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How Ideology And Pedagogy Impact Technology Adoption In The Classroom, A Causal-Comparative Study

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HOW IDEOLOGY AND PEDAGOGY IMPACT TECHNOLOGY ADOPTION IN THE CLASSROOM, A CAUSAL-COMPARATIVE STUDY

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Abstract

As the world changes from an industrial driven society to one more focused on services and knowledge, the drive for change within higher education is mounting from both students and employers. With the availability of the vast majority of the world's knowledge available to an ever-increasing populace via the Internet, students and employers alike are no longer satisfied with the three r's – reading, writing, and arithmetic. Instead, employers are expecting graduates to be knowledgeable of the three C's – collaboration, communication, and creative problem solving to negotiate a progressively complex global market.

Through advances in cognitive science, we now have a better understanding of how individual learners construct and retain new knowledge. At odds with this understanding of how individuals learn is the continued use of the lecture class format where an instructor is the center of the classroom. The lecture class format or Socratic Method has not only demonstrated a lack of effectiveness compared to other methods such as active-learning which places the student at the center of the classroom but may even disenfranchise students leading to lower test scores and retention issues. Yet, when higher education institutions attempt more productive methods of learning based on the ideas of constructivism such as active-learning or student-centered learning the efforts fail as instructors naturally revert back to the lecture method for a variety of reasons.

Where technology has enabled change in other areas of our lives such as social media, entertainment, and retail it has yet to make as profound of an effect in higher education.

Understanding to what extent certain curricular ideologies may predict the adoption of technology in the classroom may be beneficial in emboldening change from the Socratic Method to a more student-centered learning experience. Other benefits may include improvements in the return on investments made by higher education institutions as well as shortened technology deployment timelines improving opportunities to keep up with rapidly changing technology trends.

Using a combination of two survey instruments, the Schiro Curriculum Ideology Instrument (2013) and the iTEaCH Instrument (Choy, 2013), this causal-comparative research study analyzed data collected from both full-time and part-time faculty at a private liberal arts institution. Through the application of a one-way ANOVA and Tukey-Kramer post hoc test, the results identified statistically significant differences among several of the curriculum ideology types and the adoption of technology in the classroom. Insight into the relationship between curriculum ideology and technology adoption can be used both by technologists and pedagogical specialists as part of technology deployments to improve not only the use of technology in the classroom but also enabling faculty seeking opportunities to change the classroom dynamic focusing more on students and opportunities for individual learning.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

The world is facing profound change as humans move from an industrial based society to one based on knowledge (Fung & Yuen, 2006). The increasing number of individuals across the planet with instant access to information via the Internet continues to increase with an estimated 4 billion individuals with Internet access (World Internet Users Statistics and 2018 World Population Stats, 2018). Research also indicates a coinciding increase in education levels globally with an increasing number of individuals seeking to improve their opportunities in life through higher education (Roser & Ortiz-Ospina, 2018; Spence, 2001). Over the past few decades, higher education in the United States has increasingly come under fire for no longer meeting the needs of its consumers (Spence, 2001; Traxler, 2010; Woodall, Hiller, & Resnick, 2012). One of the perceived challenges to this dichotomy is the continued use of the traditional lecture or Socratic Method as the primary means of educating individuals (Baytiyeh, 2017; King, 1993; Spence, 2001).

Given the disruptive nature of technology from communications to social media and even entertainment, the increasing use of technology in higher education could well be a disruptive factor and a driver for change (Ertmer & Ottenbreit-Leftwich, 2010; Vongskulluksn, Xie, & Bowman, 2018). While technology has certainly had an impact in the higher education classroom, it has not had the impact predicted by researchers (Abrams, 2010). The dichotomy of increased technology in education versus other verticals such as manufacturing, retail, healthcare, automotive, or aerospace is perhaps best reflected by a quote from Larry Spence in "The Case Against Teaching" (2001):

> For just a moment, assume that time travel is possible. Plop a medieval peasant down in a modern dairy farm, and he would recognize nothing but the cows. A physician of the 13th century would run screaming from a modern operating room; Galileo could only gape and mutter touring NASA's Johnson Space Center. Columbus would quake with terror in a nuclear sub. But a 15th century teacher from the University of Paris would feel right at home in a Berkeley classroom. (pp. 12–13)

While this quote is more than 17 years old, many students, faculty, and technology support staff can elucidate a lack of technology in the learning process in comparison to their daily lives (Traxler, 2010). Given the rapid pace of technology change and impact upon our lives, the opinion reflected by Spence on the lack of technology use in the classroom and its relevance to current day—more than 17 years later—is ironically further support for a likely insufficient technological impact in the classroom.

