessons that appropriately combine writing, technologies, and my teaching approaches.]	.139	2.374	.019
L. [Understanding and using best practices of teaching with technology.]	.166	2.904	.004
B. [I would use technology tools more if I could receive training from someone who has worked in my area of specialty;]	-.136	-2.738	.007

R= .757 R^2 = .573 N= 203 F= 52.847 sig f = .007

As noted above, Figure 3 presents the "after" path diagram.

Figure 2. Path Model – Proposed

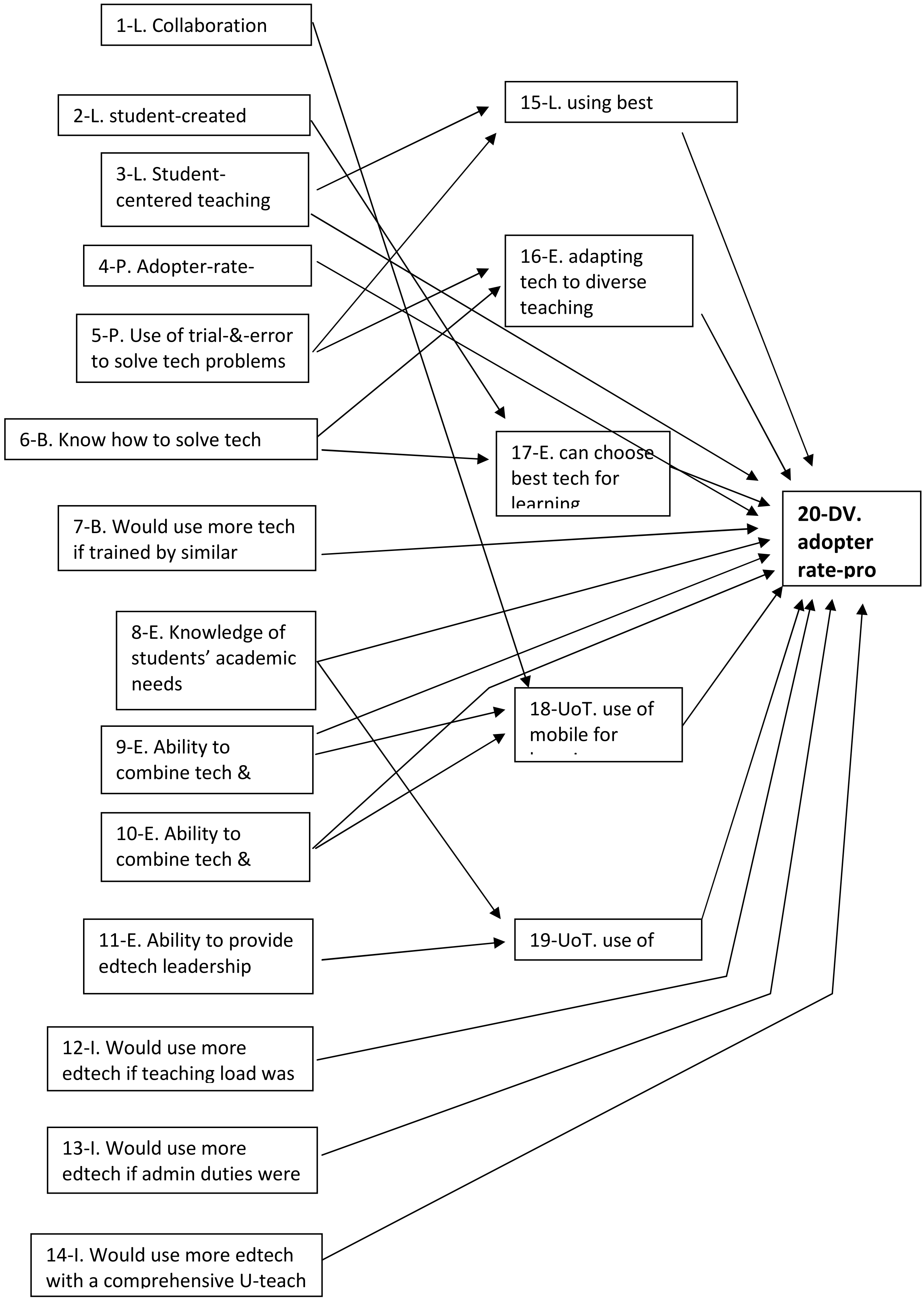
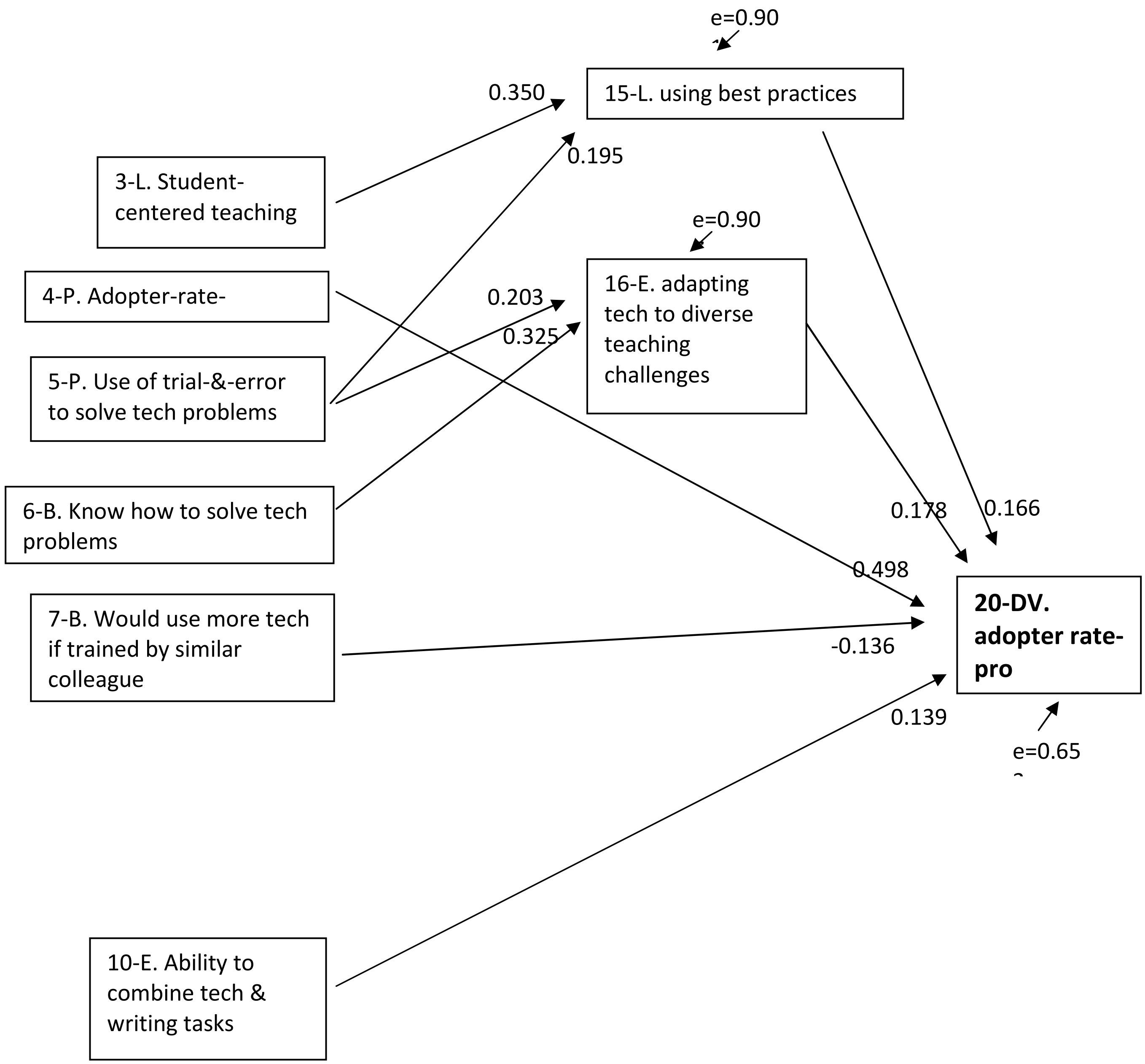


Figure 3. Path Model – Resulting Path Diagram for all Faculty Participants



In education research, most studies do not meet the criteria for experimental designs. This design is powerful because it requires a control group which often accounts for hidden effects on the variables of interest. Absent such a design, the researcher must account for such effects by other means. One approach is to measure all possible variables that might have an effect on the variables of interest. When doing so, researchers must be concerned with multicollinearity. This happens when multiple predictor variables are excessively related with one another. Path analysis helps to address this concern by measuring indirect relationships between predictor and interest variables. Some predictor variables in this study have been termed exogenous. Intermediate endogenous variables are those that are impacted by another variable while impacting the ultimate endogenous variable. The concerns about multicollinearity are at least partly addressed with such analysis techniques (Darmawan & Keeves, 2006).

The following table presents for each pair of variables direct effects, indirect effects, and total causal effects. In addition, they present the original covariation and the residual, or noncausal, effects.

Table 11. Decomposition Table for the Ultimate Endogenous Variable: Adopter Rate for Professional Uses – All Faculty Participants

Path	Direct Effects	Indirect Effects	Total Effects	Original Covariation	Noncausal
20/1				0.435	0.435
20/2				0.434	0.434
20/3		0.058	0.058	0.327	0.269
20/4	0.498		0.498	0.672	0.174
20/5		0.069	0.069	0.333	0.264
20/6		0.058	0.058	0.528	0.470
20/7	-0.136		-0.136	-0.121	0.015
20/8				0.155	0.155
20/9				0.445	0.445
20/10	0.139		0.139	0.438	0.299
20/11				0.576	0.576
20/12				0.118	0.118

20/13				0.114	0.114
20/14				0.104	0.104
20/15	0.166		0.166	0.445	0.279
20/16	0.178		0.178	0.488	0.310
20/17				0.412	0.412
20/18				0.439	0.439
20/19				0.321	0.321

Predictive power of a variable is reflected in the total effect as displayed in the decomposition table (Table 16). The fit of the model can be assessed by examining the error vectors and the noncausal measures listed in the decomposition table. In this path analysis, the largest total effect was for variable 16. Variable seven shows an inverse relationship with adoption of technology, meaning that as such training increased, adoption rate decreased.

Subgroup Path Models

Figures four, five, six and seven display the resulting path models for each of the four pairs of subgroups, followed by the accompanying decomposition tables. Each of these subgroups began with the same proposed model (Figure 2).

Figure three demonstrates the differences between male and female faculty regarding technology adoption. While each showed five variables entering the stepwise analysis, there was only one variable common between the two subgroups. This variable was the adoption rate for personal uses of technology. No variable from the learning impact construct entered for males whereas two entered for the females. One of these two was indirectly related with adoption of technology for professional uses. This was the creation of student-centered teaching through technology use. Males had two variables from the barrier construct while the females had none. One of these two variables was indirect while the other was direct. The indirect barrier variable was the ability to solve technical problems. The direct barrier variable was the training by a similar colleague. Males would use more technology if there was a comprehensive technology plan at the institution. This variable did not enter for the females. Males who were able to adapt technology to diverse teaching challenges were more likely to adopt technology use. This variable did not enter for females. Females who believed that technology use helped determine best instructional practices were more likely to adopt technology use whereas this variable did not enter for males.

Figure 4. Resulting Path Diagram by Gender

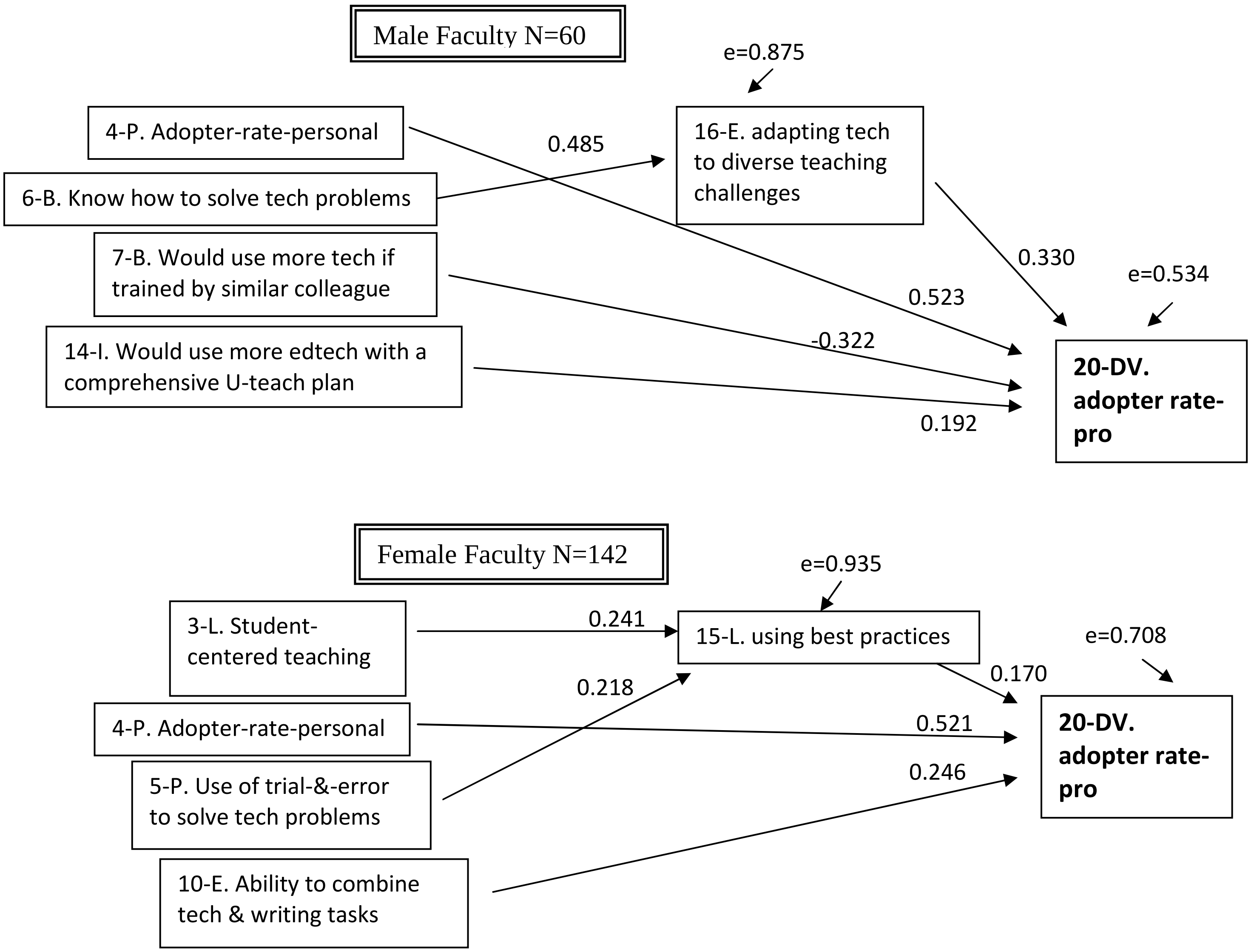


Table 17. Decomposition Table for the Ultimate Endogenous Variable: Adopter Rate for Professional Uses for the Gender Subgroup

Male Faculty

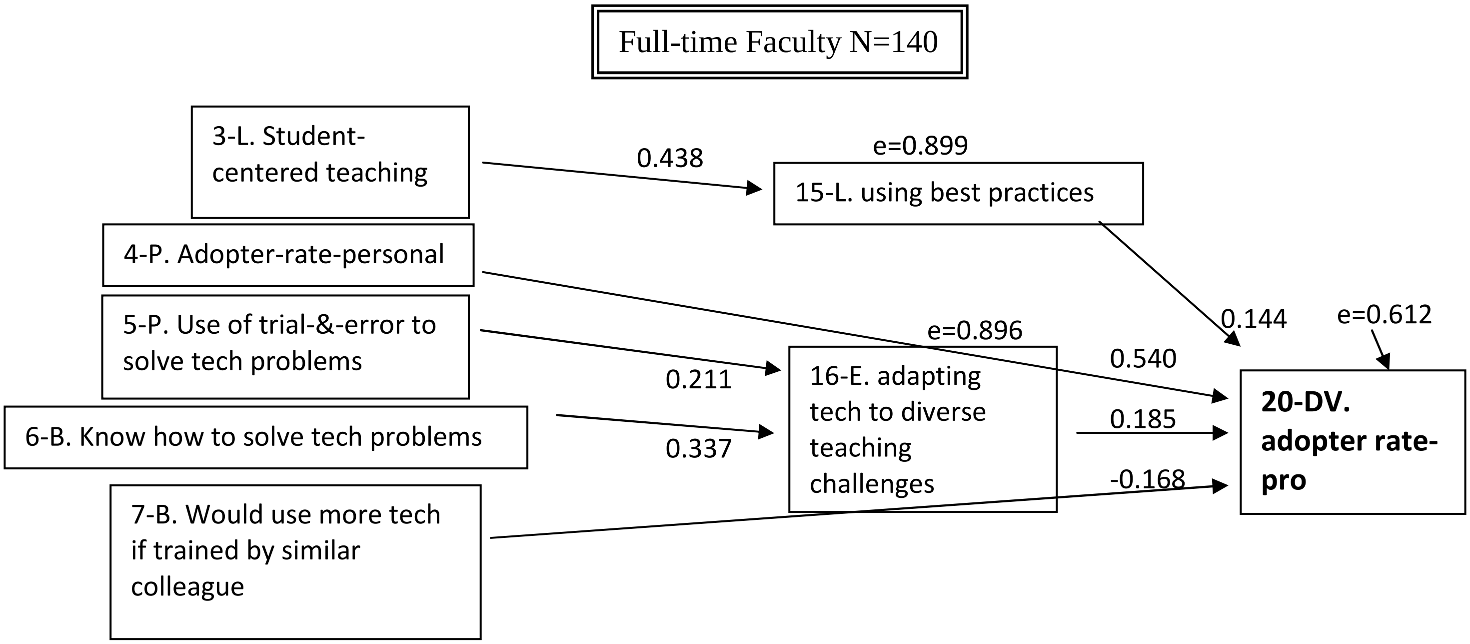
Path	Direct Effects	Indirect Effects	Total Effects	Original Covaraition	Noncausal
20/1				0.435	0.435
20/2				0.434	0.434
20/3				0.327	0.327
20/4	0.523		0.523	0.672	0.149
20/5				0.333	0.333
20/6		0.160	0.160	0.528	0.368
20/7	-0.322		-0.322	-0.121	0.201
20/8				0.155	0.155
20/9				0.445	0.445
20/10				0.438	0.438
20/11				0.576	0.576
20/12				0.118	0.118
20/13				0.114	0.114
20/14	0.192		0.192	0.104	-.088
20/15				0.445	0.445
20/16	0.330		0.330	0.488	0.158
20/17				0.412	0.412
20/18				0.439	0.439
20/19				0.321	0.321

Female Faculty

Path	Direct Effects	Indirect Effects	Total Effects	Original Covaraition	Noncausal
20/1				0.435	0.435
20/2				0.434	0.434
20/3				0.327	0.327
20/4	0.521		0.521	0.672	0.151
20/5		0.037	0.037	0.333	0.296
20/6				0.528	0.528
20/7				-0.121	-0.121
20/8				0.155	0.155
20/9				0.445	0.445
20/10	0.246		0.246	0.438	0.192
20/11				0.576	0.576
20/12				0.118	0.118
20/13				0.114	0.114
20/14				0.104	0.104
20/15	0.170		0.170	0.445	0.275
20/16				0.488	0.488
20/17				0.412	0.412
20/18				0.439	0.439
20/19				0.321	0.321

The full-time and part-time subgroups showed three variables in common (Figure 5). These were adopter rate for personal technology uses, use of trial-and-error to solve technology problems, and the belief that technology use helps identify best instructional practices. For full-time faculty, the use of trial-and-error variable was mediated by the ability to adapt technology to diverse teaching challenges, whereas, the same variable for the part-time faculty was mediated by the belief that technology use helps identify best practices. Full-time faculty were more likely to adopt technology use if they believed it helps create student-centered teaching, if they know how to solve technical problems, and knew how to adapt technology to diverse teaching challenges. None of these variables entered for the part-time faculty. Part-time faculty were more likely to adopt technology use if they believed in the collaborative benefits, had the ability to combine technology use with analysis-based tasks, and used mobile devices for learning. None of these three variables entered for full-time faculty.

Figure 5. Resulting Path Diagram by Full/Part Time Status



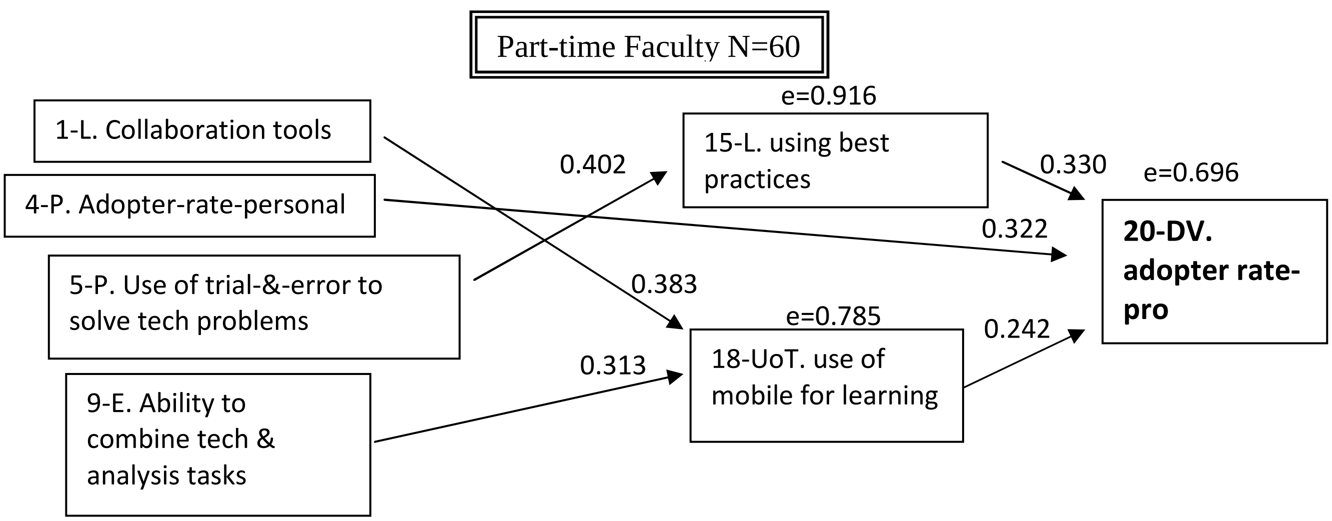


Table 18. Decomposition Table for the Ultimate Endogenous Variable: Adopter Rate for Professional Uses for the Full/Part Time Status Subgroup

Full-time Faculty

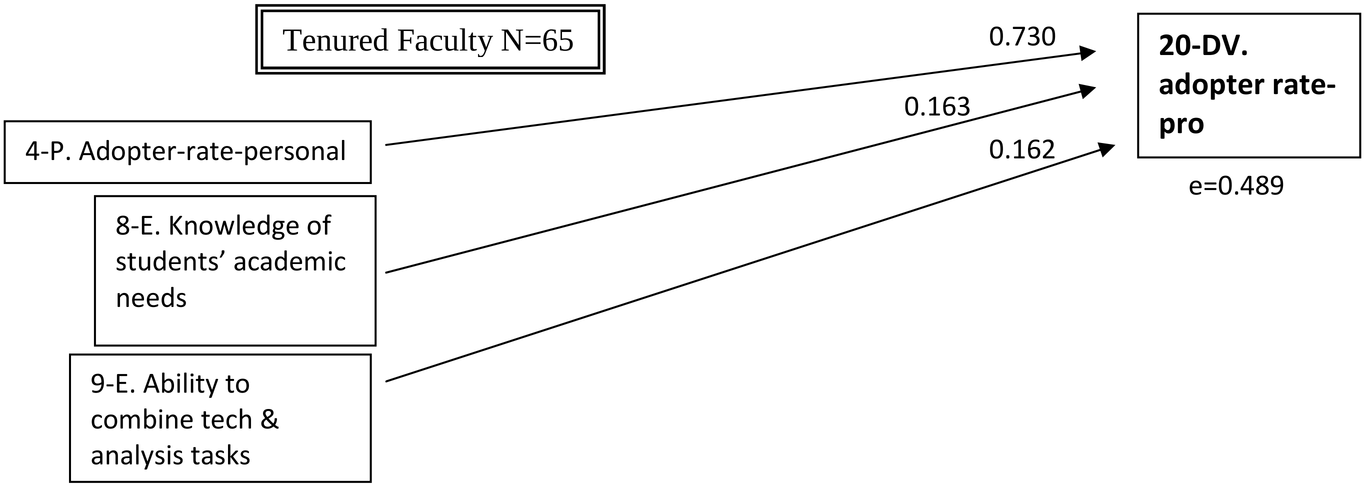
Path	Direct Effects	Indirect Effects	Total Effects	Original Covaraition	Noncausal
20/1				0.435	0.435
20/2				0.434	0.434
20/3		0.063	0.063	0.327	0.264
20/4	0.54		0.540	0.672	0.132
20/5		0.039	0.039	0.333	0.294
20/6		0.062	0.062	0.528	0.466
20/7	-0.168		-0.168	-0.121	0.047
20/8				0.155	0.155
20/9				0.445	0.445
20/10				0.438	0.438
20/11				0.576	0.576
20/12				0.118	0.118
20/13				0.114	0.114
20/14				0.104	0.104
20/15	0.144		0.144	0.445	0.301
20/16				0.488	0.488
20/17				0.412	0.412
20/18				0.439	0.439
20/19				0.321	0.321

Part-time Faculty

Path	Direct Effects	Indirect Effects	Total Effects	Original Covaraition	Noncausal
20/1		0.093	0.093	0.435	0.342
20/2				0.434	0.434
20/3				0.327	0.327
20/4	0.322		0.322	0.672	0.350
20/5		0.133	0.133	0.333	0.200
20/6				0.528	0.528
20/7				-0.121	-0.121
20/8				0.155	0.155
20/9		0.076	0.076	0.445	0.369
20/10				0.438	0.438
20/11				0.576	0.576
20/12				0.118	0.118
20/13				0.114	0.114
20/14				0.104	0.104
20/15	0.330		0.330	0.445	0.115
20/16				0.488	0.488
20/17				0.412	0.412
20/18	0.242		0.242	0.439	0.197
20/19				0.321	0.321

The differences between tenured and non-tenured faculty are displayed in Figure 6. There were two common variables between them, adopter rate for personal technology use and ability to combine technology use with analysis-based tasks. Tenured faculty were more likely to adopt technology use if they had knowledge of students' academic needs. Non-tenured faculty, however, were more likely to adopt if they believed in the collaborative benefits of technology use, they knew how to solve their own technology problems, had the ability to adapt technology use to diverse teaching challenges, and they used mobile devices for learning.