Knowledge over the past three decades has increased dramatically in understanding how individuals learn (Greer, Crutchfield, & Woods, 2013; Spence, 2001). Cognitive science studies contradict the notion of learning as a simple act of absorption of information or transfer of knowledge from a teacher to a student, but a much more complicated act of representing information (Greer et al., 2013). Instead of the traditional *sage on the stage* mentality (King, 1993), cognitive science studies show that individuals learn best "When students are engaged in actively processing information by reconstructing that information in such new and personally meaningful ways, they are far more likely to remember it and apply it in new situations" (King, 1993, p. 30). Most educational institutions continue to practice an educational model based solidly on the Socratic Method or *Sage on the Stage* (King, 1993), a didactic methodology where the teacher is responsible for educating the student, the center of the classroom and the fount of knowledge which is transferred to the student, who memorizes and regurgitates it on an examination (King, 1993). A cross-institutional study conducted in 2018 backs up the lack of active learning in the higher education classroom with 55 percent of observed class time spent using conventional lecture and another 27 percent of class time lecturing with the addition of technology as an ancillary tool (Stains et al., 2018). In the Stains study the researchers observed that only 18% of over 2000 observed STEM (Science, Technology, Engineering, and Math) classes could be identified as using a student-centered learning style versus the teacher-focused Socratic method of lecturing (Stains et al., 2018).

Although lecturing is standard practice for many classrooms, it is not always the best choice to imbue knowledge upon even the most willing of students. Some of the earliest research on lecturing has shown that after ten minutes of lecturing, there is a decline in student attention (Hartley & Cameron, 1967). Newer research suggests that the overuse in lecturing may leave a negative impact among college students on many of the STEM fields leading to low enrollment and poor retention (Baytiyeh, 2017).

A variety of technologies are used in classrooms today, including electronic whiteboards, video projectors, and the Internet. For many institutions of higher education, these technologies are commonplace and readily available in classrooms and learning spaces across campus. While the technology is readily available, these traditional types of technology are rarely used to change the dynamics of the classroom. Instead, these technologies are regularly used as an augment to the Socratic Method. The use of the Socratic Method is contrary to a more student-centered learning environment where knowledge can be built instead of memorized, often referred to as *constructivism* (Ertmer & Ottenbreit-Leftwich, 2013).

Existing research does not suggest faculty are averse to attempting to use new technology to enable change in the classroom environment, but often when attempted, many instructors still fall back to the Socratic Method of instruction (Ertmer & Ottenbreit-Leftwich, 2010). The reluctance to use technology in a classroom can be attributed to a variety of challenges, including lack of technology or training, pedagogical integration and teacher beliefs (Ertmer & Ottenbreit-Leftwich, 2010; Ling Koh, Chai, & Tay, 2014). The ability to leverage these technologies to move to a more student-centered learning environment, however, lies with the instructor as "technologies never of themselves cause substantial change in schools" (Ertmer, 1999, p. 51). Identifying and adapting to the challenges faced by faculty in the use of technology in the classroom is key to improving the adoption of technology-enabled change.

The benefits of the use of the Socratic Method of instruction should not be dismissed, but educators must recognize that the increasing diversity and size of many classes do not enable the same dialogue between teacher and student as the Socratic Method once did. Over the past century, the number of high school graduates continuing into higher education has increased from 3% to 32% (Spence, 2001). More recently, the U.S. Bureau of Labor and Statistics estimated 69.2% of high school graduates from 2016 were attending a postsecondary institution (Ginder, Kelly-Reid, & Mann, 2017). Alongside this growth in students, the number of students reporting disabilities has increased dramatically as well (Watt et al., 2014) with an estimated 11% of students reporting disabilities (National Center for Education Statistics, 2016). Since 2010, with a dwindling population of native U.S. students and more competition among schools, especially traditional brick and mortar versus online, increasingly higher education institutions seek to attract increasing numbers of international students (Ruiz & Radford, 2017) to meet enrollment goals and improve diversity. The larger classes and increased diversity of the student population challenge the Socratic Method of teaching, which initially was based on a one-to-one teacher to student relationship.

The drive to change education and specifically higher education is evident. EDUCAUSE, a nonprofit organization whose mission is to “advance higher education through the use of information technology” (“EDUCAUSE Mission and Organization,” 2018), publishes an annual list of top issues facing higher education. The top five issues in teaching and learning for 2018 include four that were directly related to the classroom educational environment. The top issue according to EDUCAUSE is academic transformation, defined as “Breakthrough teaching and learning models, innovative partnerships and alliances, and strategic transformation of the campus mission” (“Key Issues in Teaching and Learning,” 2018). The recognition of the need for academic transformation is not new with the EDUCAUSE 2018 report, as it has been in the top two since 2015.