Figure 6. Resulting Path Diagram by Tenure Status



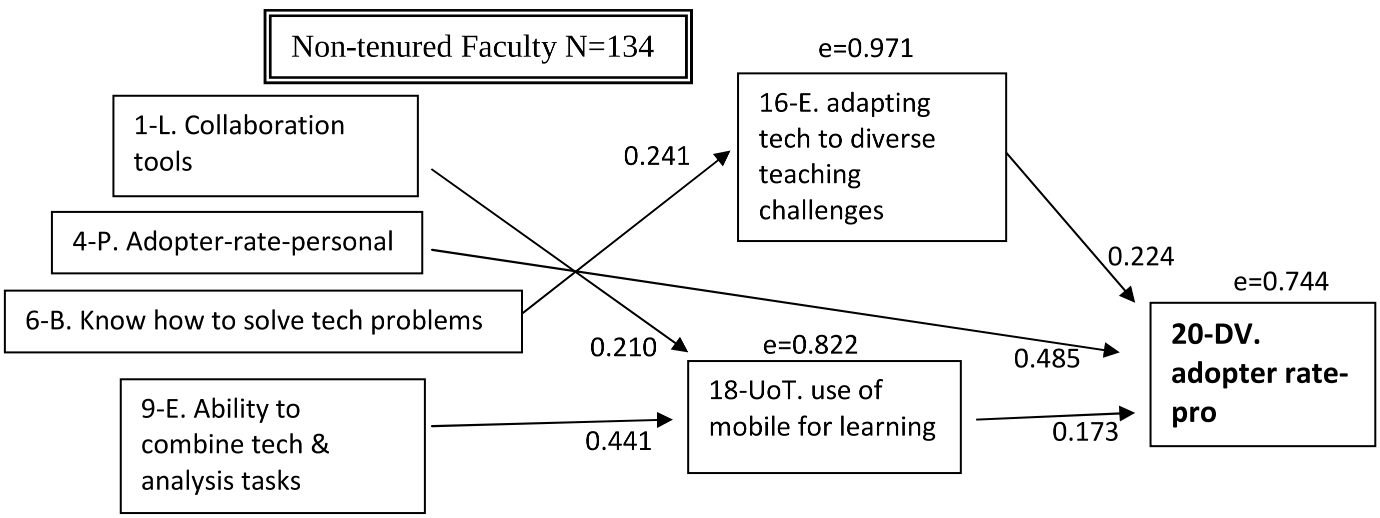


Table 19. Decomposition Table for the Ultimate Endogenous Variable: Adopter Rate for Professional Uses for the Tenure Subgroup

Tenured Faculty

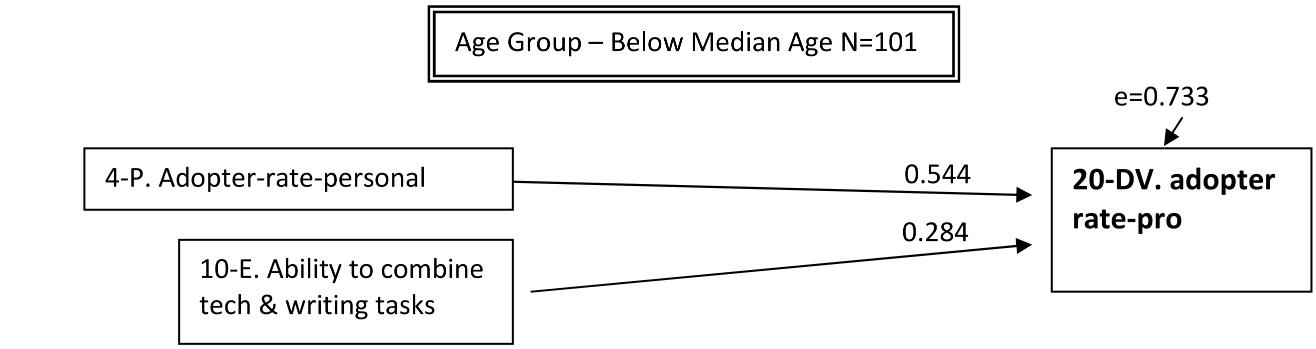
Path	Direct Effects	Indirect Effects	Total Effects	Original Covaraition	Noncausal
20/1				0.435	0.435
20/2				0.434	0.434
20/3				0.327	0.327
20/4	0.730		0.730	0.672	-0.058
20/5				0.333	0.333
20/6				0.528	0.528
20/7				-0.121	-0.121
20/8	0.163		0.163	0.155	-0.008
20/9	0.162		0.162	0.445	0.283
20/10				0.438	0.438
20/11				0.576	0.576
20/12				0.118	0.118
20/13				0.114	0.114
20/14				0.104	0.104
20/15				0.445	0.445
20/16				0.488	0.488
20/17				0.412	0.412
20/18				0.439	0.439
20/19				0.321	0.321

Non-tenured Faculty

Path	Direct Effects	Indirect Effects	Total Effects	Original Covaraition	Noncausal
20/1		0.036	0.036	0.435	0.399
20/2				0.434	0.434
20/3				0.327	0.327
20/4	0.485		0.485	0.672	0.187
20/5				0.333	0.333
20/6		0.054	0.054	0.528	0.474
20/7				-0.121	-0.121
20/8				0.155	0.155
20/9		0.076	0.076	0.445	0.369
20/10				0.438	0.438
20/11				0.576	0.576
20/12				0.118	0.118
20/13				0.114	0.114
20/14				0.104	0.104
20/15				0.445	0.445
20/16	0.224		0.224	0.488	0.264
20/17				0.412	0.412
20/18	0.173		0.173	0.439	0.266
20/19				0.321	0.321

The resultant path models for the age subgroup are revealing (Figure 7). The median age of 46 years was used as the threshold to separate the sample in two groups. The below median age group showed just two predictor variables, both of which were directly related with the ultimate endogenous variable. These were adopter rate for personal uses of technology and the ability to combine technology and writing tasks during instruction. For the above median age group, there were three variables directly related with the ultimate endogenous variable. These were the identification of best practices, adopter rate for personal technology use, and the ability to adapt technology to diverse teaching challenges. The variables indirectly related with the ultimate endogenous variable are the benefits of student-centered teaching, use of trial-and-error to solve technology problems, and the knowledge to solve technology problems.

Figure 7. Resulting Path Diagram by Age Group



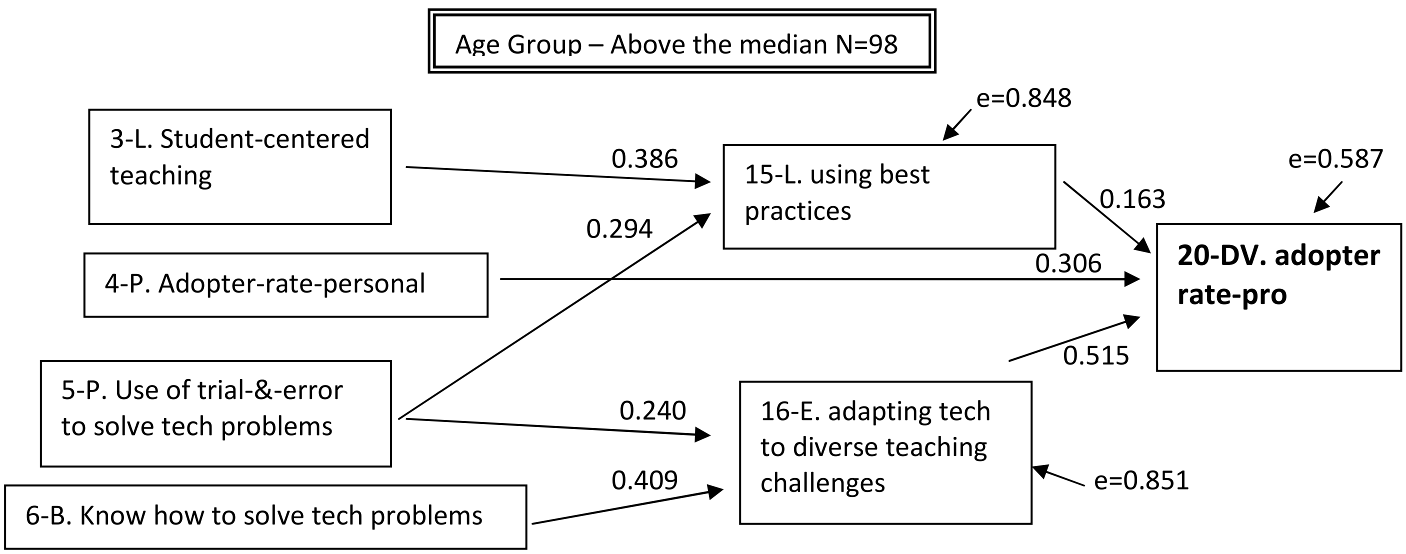


Table 20. Decomposition Table for the Ultimate Endogenous Variable: Adopter Rate for Professional Uses for the Subgroup based on Age

Below Median Age Faculty

Path	Direct Effects	Indirect Effects	Total Effects	Original Covaraition	Noncausal
20/1				0.435	0.435
20/2				0.434	0.434
20/3				0.327	0.327
20/4	0.544		0.544	0.672	0.128
20/5				0.333	0.333
20/6				0.528	0.528
20/7				-0.121	-0.121
20/8				0.155	0.155
20/9				0.445	0.445
20/10	0.284		0.284	0.438	0.154
20/11				0.576	0.576
20/12				0.118	0.118
20/13				0.114	0.114
20/14				0.104	0.104
20/15				0.445	0.445
20/16				0.488	0.488
20/17				0.412	0.412
20/18				0.439	0.439
20/19				0.321	0.321

Above Median Age Faculty

Path	Direct Effects	Indirect Effects	Total Effects	Original Covaraition	Noncausal
20/1				0.435	0.435
20/2				0.434	0.434
20/3		0.063	0.063	0.327	0.264
20/4	0.306		0.306	0.672	0.366
20/5		0.172	0.172	0.333	0.161
20/6		0.211	0.211	0.528	0.317
20/7				-0.121	-0.121
20/8				0.155	0.155
20/9				0.445	0.445
20/10				0.438	0.438
20/11				0.576	0.576
20/12				0.118	0.118
20/13				0.114	0.114
20/14				0.104	0.104
20/15	0.163		0.163	0.445	0.282
20/16	0.515		0.515	0.488	0.027
20/17				0.412	0.412
20/18				0.439	0.439
20/19				0.321	0.321

Heuristic Analyses: Regressions of the Ultimate Endogenous Variable onto the Variables within Each Construct

In this section, regressions were run to determine the relationships with the ultimate variable. While many variables were included in the data collection instrument, the 19 exogenous and intermediate endogenous variables in Figure 2 were selected for the primary conceptual model based on strong support from prior studies.

Linear regressions were run with the variable of interest, adoption rate for professional uses of technology, as the dependent, or ultimate endogenous, variable. To identify key relations between construct variables and adoption rate, each set of variables within a given construct was entered using the stepwise method separately. The variables entered for each construct were listed earlier in Table 1. For example, of all the barrier variables included in the analysis, only two entered using the stepwise method. These were keeping abreast of technology news and having the technical skills needed to use technology (Tables 10-14). These variables were responsible for 37.5% (R squared value of 0.375) of the variation in adoption rate. The second of these variables had been included in the path model while the first was not. The primary reason is that technology news updates did not appear with any degree of prominence in the review of prior studies nor was it evident as important in the commentary by the current study's participants. The additional barrier variable that indeed was added to the model was training by a similar peer or colleague. This inclusion was based on the change agent qualities described by Rogers (2003).

The efficacy construct similarly showed two variables entering the analysis. These were the ability to provide leadership in education technology matters and the ability to adapt technology to diverse teaching challenges. The Rsquared value for these two was 0.348. Both of these variables had been included in the model. Additional efficacy variables were added to the model. These were the ability to combine technology use with analysis tasks, ability to combine technology with writing tasks, the knowledge of students' common misunderstandings of the subject matter, and the ability to choose the best technology for instruction. Prior studies have indicated the importance of efficacy with the subject matter being taught in technology adoption. These three additional efficacy variables specifically reference this aspect of instruction.

The personal use of technology construct produced five variables in the regression output. These were adopter rate for personal uses of technology, use of trial-and-error to solve technology problems, receiving regular newsfeeds on technology matters, sharing media such as videos and photos, and having a Facebook account. Only the first two variables listed here had been included in the path model. The others were excluded given their absence as key factors in the body of literature. The combination of these five variables produced an R squared value of 0.539.

The analysis of the learning benefits construct produced four significant variables. These were using best practices, helping with differentiated learning styles, student-created content, and managing courses online. The R squared for these variables was 0.318. Of these, using best practices and student-created content had been included in the path model. While some prior studies supported the benefits for different learning styles, several found no impact. Therefore, this variable was excluded. The management of courses online was scantily supported by prior studies. For this construct, two additional variables were added to the model. These were the use of collaborative tools and student-centered teaching. These additions were based on prior research supporting their inclusion. For example, Ma, Williams, Prejean, Lai, and Ford (2008) indicated the important role technology can play in creating student-centered teaching. Their study examined this relationship during field experience portions of a teaching program and emphasize the benefits of student-centered teaching. Jeffs and Banister (2006) found improvements in collaboration between those teaching in special education and those teaching in general education when the use of technology was employed. Both types of teachers had face to face as well as online meetings. The study participants indicated much more meaningful and deeper interactions during the online collaboration sessions (Jeffs & Banister, 2006).

The institutional policy construct produced three significant variables. These were improving adopter rate, use of technology if on-demand training was available, and attending technology-focused professional development if available. Their R squared value was 0.567. Given the overwhelming support in prior studies for variables other than these, none had been included in the current model. Rather, course load and administrative duty reductions as well as a clear institutional vision for technology were amply supported by prior studies and thus included. Additionally, these variables were strongly supported by the summarized commentary provided by participants of the current study (Table 18). Wallace (2007) indicated the imperative for institutions to examine their policies regarding faculty workload and responsibilities. Her suggestion is to have such policies allow for flexibility such that faculty can have time to research and implement technologies and students are free to interact with the content as most appropriate.

Table 10. Predictor Variables from the Barrier Construct using the Adopter Rate for Professional Uses as the Dependent Variable

Barrier Construct Variables	β	t	Sig.
B. [I keep up with important new education technologies.]	.411	5.565	.000
B. [I have the technical skills I need to use education technology.]	.260	3.516	.001

R= .613 R^2 = .375 N= 203 F= 60.070 sig f = .001

Table 11. Predictor Variables from the Efficacy Construct using the Adopter Rate for Professional Uses as the Dependent Variable

Efficacy Construct Variables	β	t	Sig.
E. [I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches in my college/department.]	.449	5.987	.000
E. [I can adapt the use of the technologies that I am learning about to different teaching activities.]	.196	2.616	.010

R= .595 R^2 = .354 N= 203 F= 54.857 sig f = .010

Table 12. Predictor Variables from the Personal Use Construct using the Adopter Rate for Professional Uses as the Dependent Variable

Personal Use Construct Variables	β	t	Sig.
P. [When new technologies are released, I am typically among the following group of adopters for personal use (cell phones, computers, laptops for personal use).]	.573	10.795	.000
P. [Using a "trial and error" approach has increased my knowledge on use of education technologies.]	.219	4.484	.000
P. [I receive regular news feeds about education technology (newsletters, email listservs, reviews of web news).]	.155	3.098	.002
P. [I post videos/photos to a sharing service (Flickr, YouTube, Google Docs, etc.).]	.159	2.794	.006
P. [I have a Facebook account and log onto it.]	-.122	-2.214	.028

R= .742 R^2 = .550 N= 203 F= 48.229 sig f = .028

Table 13. Predictor Variables from the Learning Benefit Construct using the Adopter Rate for Professional Uses as the Dependent Variable

Learning Benefit Construct Variables	β	t	Sig.
L. [Understanding and using best practices of teaching with technology.]	.198	2.582	.011
L. [Technology can help accommodate different learning styles.]	.242	3.888	.000
L. [Student-created content (i.e. video, audio, web pages);]	.190	2.502	.013
L. [Teaching and managing courses delivered entirely online;]	.153	2.366	.019

R= .564 R^2 = .318 N= 203 F= 23.115 sig f = .019

Table 14. Predictor Variables from the Institutional Policy Construct using the Adopter Rate for Professional Uses as the Dependent Variable

Institutional Policy Construct Variables	β	t	Sig.
I. [I could be among the following adopter type if my university/college provided more support.]	.692	14.154	.000
I. [I would use technology tools more if I could receive on-demand training support in addition to the initial training session;]	-.206	-4.075	.000
I. [I would attend technology-based professional development activities if my university/college offered them.]	.143	2.719	.007

R= .753 R^2 = .567 N= 203 F= 86.733 sig f = .007

Alternative Path Analysis

The survey instrument included several items that were not included in the path models above. These items were included on the survey based on the body of literature on the topic and/or personal experiences of the principal researcher of the current study. A path analysis was conducted using all 65 variables included in the survey (Figures 8 and 9). Each endogenous variable was regressed against all the variables within the constructs that are directly related to it. The ultimate endogenous variable adoption rate for professional uses was regressed against all 65 variables. Of all the “efficacy” variables, three entered the stepwise analysis. Each of these three efficacy variables was treated as a dependent variable and regressed against all “learning benefits”, “personal uses”, and “barriers” variables (based on the model presented in Figure 8). The resultant model is presented in Figure 9.

Figure 8. Proposed Path Model using Constructs

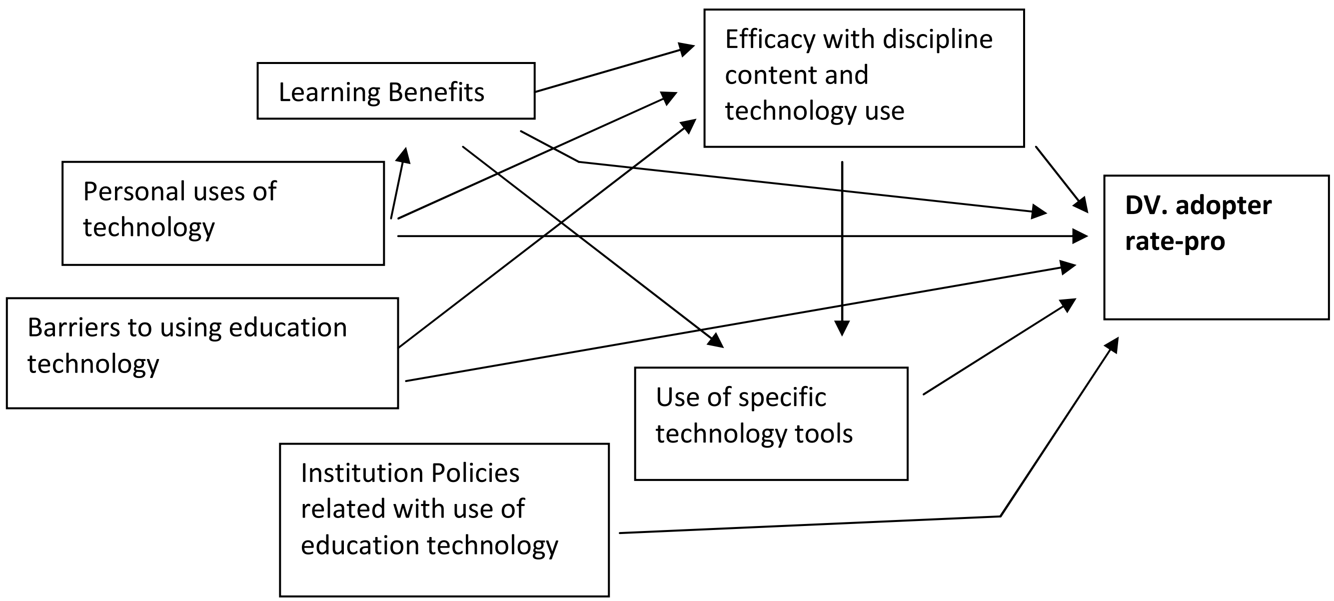


Figure 9. Resultant Path Model using all Variables within each Construct

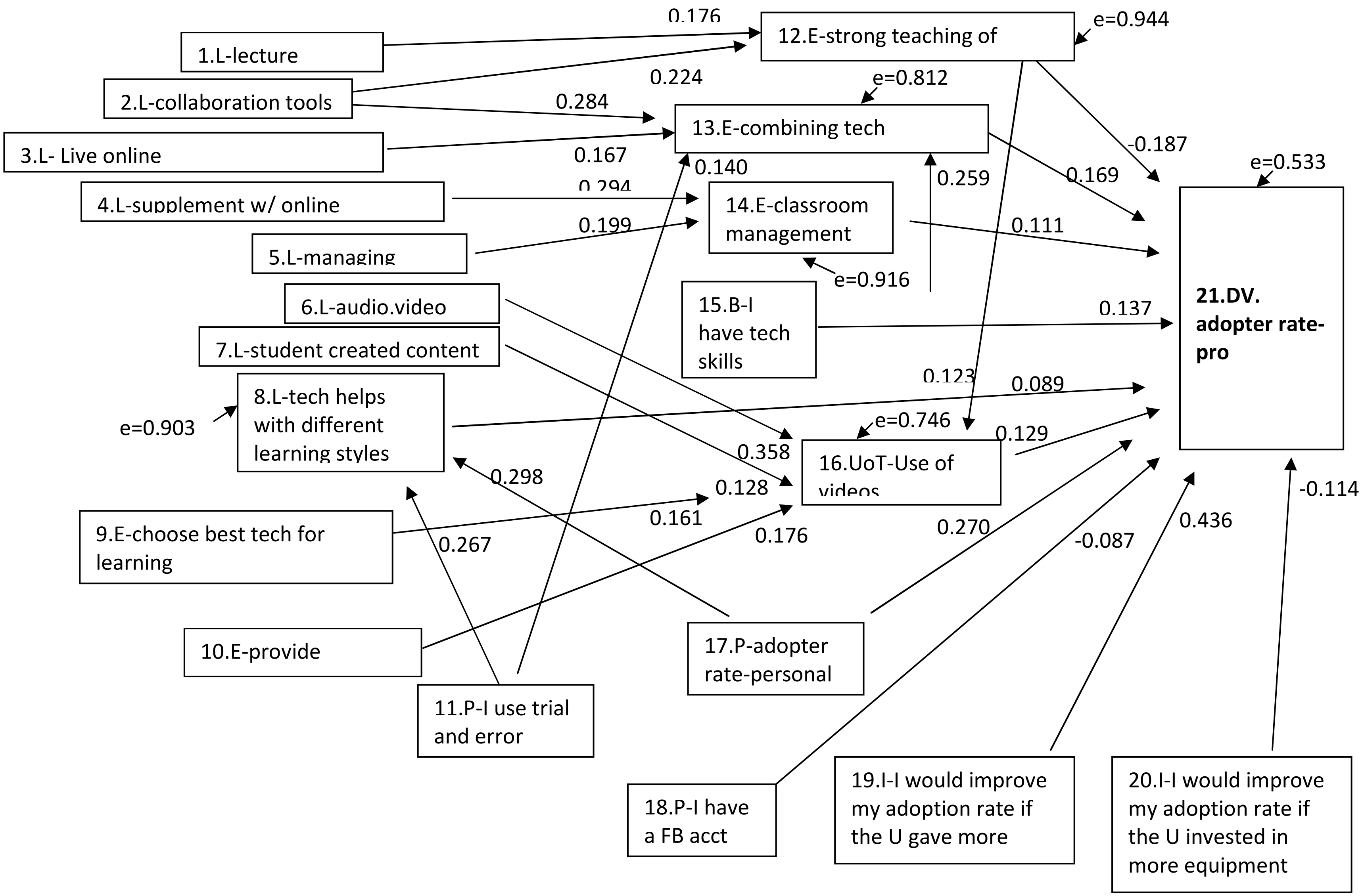


Table 21. Decomposition Table for the Ultimate Endogenous Variable: Adopter Rate for Professional Uses (before model entered 65 independent variables)

Path	Direct Effects	Indirect Effects	Total Effects	Original Covaraition	Noncausal
21/1		-0.033	-0.033	0.237	0.27
21/2		-0.042	-0.042	0.435	0.477
21/3		0.028	0.028	0.367	0.339
21/4		0.033	0.033	0.334	0.301
21/5		0.022	0.022	0.255	0.233
21/6		0.046	0.046	0.320	0.274
21/7		0.017	0.017	0.434	0.417
21/8	0.089		0.089	0.387	0.298
21/9		0.021	0.021	0.412	0.391
21/10		0.023	0.023	0.576	0.553
21/11		0.048	0.048	0.333	0.285
21/12	-0.187	0.016	-0.171	0.130	0.301
21/13	0.169		0.169	0.438	0.269
21/14	0.111		0.111	0.255	0.144
21/15	0.137		0.137	0.449	0.312
21/16	0.129		0.129	0.444	0.315
21/17	0.270	0.027	0.297	0.672	0.375
21/18	-0.087		-0.087	0.133	0.22
21/19	0.436		0.436	0.726	0.29
21/20	-0.114		-0.114	0.113	0.227

The resultant diagram in Figure 9 displays the variables that remained after conducting the analysis using stepwise entry. The ultimate endogenous variable has an error vector of 0.533. This error vector is slightly lower than that of the original resultant path diagram (Figure 3). That error vector was 0.653. The original conceptual model in Figure 2 shares seven variables with the new resultant diagram in Figure 9 (variables 1, 2, 4, 5, 6, 10, and 11 in Figure 2). The resultant diagram from the original conceptual model in Figure 3 shares four variables with the resultant diagram in Figure 9 (variables 4, 5, 6, and 10 in Figure 3).

Open-Ended Survey Responses

Table 22 lists the themes that emerged from the open-ended item responses. Since some participants offered more than one comment, the total number of comments exceeds the number of survey completers. Highlighted in grey are the comments made by 10 or more participants.

Increases in technology adoption were more likely if faculty had more time to learn and experiment with such tools, had access to updated and working equipment, and had training that was relevant, effective, and on-demand.

Table 22. Themes from Open-Ended Survey Responses

Themes from Open-Ended Responses		
	# of comments made by faculty participants	% represented
tech support-on demand & one-to-one	15	6%
access to updated & working equipment by faculty	55	21%
access to working equipment by students	6	2%
U policy-ease of use policies	5	2%
students not tech savvy; digital natives a farse	12	5%
time to learn and use equipment	70	27%
training that is relevant and effective	28	11%
discipline specific support	5	2%
training from similar colleague	3	1%
lack of collaboration	6	2%
networking effectiveness; mac v PC; off-site support	10	4%
bandwidth	1	0%
simpler/integrative SW&HW equipment	4	2%
Supportive culture; buy-in from fac & admins	13	5%
resistant faculty	3	1%
learning curve	4	2%
incentive; pedagogical or financial benefits	14	5%
financial incentive	2	1%
tech vision	4	2%
Total	**260**	**100%**

Chapter 5
Discussion/Conclusions

Introduction

The findings of the current study and their relationships to prior studies are presented below. Four of the five hypotheses have been supported. Each hypothesis predicted a significant relationship between a construct and the adoption rate. The one construct that did not persist as a predictor was the institutional policy. Table 23 displays the strongest predictors of technology adoption for all faculty participants as well as for each subgroup. Using the total causal effect for each group, the top three variables are indicated with an 'X'. Adoption rate for personal uses was most persistent among all these groups. This is followed by the variables belief that it is important to identify and use best instructional practices incorporating technology and the ability to adapt technology to diverse teaching challenges. The least persistent variables in Table 23 include technical ability to resolve glitches (appeared for the above median age group only), knowledge of students' academic needs (appeared for tenured group only), and the ability to combine technology with writing tasks (appeared for tenured group only).

Table 23. Summary Presentation of Key Predictors of Technology Adoption

	Faculty Groups								
	All	Male	Female	Full-time	Part-time	Tenured	Non-Tenured	Below Median Age	Above Median Age
4-P. Adopter-rate-personal	X	X	X	X	X	X	X	X	X
6-B. Know how to solve tech problems									
7-B. Would use more tech if trained by similar colleague		X		X					
8-E. Knowledge of students' academic needs						X			
9-E. Ability to combine tech & analysis tasks						X			
10-E. Ability to combine tech & writing tasks			X					X	
15-L. using best practices	X		X	X	X				
16-E. adapting tech to diverse teaching challenges	X	X					X		X
18-UoT. use of mobile for learning					X		X		

Barriers

Using the importance of achievement, fulfillment, administrative support, growth, and compensation as bases for the theoretical framework, Gautreau (2010) examined the factors most important in motivating the use of technology in higher education instruction. She found that non-tenured faculty were more likely to adopt technology for teaching. She also found that personal uses of technology transferred to professional uses among this study sample. The top three motivating factors identified in this study were compensation, responsibility, and achievement. Additionally, she confirmed the importance of sufficient training and development in effective adoption. Suggestions for further work include increasing awareness of motivational factors among subgroups, examining of prohibitive factors, faculty development, and enhancing technology skills (Gautreau, 2011).

These findings are aligned with the current study. The two barrier variables in the proposed model were the ability to solve technology problems and receiving training from a similar colleague. The first variable was chosen to address an intimidation factor regarding technology use. The second variable was chosen based on the Rogers' (2003) change agent principle. This states that adoption is more successful if the trainee deems the trainer as similar in rank, status, or position. For all faculty, the barrier related with technical skill was indirectly related with the likelihood to adopt technology. The intermediate endogenous variable in the indirect relationship was the ability to adapt to diverse teaching challenges.. Additionally, access to training by a peer trainer was related directly with the ultimate endogenous variable and produced a path coefficient of -0.136. Given the negative coefficient, the relationship between this training barrier and adoption of technology is inverse (Figure 2).

When examining this construct in the males versus females model, the training by a similar colleague was inversely related with adoption for males. Neither of the barrier variables entered for females. This means that intimidation was not a factor in the adoption of technology. Neither barrier variable was related to adoption of technology when comparing full-time versus part-time faculty. For full-time faculty, the ability to solve technical problems was indirectly related to adoption through the mediating variable ability to adapt technology to diverse teaching challenges. Neither barrier variable was directly related to adoption when assessing tenured versus non-tenured faculty. However, the ability to solve technology problems was indirectly related to adoption for non-tenured faculty. This was mediated by the variable ability to adapt technology to diverse teaching challenges.

It is instructive to know that these barrier variables had no prominent role in the adoption of technology. Since the training variable was not key, training program at institutions need no major reorganization based on peer training models. The ability to solve technology problems was, however, more important. Change agents should address this gap with effective support on key technology problems and their solutions.

Learning impact

Education technologies allow for student-centered instruction in ways not possible otherwise. Students are better positioned to take more responsibility over their learning. This is often done by equalizing the access to the "microphone" during online discussions and interactions (Sadykova & Dautermann, 2006). For all faculty in the current study, beliefs in the benefits of student-centered teaching related indirectly with the adoption of technology. This variable was mediated by the belief that using technology for instruction would help identify best practices. The total causal effect for these relationships was 0.058. The error vector, 0.901, suggests moderate predictive power (Figure 2).

Oner and Adadan (2011) identified the following as learning benefits when using technology-based platforms for instruction: easy access to content, supported organizational challenges, timely collaboration with peers, and ease of assignment submission. In their study, students lauded specific characteristics of technology-driven instruction. Online discussions encouraged students to present well-researched information. They also suggested that online and transparent feedback from peers placed positive pressure to be well-informed. This was done by more reflection and draft-writing on the part of students (Oner & Adadan, 2011). While the current study included peer collaboration and student-created content, neither variable entered using the stepwise procedures for all faculty participants. However, for both part-time faculty and non-tenured faculty, the variable benefits of collaboration was indirectly related with technology adoption. In each case, this learning impact variable was mediated by the use of mobile devices for learning variable. It might be argued that there is much overlap between the part-time faculty and non-tenured faculty subgroups. Some non-tenured faculty might be full-time and simply on a non-tenure track position, while others might be adjuncts.

Sherman, Crum, and Beaty (2010) found that students in education leadership programs identified several benefits to using education technologies in higher education. These included creation of more independent learners, connections between theory and application, as well as display of knowledge and skills related to program standards. However, whether the delivery of content via technology was superior to face to face modalities was equivocal. The suggestions for future researchers on this topic were to allow the measure of technology efficiencies to be based on guidance of peers, importance of networks, and role of technology-based communities

(Sherman, Crum, & Beaty, 2010). Some faculty indicated the importance of the application of theory using technology-enhance instruction in the open-ended responses of the current study.

In a study by Brown (2011), student feedback on the role of education technology on learning was investigated. While students thought there was an increase in workload with the use of education technology, they believed learning improved. The increased workload was related to the required adjustment to use of the technology tools. A concern expressed by faculty was about questionable authenticity of student work. Some have suggested requiring hard copy versions of artifacts until technology-based solutions to verify authenticity are devised (Brown, 2001). In the current study, student work authenticity was not a concern, however, the added workload was. During some open-ended survey responses, faculty indicated the need to teach and for students to learn about the use of particular technology tools. This often subtracted from time and effort toward learning the content of the course.

Kay and Lauricella (2011) were interested in the technology behaviors of undergraduate students with special focus on the driving forces. They identified the advantages and disadvantages of technology use in higher education instruction. A salient finding was that the list of advantages overwhelmed the list of disadvantages. The advantages included note-taking, communication for collaboration, academic research, among others. Disadvantages were about distractions. These included instant messaging for personal reasons, engaging in games, movie-watching and internet surfing, as well as technical problems, maintaining focus on academics, and self-discipline (Kay & Lauricella, 2011). The current study reinforced the benefits of technology use by highlighting that it helps faculty create student-centered teaching and the identification of best instructional practices. These variables were important in the resulting path model for all subgroups except tenured and male faculty. That is, female, full-time, part-time, and non-tenured faculty used technology for these two learning benefits.

Jefferies and Hyde (2010) revealed the high expectations students have of professors regarding technology use. This was to the extent that students invested their own money on updated equipment and subscriptions for technology use for their learning. These uses were creative and innovative. However, they rendered the modeling by professors inadequate. These self-guided students showed increased competence and confidence with technology use for learning benefits during their course of study. Use of an LMS was seen as critical to a positive learning experience. While busier students were shown to use technology for learning purposes more than others, most students favored blended learning environments rather than those that were strictly technology-based or classroom-based (Jefferies & Hyde, 2010). This is contrary to the responses by faculty to the open-ended survey items in the current study. Many were concerned that students lacked the technical knowledge and inquiry to use technology effectively. Several indicated the need to spend much instructional time teaching the technology prior to the content of the courses.

Littlejohn, Margaryan and Vojt (2010) examined the learning benefits of technology use in teaching. These benefits were reported by students and were strongly connected to technology use. The learning impact varied by students' technology skills. Those with higher skills believed in the learning benefits more than those with low skills. This was true even though most students did not expect to see a difference in learning benefits at the onset. Additionally, the correlation between students' self-efficacy with the content and their technology use was low. One possible explanation for this was that institutional practices favored traditional, tutor-based instruction. This explanation is also offered to clarify the reason why students use technology more prolifically outside the classroom than in. Examples include employment, social and personal uses of technology (Littlejohn, Margaryan & Vojt, 2010). Several faculty in the current study identified the gap between personal uses of technical (such as texting, facebook participation and email use) and the willingness to invest with similar interest in classroom-based technology tools.

With a focus on serving student needs through assessment, Pellegrino and Quellmalz (2010) discuss the emerging synergy among uses of technology, instruction, theory and practice. Current technologies offer deeper insights into what students learn, how they learn it and ways to improve learning. With such an emphasis on cognitive development, Pellegrino and Quellmalz (2010) laud the potential and untapped benefits of technology-driven student assessment. Measurements of learning can be more accurate, timely and efficient. This would be true even when the amount of instructional data is multiplied. Formative and diagnostic uses of technology-based assessments are certain to improve student learning (Pellegrino & Quellmalz, 2010). In the current study, faculty who adopted technology more readily believed in its ability to help identify best instructional practices. This was true for the all-faculty model, the model based on full-time/part-time faculty, and for the female faculty. The male, tenured, and non-tenured subgroups showed no connection between best practices and technology adoption.

Bell (2011) argues for the improvement and spreading of technology-driven learning. The alternative theory offered, called Connectivism, touts the learning benefits of technology-driven instruction. Described are five requirements for such benefits to be realized. The first is the teacher's use of advanced technology tools in the classroom, otherwise, known as Web 2.0. Blogs and wikis provide insight into students' thinking and learning development. Deep integration of these tools allows instructors to capitalize on the instructional benefits of technology use. Secondly, institutions should welcome the open resource communities. Building on the actor-network framework, connectivism encourages the accumulation of freely accessible resources and content for the benefit of all. Information literacy is the third requirement. With the student experience as the focus, information literacy is most successful when training efforts are measured as a return on investment. The fourth requirement is the study of informal and educational uses of technology by students. The personal versus educational divide regarding the use of technology is of interest here. While low achieving with school content, some students demonstrate deep investment in self-directed learning using Web 2.0. The final requirement is community-based. There should be assurance that low-resource communities have access to Web 2.0 tools to foster community learning (Bell, 2011). The current study demonstrated faculty's belief in the learning benefits of technology use. These benefits varied among the various subgroups, however, the consensus is that technology use should indeed be encouraged and supported for the sake of student learning.

Institutional Policy

The relationship between institutional policies and education technology adoption was described by Cao and Sakchutchawan (2011). Such policies that supported access to content delivery by distant faculty and students enhanced the use of such tools. To enhance an institution's cultural relevance, realize maximum learning benefits, and attract creative faculty, Sadykova and Dautermann (2006) recommend the following: supporting the gap between students' and faculty's technology prowess with clear postings and articulation of expectations, precise advisement to students about such expectations, and robust and ongoing training support for faculty. The current study offered lessons in the importance of aligning the technical know-how between faculty and students.

The Parisot (1997) study examined the importance of institutional policies in faculty adoption of technology. Recognizing the centrality of the faculty experience, this study focused on ways to recruit faculty participation in education technology initiatives. Because the identified barriers included faculty concerns about learning benefits, the changing role of the instructor, and perceiving the technology movement as threatening, suggestions were offered to overcome these. Modeling, encouragement, and training were some of these proposed solutions. It was also found that adoption rates varied by college departments so a unit-wide rate wasn't seen as representative. One of the reasons for this is the varying degrees of support and modeling available to faculty which are not uniform across the college unit. The best results occurred when faculty were able to pilot the technology tools and observe others using them. These are two key principles in Rogers' (2003) framework. The findings of this study resulted in a theoretical model which builds on Rogers' (2003). The focus of this model is on faculty agreement regarding the benefits and uses of education technologies. The four-part model includes acknowledgement, awareness, acculturation and affirmation. Acknowledgement is the first step to unit-wide adoption; requiring faculty ownership of technology use being central. Awareness is the stage when faculty agreement is built. There must be clarity on the benefits of and roles education technologies should have in the instructional programs. This clarity will help mitigate what is referred to as cyberphobia. Technology use should be driven by outcome benefits, not merely the need to use the most current tools. Acculturation is when decisions are made to adopt. This requires faculty to take on facilitator roles for the purpose of modeling and garnering buy-in. This also demands that technology initiatives be student-centered which will assist in the faculty adoption. Affirmation is when the decisions made during the acculturation stage are reinforced. This stage is a critical one and is supported by institutional policies. For example, release time, monetary incentives, and professional development support are all policies that will help sustain the unit adoption of education technologies (Parisot, 1997).

In addition to the learning benefits of technology use, Junco and Chickering (2010) examined the social and communication impacts. They describe the significance of clearly and widely-publicized institutional policies on use of technology. Guidelines should include rules for engaging via technology-driven interactions, appropriate roles for students, faculty, and staff, as well as the role for opinion leaders, referred here as technology ambassadors. They describe the need for civil interactions regarding online communication which starts with institutional policy declarations. Additionally, policy statements can foster responsible and effective uses of technology for learning and general communication. Such statements should also sanction the role and value of opinion leaders to achieve the requisite faculty engagement as well as support faculty modeling regarding effective uses of technology (Junco & Chickering, 2010).

Diem (2002) touts the learning benefits of technology use for instruction in high school. This, however, requires appropriate technology training and support during pre-service instruction. Such curriculum-based training should be supported by institutional policies. Otherwise, the digital divide between newly trained teachers and the students they serve will create conflict regarding effective technology use. Such deficiencies in teacher training prevent authentic integration of technology in instruction. While institutional policies can have a progressive impact on such trends, it remains true that student demand for technology use outpaces policy-driven practices (Diem, 2002).

While institutional policy variables did not enter the stepwise analysis in the current study, there were several references by faculty to the importance of creating and maintaining supportive culture. Elements of this included the need for buy-in from faculty and administrators as well as the need for effective and on-demand training. Such a culture can be supported by institutional policies that foster and celebrate the effective use of education technology.

The three institutional policy variables used in the current study did not enter the analysis. These variables included reduction in course load for use of technology, reduction in administrative duties for use of technology, and an institution-driven technology plan. This is countered by the comments made in the open-ended item survey responses. Among the prominent themes was the need for more time to learn and use new technologies. The lesson learned regarding this construct is that change agents should support faculty adoption of technology by identifying efficient ways to provide time allowances to learn and experiment with such tools.

Personal use

Shoffner (2009) identified a connection between personal uses of computers and use for instructional purposes. Those who spent more time on a computer for personal reasons also used blogs and discussion boards that were course content-based. Faculty who engage with education technologies are typically self directed, early adopters. They are more apt to learn these new tools and transfer their personal to professional uses (Sadykova & Dautermann, 2006). The two personal use variables in the current study that were part of the proposed path model entered the stepwise analysis. The adopter rate for personal use was directly related with the adopter rate for professional use for all faculty. This path coefficient was 0.498, the strongest of all paths to the endogenous variable. The other personal use variable, use of trial-and-error, was indirectly related with the ultimate endogenous variable. The first indirect relationship was through the learning impact variable identifying best practices. This total causal effect coefficient was 0.032. The second indirect relationship was through the efficacy variable adapting technology to diverse teaching challenges. This aggregated path coefficient was 0.036. The use of trial-and-error was evidently important for both identifying best practices for learning and for adapting to teaching challenges.

Kumar and Vigil (2011) also highlight the importance of modeling effective and creative uses of technology-driven instruction. Even with clear standards for technology use, teacher preparation programs lack appropriate support for optimal modeling. Such standards include those from the International Society for Technology Education (ISTE), the National Education Technology Standards for Students (NETS-S), and the National Council on Accreditation of Teacher Education (NCATE). Among students, personal uses of technology don't seem to transfer to classroom uses in an automated way. Additionally, of seven technology platforms (online forums, social bookmarking, Google Docs, blogs, wikis, podcasts and online videos), only one showed more use for education than in private lives. This platform was online forum and the explanation was that such forums have been in use for many years and consequently are embedded in higher education culture (Kumar & Vigil, 2011).

With an emphasis on constructivist teaching, Rakes, Fields, and Cox (2006) examined the impact of personal technology use on teaching. They found low uses of instructional technologies were caused by lack of time with the tools. Even when personal uses of technologies were deemed high, instructional uses were still low. When treating the instructional use variable as the dependent and personal use variable as independent variables in a multiple regression technique, they found personal use as a strong predictor of instructional use of technology. Additionally, technology adoption was found to be a strong predictor of constructivist teaching. These findings are especially significant since they cite the benefits of technology adoption on higher cognitive skill and development of complex thinking (Rakes, Fields, & Cox, 2006).

Panda and Mishra (2007) explored barriers, institutional policies and personal interests as related to technology adoption. Faculty attitudes toward technology were measured at the onset of the study and were found to be moderately positive. While these faculty predisposition were initially encouraging, it was found that attitudes did not improve with increased support and training. The requisite professional development should focus on the top barriers to embracing technology use. The top general barriers include concerns about student access, training, strength of institution networks, institutional policies and on-going support. With specific focus on incentives, focus should be placed on personal interest and usage and intellectual challenge. A necessity to help encourage adoption, especially for the positively predisposed, is the removal of key barriers. Supporting faculty personal interest should include ongoing development of the integration of technology use and pedagogy, a supportive institutional policy facilitating the design, implementation and reflective stages of adoption, access to network resources, hardware and software (Panda & Mishra, 2007).

Lowther, Inan, Strahl, and Ross (2008) examined the impact of removing barriers to technology use on the integration of it in instruction. The identified barriers include access to computer equipment, access to relevant curricula, beliefs of instructors, technology competence of instructors, and support. When these barriers were mitigated, technology usage improved. For example, the treatment group saw statistically significant differences in the following: technology use as a resources, project-based and technology-driven learning, inquiry-based research activities, collaborative learning using technology tools, and computer use for a variety of instructional delivery methods. The treatment group also demonstrated more student-centered instruction and more committed beliefs in the learning benefits of technology use. While those in the treatment group also saw more student learning, technology skills greater than self-perceived, and more meaningful integration of technology during instruction, deficiencies were still present. The assortment of tools used was limited as was the level of creative uses. This suggests the imperative need for initial and ongoing support for professional development. While this study was revealing, suggestions for future study were offered. Of importance for such work should be use of technology relative to content standards and assessment, the sustainability of technology use initiatives, and effective support mechanisms (Lowther, Inan, Strahl, & Ross, 2008).

Karasavvidis (2010) studied the use of wikis for instructional purposes. While he found that wikis helped improve learning, their use was not as universal as one might expect. There were two primary reasons for this. These include the style of learning and student perceptions of the tool. Student perceptions hindered use of wikis based on low value placed on collaboration with peers. Even when wikis were used, it became evident that artifacts were produced individually, not collaboratively. Learning styles also inhibited collaboration through wikis. For example, critique of student work by peers was often seen as excessively critical, not constructive. Students must be acculturated to the benefits such learning styles.

Rather than viewing these challenges as technology-based, Karasavvidis (2010) suggest that the challenge is more fundamental. The core issue is the instructional practices and the need to adapt them for effective use of current technology tools. One key example is the students' hesitance to modify work created by peers. This collaborative technique requires direct guidance and establishing of rules for effective use. Key issues to address in this effort are the need for instructional scaffolding and mitigating the tendency of students to lean on others during group activities (Karasavvidis, 2010).

The current study showed that faculty's self-reported adopter rate for personal and professional uses were strongly related. This might suggest the need for change agents to identify committed users of technologies for personal reasons.. This seems to increase the likelihood of technology adoption for instructional purposes. Additionally, personal uses of technology should be allowed to transfer to instructional uses. This might be accomplished by providing appropriate resources to support use of blogs, wikis, and social networking media. Providing training support to foster trial-and-error approaches to problem-solving would also encourage technology adoption.

Self-efficacy

A challenge for the use of education technologies cited by faculty includes the difficulty in providing feedback to students. This was especially cited as a challenge by those who were reticent to adopt education technologies (Martinez et al., 2006).

Using Rogers' (2003) social systems postulate, Talab (1993) examined the needs of instructors relative to technology use and adoption. Such needs were organized in alignment with Maslow's hierarchy of needs. The most primary of the needs was access to the technology tools. Then, and in order of need, there was dependability of the tools, ownership over the tools (sense of responsibility), impact on design of use, and technology integration. Talab (1993) found significant relationships between self-efficacy and performance as instructors. Self-efficacy was measured using a three-fold system including commitment to technology use, responsiveness to innovative technology, and effectiveness of role.

Benson and Mekolichick (2007) examined the use of digital technologies for learning in higher education. While they describe the ubiquity of technology use in higher education, they also note wide variations in usage by faculty. This study attempted to reveal the student-faculty interaction as related to technology use. The stakes are high since academic performance by students and professional reputations of faculty are greatly impacted by effective use of education technology. They refer to the "person-technology nexus", especially when examining self efficacy variables (p. 49). The theoretical framework used was the symbolic interaction theory and describes the importance of matching role identity and behavior. Applied in this study, the theory suggested that compatibility between role identity and technology use would result in higher technology use, higher self-efficacy regarding technology use, greater comfort with technology use, and the greater the desire to use technologies. The findings suggest positive correlations in each of these paired relationships. Results for students and faculty were similar. The implications of these findings are important. Students who had low use of education technologies hesitate to reach out to and collaborate with faculty seen as high technology users. Additionally, males were predisposed to high education technology use. Finally, low faculty use of technology was related with low academic commitment given the deep integration of education technologies into higher education life (Benson & Mekolichick, 2007). Of the four exogenous efficacy variables in the current study, one entered the stepwise analysis. This was the ability to combine technology and writing tasks. This was a direct relationship with the ultimate endogenous variable producing a path coefficient of 0.139. Of the two intermediate endogenous efficacy variables, one entered the stepwise analysis. This was the ability to adapt technology to diverse teaching challenges. This relationship produced a path coefficient of 0.178. Each of the six subgroups analyzed showed at least one efficacy variable in the resulting path models. The ability to combine technology with writing tasks predicted technology adoption for female faculty only. No other subgroup showed this relationship. The ability to adapt technology to diverse teaching challenges predicted technology adoption for male, full-time, and non-tenured faculty.

Efficacy factors are critical in the effort to encourage adoption of technology for instructional purposes. The results of the current study can guide change agents in the training and support of faculty to enhance efficacy with discipline content as well as integrating technology use.

Limitations of Study

The limitations of the current study include sampling selection, identification of teaching level, use of faculty from education schools only and identification of private versus public institutions. The gender breakdown of the participants in this study was slanted more toward the females than males. External validity might have been diminished as a result. While comparisons between the current study's demographic data were made with the national trends, caution should be exercised. The population pool used for the current study was the membership in the large professional organization rather than the total faculty population nation-wide.

The faculty chosen for the study were based on their position as instructors at the higher education level. While some faculty teach undergraduate students, others teach at the doctoral and post-doctoral level. The current study did not distinguish among these various levels. Since some survey items asked about learning benefits of technology use for students, this might also impact external validity. Addtionally, only faculty teaching in education schools were considered in this study, impacting generalizability. Finally, the current study did not distinguish between those teaching in private versus public institutions. Resource availability such as updated and working equipment as well as relevant and effective training were prominent themes in the responses to open-ended survey items. Such resource factors could be impacted by the private versus public status of the institutions.

Suggestions for Future Research

Future research in uses of education technology should delve more deeply in the variables measured in the current study. First, rather than measuring faculty beliefs in the learning impact of technology use, learning by students should be measured and related with technology use. Secondly, in addition to using self-reported efficacy variables, supervisor and peer evaluations should also be used to measure efficacy with teaching discipline content. Finally, institutional policies should be assessed through faculty input as well as input from administrators and those managing the information systems departments.

<u>References</u>

Archambault, L.M. & Crippen, K.J. (2009). K-12 distance educators at work: Who's teaching online across the United States. Journal of Research on Technology in Education, 41(4), 363-391.Lee and Rha (2009)

Aworuwa, B., Worrell, P., & Smaldino, S. (2005). Working with Partners: A reflection on partners and projects. *Tech Trends, 50*(3), 38-43.

Backer, T. & Singhal, A. (2005). Forum: The life and work of Everett Rogers - Some personal reflections. *Journal of Health Communication, 10*, 285-288.

Bell, F. (2011). Connectivism: Its Place in Theory-informed Research and Innovation in Technology-enabled Learning. *International Review of Research in Open and Distance Learning, 12*(3), 98-118.

Bennett, J. & Bennett, L. (2003). A Review of Factors that Influence the Diffusion of Innovation When Structuring a Faculty Training Program. *Internet and Higher Education*. 6, 53-63.

Benson, D. & Mekolichick, J. (2007). Conceptions of Self and the Use of Digital Technologies in a Learning Environment. *Education, 127*(4), 498-510.

Birch, T., Greenfield, L., Janke, K., Schaeffer, D., & Woods, A. (2008). Partnering with Librarians to Meet NCATE Standards in Teacher Education. Education, 128(3), 369-379.

Brown, J. (2011). Dwell in Possibility: PLAR and e-Portfolios in the Age of Information and Communication Technologies. *International Review of Research in Open and Distance Learning, 12*(1), 1-23.

Butler, T & Pinto-Zipp, G. (2006). Students' Learning Styles and Their Preferences for Online Instructional Methods. *Journal of Educational Technology Systems*. 34(2), 199-221.

BybeeR. & Starkweather K. (2006). The Twenty-First Century Workforce: A contemporary challenge for technology education. *The Technology Teacher, May/June*, 27-32.

Cao, Y. & Sakchutchawan, S. (2011). Online vs. Traditional MBA Courses: An Empirical Study of Students' Characteristics, Course Satisfaction, and Overall Success. *Journal of Human Resources and Adult Learning, 2*.

Cataldi, E., Fahimi, M, Bradburn, E., & Zimbler, L. (2004) National Study of Postsecondary Faculty (NSOPF:04) Report on Faculty and Instructional Staff in Fall 2003. E.D. TAB. NCES 2005-172.

Chen, B. (2009). Barriers to Adoption of Technology-mediated Distance Education in Higher Education Institutions. *The Quarterly Review of Distance Education*. 10(4), 333-338.

Chuang, T. & Chen, W. (2009). Effect of Computer-Based Video Games on Children: An experimental study. *Educational Technology & Society, 12*(2), 1-10.

Darmawan, I. & Keeves, J. (2006). Suppressor Variables and Multilevel Mixture Modeling. *International Education Journal*, 7(2), 160-173.

Diem, R. (2002). An Examination of the Effects of Technology Instruction in Social Studies Methods Classes. Presentation at the Annual Meeting of the American Educational Research Association, New Orleans, LA, April 1-5, 2002.

Educational Technology. (n.d.). In Wikipedia. Retrieved April 22, 2011 from http://en.wikipedia.org/wiki/Education_technology

Fahmy, M. (2004). Thinking About Technology Effects on Higher Education. *The Journal of Technology Studies*, 55-58.

Foulger, T. & Williams, M. (2007). Filling the Gap with Technology Innovations: Standards, Curriculum, Collaboration, Success. *Journal of Computing in Teacher Education*, 23(3), 107-114.

Freeman, M. Bell, A. Comerton-Forde, C. Pickering, J. & Blayney, P. (2007). Factors Affecting Educational Innovation with in Class Electronic Response Systems. *Australasian Journal of Educational Technology*. 23(2), 149-170.

Gautreau, C. (2011). Motivational Factors Affecting the Integration of a Learning Management System by Faculty. *The Journal of Educators Online, 8*(1), 1-25.

Green, K. (2009). Campus Computing Project. Educause Conference, November 2009, Denver, CO.

Hansen, S. & Salter, G. (2001). The Adoption and Diffusion of Web Technologies into Mainstream Teaching. *Journal of Interactive Learning Research*. 12(2/3), 281-299.

Hug, B. & Reese, G. (2006). How Technology Integration in Mathematics and Science Teaching Can Occur: The Role of the Maverick Teacher. *Teaching Education*. 17(2), 167-179.

Jefferies, A & Hyde, R. (2010). Building the Future Students' Blended Learning Experiences from Current Research Findings. *Electronic Journal of e-Learning, 8*(2), 133-140.

Jeffs, T. & Banister, S. (2006). Enhancing Collaboration and Skill Acquisition Through the Use of Technology. *Journal of Technology and Teacher Education*, 14(2), 407-433.

Jones, N. & Laffey, J. (2000). The Diffusion of Collaborative Technologies into a College Classroom. *Performance Improvement Quarterly*. 13(4), 29-46.

Junco, R. & Chickering, A. (2010). *Civil Discourse in the Age of Social Media*. American College Personnel Association and Wiley Periodicals, Inc. Wiley Online Library, 12-18.

Karasavvidis, I. (2010). Wiki Uses in Higher Education: Exploring Barriers to Successful Implementation. *Interactive Learning Environments, 18*(9), 219-231.

Kay, R & Lauricella, S. (2011). Exploring the Benefits and Challenges of Using Laptop Computers in Higher Education Classrooms: A Formative Analysis. Canadian *Journal of Learning and Technology, 37*(1), 1-18.

Kebritchi, M. (2008). Factors Affecting Teachers' Adoption of Educational Computer Games: A Case Study. *British Journal of Educational Technology*. 41(2), 256-270.

Keller, C. (2005). Virtual Learning Environments: Three Implementation *Perspectives. Learning Media and Technologies*. 30(3), 299-311.

Keith, T. (1988). Path Analysis: An Introduction for School Psychologists. *School Psychology Review*, *17*(2), 343-362.

Kilmon, C. & Fagan, M. (2007). Course Management Software Adoption: A Diffusion of Innovation Perspective. *Emerald Insight*. 24(2).

Kopcha, T. (2010). A System-based Approach to Technology Integration Using Mentoring and Communities of Practice. *Education Technology Research Development*. 58, 175-190.

Kumar, S. & Vigil, K. (2011). The Net Generation as Preservice Teachers: Transferring Familiarity with New Technologies to Educational Environments. *Journal of Digital Learning in Teacher Education*, *27*(4), 144-152.

Liao, H. (2005). Communication Technology, Student Learning, and Diffusion of Innovation. *College Quarterly*. 8(2).

Littlejohn, A., Margaryan, A. & Vojt, G. (2010). Exploring Students' Use of ICT and Expectations of Learning Methods. *Electronic Journal of e-Learning, 8*(1), 13-22.

Lowther, D., Inan, F., Strahl, D., & Ross, M. (2008). Does Technology Integration "Work" When Barriers are Removed. *Educational Media International*, *45*(3), 195-213.

Ma, Y., Williams, D., Prejean, L., Lai, G., & Ford, M. (2008). A Model for Facilitating Field Experience in a Technology-Enhanced Model Pedagogical Laboratory. *Journal of Computing in Teacher Education,* 24(3).

Manning, J. & Carpenter, L. (2008). Assistive Technology WebQuest: Improving Learning for Preservice Teachers. *Tech Trends, 52*(6), 47-52.

Martinez, R., Liu, S., Watson, W. & Bichelmeyer, B. (2006). Evaluation of a Web-based Master's Degree Program: Lessons Learned from an Online Instructional Design and Technology Program. *The Quarterly Review of Distance Education, 7*(3), 267-283.

Matthew, K., Felvegi E., & Callaway R. (2009). Wiki as a Collaborative Learning Tool in a Language Arts Methods Class. *Journal of Research on Technology in Education*. 42(1), 51-72.

Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K.(2009). *Evaluation of Evidence-Based Practices in Online Learning: A meta-analysis and review of online learning studies*. U.S. Department of Education: Office of Planning, Evaluation, and Policy Development.

Morin, A. (1975). An Innovator's Odyssey: How to Become a Thoughtful Change Agent. *Educational Technology*. 15(11), 42-44.

Murray, C. (2009). Diffusion of Innovation Theory: A Bridge for the Research-Practice Gap in Counseling. *Journal of Counseling & Development*. 87.

National Council for Accreditation of Teacher Education (2008). Professional Standards for the Accreditation of Teacher Preparation Institutions. Washington D.C.

Nicholas, H. & Ng, W. (2009) Fostering online social construction of science knowledge with primary pre-service teachers working in virtual teams. *Asia-Pacific Journal of Teacher Education, 37*(4), 379 – 398.

Nichols, M. (2008). Institutional Perspectives: The Challenges of e-Learning Diffusion. *British Journal of Educational Technology*. 39(4).

Paechter, M., Maier, B., & Macher, D. (2009). Student expectation of and experiences in e-learning: Their relation to learning achievement and course satisfaction. Journal of Computers and Education 54, 222-229.

Pellegrino, J. & Quellmalz, E. (2010). Perspectives on the Integration of Technology and Assessment. *Journal of Research on Technology in Education, 43*(2), 119-134.

Oner, D. & Adadan, E. (2011). Use of Web-based Portfolios as Tools for Reflection in Preservice Teacher Education. *Journal of Teacher Education, 62*(5), 477-492.

Panda, S. & Mishra, S. (2007). E-Learning in a Mega Open University: Faculty attitude, barriers and motivates. *Educational Media International, 44*(4), 323-338.

Parisot, A. (1997). Distance Education as a Catalyst for Changing Teaching in the Community College: Implications for Institutional Policy. *New Direction for Community Colleges, 99*, 5-13.

Peluchette, J. & Rust, K. (2005). Technology Use in the Classroom: Preferences of Management Faculty Members. *Journal of Education for Business*, Heldref Publications.

Rakes, G., Fields, V. & Cox, K. (2006). The Influence of Teachers' Technology Use on Instructional Practices. *Journal of Research on Technology in Education, 38*(4), 409-424.

Razzaq, L. & Heffernan, N. (2009). To Tutor or Not to Tutor: That is the Question. In Dimitrova, Mizoguchi, du Boulay & Graesser (Eds.) Proceedings of the 2009 Artificial Intelligence in Education Conference. pp. 457-464.

Rogers, E. (2003). *Diffusion of Innovations*, Fifth Edition. New York. Free Press.

Rounds, J., Kanter, M., & Blumin, M. (1987). Technology and Testing: What is Around the Corner? In Bray, D., Belcher, M., *Issues in Student Assessment. New Direction for Community Colleges* (pp. 83-93). San Francisco, CA: Jossey-Bass Inc. Publishers.

Russell, M., Kleiman, G., Carey, R., & Douglas, J. (2009). Comparing Self-Paced and Cohort-Based Online Courses for Teachers. *Journal of Research on Technology in Education.* 41(4), 443-466.

Sadykova, G. & Dautermann, J. (2006). Crossing Cultures and Borders in International Online Distance Higher Education. *Journal of Asynchronous Learning Networks, 13*(2), 89-114.

Saeed, N., Yang, Y., & Sinnappan, S. (2009). Emerging Web Technologies in Higher Education: A Case of Incorporating Blog's, Podcasts, and Social Bookmarks in a Web Programming Course based on Students' Learning Styles and Technology Preferences. *Educational Technology & Society*, 12(4), 98-109.

Samarawickerma, G. & Stacey, E. (2007). Adopting Web-Based Learning and Teaching: A Case Study in Higher Education. *Distance Education*. 28(3), 313-333.

Santilli, S. & Beck, V. (2005). Graduate Faculty Perceptions of Online Teaching. *The Quarterly Review of Online Teaching*, 6(2), 155-160.

Shacher, M. & Neumann, Y. (2010). Twenty Years of Research on the Academic Performance Differences Between Traditional and Distance Learning: Summative meta-analysis and trend examination. *MERLOT Journal of Online Learning and Teaching*. 6(2).

Shoffner, M. (2009). Personal Attitudes and Technology: Implications for Preservice Teacher Reflective Practice. *Teacher Education Quarterly,* 143-161.

Shana, Z. (2009). Learning with Technology: Using discussion forums to augment traditional-style class. *Educational Technology & Society, 12*(3), 214-228.

Sherman, W, Crum, K. & Beaty, D. (2010). Perspectives on Distance Technology in Leadership Education: Transfer, Meaning, and Change. *Journal of Research on Leadership Education, 5*(13), 589-610.

Smith, S. & Robinson, S. (2003). Technology Integration Through Collaborative Cohorts: Preparing future teachers to use technology. *Remedial and Special Education, 24*(3), 254-160.

Southworth, J., Knezek, G., & Flanigan, J. (2003). Three Decades of Distance Learning: Enrishment at the University of Hawaii. *Educational Perspectives*, 3-8.

Tabata, L. & Johnsrud, L. (2008). The Impact of Faculty Attitudes Toward Technology, Distance Education, and Innovation. *Research in Higher Education*. 49, 625-646.

Talab, R. (1993). Self Efficacy, Performance Variables and Distance Learning Facilitator Technology Adoption: Support for the Teacher Needs Hierarchy. Proceedings of Selected Research and Development Presentations at the Convention of the Association for Educational Communications and Technology Sponsored by the Research and Theory Division, January 13-17, New Orleans, LA.

Taylor, P, Parker, K., Lenhart, A., & Patten, E. (2011). The Digital Revolution and Higher Education, Pew Research Center.

Thomspon, C. (2011). The New Way to be a Fifth Grader. *Wired*, *19*(08), 127-152.

Voegel, G. (1986). *Advances in Instructional Technology.* San Francisco, CA: Jossey-Bass Inc. Publishers.

Wallace, L. (2007). Online Teaching and University Policy: Investigating the Disconnect. *Journal of Distance Education,* 22(1), 87-100.

Weiner, S. (2003). Resistance to Change in Libraries: Application of Communication Theories. *Project Muse*. 3(1), 69-78.

Wiley, D. & Gurrell, S. (2009). Context and Catalyst: A decade of development… *Open Learning*, *24*, 11-21.

Woodell, J. & Garofoli, E. (2002). Faculty Development and the Diffusion of Innovations. *Campus Technology*. 16(6).

Zhao, J., Alexander, M., Perreault, H., Waldman, L., & Truell, A. (2009). Faculty and Student Use of Technologies, User Productivity, and User Preference in Distance Education. *Journal of Education for Business,* Heldref Publications.

Appendix

Education Technology Survey -- Sammy Elzarka, Claremont Graduate University

Thank you for taking time to complete this survey. Please answer each item to the best of your knowledge. Your thoughtfulness and candid responses are greatly appreciated. Your responses will be kept completely confidential. Technology is a broad concept that can mean a lot of different things. For the purpose of this survey, education technology is referring to digital technologies used for education purposes. Examples are digital tools such as computers, laptops, handheld devices, interactive whiteboards, software programs, and the like. If an item does not apply, enter N/A in the text box.

* Required

Informed Consent Form for The Education Technology Research Project *You are being asked to participate in a research project conducted by Sammy Elzarka as part of the dissertation in the School of Educational Studies at the Claremont Graduate University (CGU). You have been selected because you are a faculty member (part-time or full-time) in higher education. PURPOSE: The purpose of this study is to identify the barriers to the use of education technology in higher education. PARTICIPATION: You will be asked to complete a survey regarding use of education technology tools in your teaching. We expect your participation to take about 20 minutes. Email addresses are requested merely for follow up communication. RISKS & BENEFITS: The potential risk associated with this study includes the time required to complete the survey. In addition, we expect this research to benefit science and higher education instruction by providing information about how to recruit faculty members' uses of educational technology tools to further the learning process. COMPENSATION: You will receive no compensation. VOLUNTARY PARTICIPATION: Please understand that participation is completely voluntary. Your decision whether or not to participate will in no way affect your current or future relationship with CGU or its faculty, students, or staff. You have the right to withdraw from the research at any time without penalty. You also have the right to refuse to answer any question(s) for any reason, without penalty. CONFIDENTIALITY: Your individual privacy will be maintained in all publications or presentations resulting form this study. All survey data will be collect using the Google Docs forms product and all responses will be accessible only to the primary investigator. In order to preserve the confidentiality of your responses, we have ensured that the online forms are secured and password-protected. Please note that, while all data will be kept tightly confidential, they are not anonymous. Only aggregated summaries will be reported as part of the study's findings. No individual responses will be identifiable with respondents. If you have any questions or would like additional information about this research, please contact Sammy Elzarka at 626-869-8190 or Sammy.education@gmail.com. You can also contact the research advisor, Dr. David Drew, at 909-621-8000. The CGU Institutional Review Board, which is administered through the Office of Research and Sponsored Programs (ORSP), has approved this project. You may also contact ORSP at (909) 607-9406 with any questions. I understand the above information and have had all of my questions about participation in this research project answered. By checking this box, I voluntarily consent to participate in this research study.

- ☐ I accept these terms and agree to voluntarily complete this survey.

Gender *

- Male
- Female

Your e-mail address (this will only be used for follow-up communication and not distributed to any person or organization) *

Age *

With which race/ethnicity do you identify (check all that apply)?: *

- White/Caucasian
- Hispanic/Latino/Latina
- African American/Black
- Asian/Asian American
- Native American

Area of your specialization based on current research/teaching interests (check all that apply): *

- Cognitive Psychology
- Early Childhood Development and/or Instruction
- English and Language Arts (includes reading, literacy, writing, etc.) Pedagogy
- Race/multi-cultural Studies
- Leadership Studies/Education Administration
- Education Technology
- Curriculum and Instruction
- Mathematics Pedagogy
- Education Policy
- Science Pedagogy
- Special Education
- Education Assessment and/or Research Methods
- School Psychology or Counseling
- Pedagogy/learning
- Teacher Education
- Higher Education
- Other:

Number of years teaching at the college level (including all levels of post-secondary education) *

Name of higher education institution where you are currently employed; if more than one, list them all *

Degree or certificate earned in any branch of education technology; if more than one, list them all *

If you are certified or have a degree in education technology, indicate the number of hours of training or course unit equivalent you completed. *

What is your job title or rank? *

Are you a full-time faculty member? *

- Yes
- No

Do you have tenure? *

- Yes
- No

For each of the following five items, respond using the scale provided. *

	Frequently (once weekly)	Occasionally (once monthly)	Rarely (quarterly)	Never
I receive regular news feeds about education technology (newsletters, email listservs, reviews of web news).				
I have a Facebook account and log onto it.				
I manage a blog and/or wiki.				
I use video conferencing programs.				
I post videos/photos to a sharing service (Flickr, YouTube, Google Docs, etc.).				

How many email accounts do you use regularly (at least once monthly)? *

How many computers, laptops, and/or tablets do you actively use (at least once monthly)? *

Please answer the following three items using the scale provided. *

	Strongly Agree	Agree	Disagree	Strongly Disagree
I know how to solve my own education technology problems.				
I keep up with important new education technologies.				
I have the technical skills I need to use education				

	Strongly Agree	Agree	Disagree	Strongly Disagree
technology.				

Please answer all of the following items using the scale provided. *Each of the following is important for my students' learning:

	Strongly Agree	Agree	Disagree	Strongly Disagree
Supplementing a course with online resources;	◯	◯	◯	◯
Putting course and/or lecture content online;	◯	◯	◯	◯
Capturing lectures with video equipment;	◯	◯	◯	◯
Teaching and managing courses delivered entirely online;	◯	◯	◯	◯
Web page design and development;	◯	◯	◯	◯
Teaching and managing courses with large enrollment;	◯	◯	◯	◯
Managing assignments;	◯	◯	◯	◯
Automating or managing grades;	◯	◯	◯	◯
Offering broader access to course materials;	◯	◯	◯	◯
Using digital audio and video;	◯	◯	◯	◯
Creating and using effective presentation technologies;	◯	◯	◯	◯
Live online meetings/classes/seminars;	◯	◯	◯	◯
Technology-equipped classrooms;	◯	◯	◯	◯
Virtual classroom space (i.e. Learning Management Systems such as Blackboard or Moodle);	◯	◯	◯	◯

	Strongly Agree	Agree	Disagree	Strongly Disagree
Student-created content (i.e. video, audio, web pages);				
Collaboration tools for students;				
Instructional simulations or games;				
Using alternative assessment strategies;				
Understanding and using best practices of teaching with technology.				

Adopter types.Use the adopter type definitions to answer the three items below.

- Innovators (2.5% of the general population) – are the first individuals to adopt an innovation; Innovators are willing to take risks, very social and have closest contact to scientific sources and interaction with other innovators; Risk tolerance has them adopting technologies which may ultimately fail; Financial resources help absorb these failures;
- Early adopters (13.5% of the general population) – This is the second fastest category of individuals who adopt an innovation; They are more discrete in adoption choices than innovators; Realize judicious choice of adoption will help them maintain central communication position (opinion leaders);
- Early majority (34% of the general population) – Individuals in this category adopt an innovation after a varying degree of time; This time of adoption is significantly longer than the innovators and early adopters; Early Majority tend to be slower in the adoption process, contact with early adopters, and seldom hold positions of opinion leadership in a system;
- Late Majority (34% of the general population) – Individuals in this category will adopt an innovation after the average member of the society; These individuals approach an innovation with a high degree of skepticism and after the majority of society has adopted the innovation; Late Majority are typically skeptical about an innovation, are in contact with others in late majority and early majority, have very little opinion leadership;
- Laggards (16% of the general population) – Individuals in this category are the last to adopt an innovation; Unlike some of the previous categories, individuals in this category show little to no opinion leadership; These individuals typically have an aversion to change-agents; typically tend to be focused on "traditions", in contact with only family and close friends, very little to no opinion leadership.

Use the above definitions to respond to these three items. *

	Innovator	Early adopter	Early majority	Late majority	Laggard

	Innovator	Early adopter	Early majority	Late majority	Laggard
When new technologies are released, I am typically among the following group of adopters for personal use (cell phones, computers, laptops for personal use).	◻	◻	◻	◻	◻
When new technologies are released, I am typically among the following group of adopters for professional use (cell phones, computers, laptops for instructional use or with my students).	◻	◻	◻	◻	◻
I could be among the following adopter type if my university/college provided more support.	◻	◻	◻	◻	◻

Please answer all of the following items using the scale provided. *

	Strongly Agree	Agree	Disagree	Strongly Disagree
I can adapt my teaching based upon what students currently understand or do not understand.	◻	◻	◻	◻
I can assess student learning in multiple ways.	◻	◻	◻	◻
I can use a wide range of teaching approaches in a classroom setting (collaborative learning, direct instruction, inquiry learning, problem/project based learning, etc.).	◻	◻	◻	◻
I am familiar with common student understandings and misconceptions.	◻	◻	◻	◻

	Strongly Agree	Agree	Disagree	Strongly Disagree
I know how to organize and maintain classroom management.	☐	☐	☐	☐
I know how to select effective teaching approaches to guide student learning in analytical tasks.	☐	☐	☐	☐
I know how to select effective teaching approaches to guide student learning in writing tasks.	☐	☐	☐	☐
I can choose technologies that enhance students' learning for a lesson.	☐	☐	☐	☐
The experiences I have had teaching in my current program have caused me to think more deeply about how technology could influence the teaching approaches I use in my instruction.	☐	☐	☐	☐
I can adapt the use of the technologies that I am learning about to different teaching activities.	☐	☐	☐	☐
I effectively use a learning management system (such as Blackboard, Moodle, etc.) to teach and organize instructional content.	☐	☐	☐	☐
I effectively use videos to teach and organize instructional content.	☐	☐	☐	☐
I effectively use mobile devices (including smartphones, tablets, laptops, etc.) to teach and organize instructional content.	☐	☐	☐	☐

	Strongly Agree	Agree	Disagree	Strongly Disagree
I can teach lessons that appropriately combine analysis, technologies, and my teaching approaches.				
I can teach lessons that appropriately combine writing, technologies, and my teaching approaches.				
I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches in my college/department.				
I would use technology tools more if I could reduce my teaching load.				
I would use technology tools more if I could reduce my project list/administrative duties.				
I would use technology tools more if the tools were simpler to use;				
I would use technology tools more if I could receive training from someone who has worked in my area of specialty;				
I would use technology tools more if I could receive on-demand training support in addition to the initial training session;				
I would use technology tools more if I would receive a stipend for the added workload;				

	Strongly Agree	Agree	Disagree	Strongly Disagree
I would use technology tools more if I would receive recognition for the effort from my supervisor;	☐	☐	☐	☐
I would use technology tools more if I would receive recognition from my peers;	☐	☐	☐	☐
I would use technology tools more if my university's (or college's) policies allowed for flex time to work with technologies;	☐	☐	☐	☐
I would use technology tools more if my university (or college) would invest in updating the technology equipment;	☐	☐	☐	☐
I would use technology tools more if my university (or college) would provide more academically relevant training.	☐	☐	☐	☐

For the following two items, use the scale provided for your responses. *

	25% or less	26% - 50%	51% - 75%	76% - 100%
In general, approximately what percentage of your peers within your department have provided an effective model for combining content, technologies and teaching approaches in their teaching?	☐	☐	☐	☐
In general, approximately what percentage of your peers outside your college/department, but within your university, have provided an effective model for combining content, technologies and teaching approaches in their teaching?	☐	☐	☐	☐

Please answer all of the following items using the scale provided. *

	Strongly Agree	Agree	Disagree	Strongly Disagree
Using a “trial and error” approach has increased my knowledge on use of education technologies.	○	○	○	○
If I collaborated with others to examine the use of computers in educational practice, it would increase the likelihood of my technology adoption.	○	○	○	○
A university/college technology plan, in which skills needing to be achieved are clearly spelled out, would help me to integrate technology.	○	○	○	○
Textbooks will be replaced by electronic media within five years.	○	○	○	○
My role as the teacher will be dramatically changed because of the education technology within five years.	○	○	○	○
I would attend technology-based professional development activities if my university/college offered them.	○	○	○	○
Technology can help accommodate different learning styles.	○	○	○	○
I would use technology if I had more of a voice in the decision-making process (i.e., purchases, creation of the technology plan, etc.).	○	○	○	○
A teacher should be at ease using education technology.	○	○	○	○

	Strongly Agree	Agree	Disagree	Strongly Disagree
A teacher should use education technology, whether he/she is rewarded or not.				
A teacher who plans lessons that are learner-centered uses education technology.				
My experience using technology to learn has been successful.				

Please complete this section by typing your responses in the space provided. *Describe a specific episode where a peer effectively demonstrated or modeled combining content, technologies and teaching approaches in a classroom lesson. Please include in your description what content was being taught, what technology was used, and what teaching approach(es) was implemented.

Please complete this section by typing your responses in the space provided. *Expand on the barriers to the use of education technology by describing how these barriers can be mitigated for you. List the top three barriers and describe remedies for each.

Please complete this section by typing your responses in the space provided. *Describe a specific episode where you effectively demonstrated or modeled combining content, technologies and teaching approaches in a classroom lesson. Please include in your description what content you taught, what technology you used, and what teaching approach(es) you implemented. If you have not had the opportunity to teach such a lesson, please indicate that you have not and describe why.

Please complete this section by typing your responses in the space provided. *Describe any additional information you would like to share regarding your use of education technology for instructional purposes.

Submit