Statement of the Problem

Encouraging the move to a more engaging classroom environment where the pedagogical mission is centered on the students and their needs is one of the significant challenges facing higher education in the classroom. Technology can provide an opportunity to engage students in an active-learning environment that can improve the educational experience (EDUCAUSE, 2018; Stains et al., 2018). Information and Communication Technologies (ICT), such as digital whiteboards, video projection, and the Internet are valuable additions to the classroom (Abrams, 2010; Angeli & Valanides, 2009; Ling Koh & Chai, 2016) they have not enabled significant change in the educational process. These technologies mainly continue to replicate and support the Socratic method of teaching (Ertmer & Ottenbreit-Leftwich, 2010).

The demand for technology to have a more significant impact on higher education is likely to continue at an ever-increasing pace. From school administrators looking to improve student outcomes via learning analytics (Aguilar, 2017) to students who have been raised in the visual and highly interactive gaming and education environment of the Apple iPad, the ongoing push for technology-driven change is evidenced by student use of technology and their rapid adoption of new technologies and applications. Students' rapid adoption of technology can often cause challenges in the classroom as teachers are unprepared for newer technologies leading to a role reversal in the classroom (NMC Horizon Project, 2018; Shelton, 2013, 2018).

External pressure to change higher education is motivated by the end consumer of the higher education product, the employers of graduates (Brantley-Dias & Ertmer, 2013). In many cases, employers feel that recently graduated students cannot meet the needs of today's employers without significant on the job training (Angeli & Valanides, 2009; Spence, 2001). Twenty-first-century skills being demanded by employers are those that have students "think for themselves, pose and solve complex problems, and generally produce knowledge rather than reproduce it" (King, 1993, p. 30), almost none of which come naturally via the Socratic Method of instruction. In a knowledge-based economy, the idea of individuals being passive learners as exemplified in the Socratic Method is out of date (King, 1993).

With new technologies on the horizon, such as augmented reality, virtual reality, artificial intelligence, and the Internet of Things, a significant challenge of implementing technology in the classroom environment is a lack of knowledge about how faculty use technology and their beliefs about technology. Central technology organizations, such as information technology departments, who are frequently charged with deploying these technologies may not have an understanding of the pedagogical needs in the classroom (Koehler, Mishra, Hershey, & Peruski, 2004). Without the use of either a centralized technology or digital pedagogy organization whose purpose is to develop the integration of digital technologies into individual curricula; innovative faculty members may select technology based on personal preferences or cost, which rarely translates into a scalable system or one that works for a larger group (Dron, 2012). By providing central technology organizations better insight into how faculty view and use technology, new technology solutions, processes, and education may be developed to the benefit of all stakeholders—faculty, students, and staff alike. Comparable to other industries where technology has enabled change, these process changes can reduce costs and improve services in higher education.

Purpose of the Study

This causal-comparative study sought to gain an understanding of the impact of curricular ideologies and faculty beliefs and their impact in the use of technology in the classroom at a single liberal arts institution of higher education. Through the identification of the relationship between certain curricular ideologies and pedagogical knowledge (PK) and technology use in the classroom, technologists may be able to develop improved methodologies that support the deployment of classroom technology. Improving the delivery of technology in the classroom can reduce the barrier of entry for many faculty looking to leverage technology in the classroom environment, thus leading to more opportunities for technology-enabled change and a greater return on investment in both time and money for the higher education institution. Although this study focuses on a single institution, other organizations could undertake similar analysis methods in better understanding the interrelation between curricular ideology and technology in support of their technology deployment.

Research Question

This research study focused on obtaining a better understanding of the relationship between technology knowledge (TK) and technology adoption in the classroom environment in correlation to pedagogical knowledge (PK) and Curriculum Ideology, framed by the following question:

> To what extent does pedagogical knowledge (PK) and Curricular Ideology (CI) predict technology usage in the classroom?

Conceptual Framework

In the Socratic Method, teachers are expected to have two types of knowledge: content knowledge, which is required as they were expected to be the "sage on the stage" (King, 1993), and pedagogical knowledge, which is meant to engage the student with an understanding of the topic and to stimulate interest. In understanding that the original Socratic Method was a one-to-one model, as classrooms have scaled up and become more diverse, this method may no longer be the best approach to stimulate true learning (Spence, 2001). Using technology is one way institutions can enable change in the classroom through newer methods of instruction that are more student-centered. Student or learner-centered education is better aligned with current student needs and based on current best practices of learning by cognitive scientists (Greer et al., 2013; Spence, 2001).

To better understand the situatedness of technology to the Socratic Method of teaching, this research utilized a conceptual framework that helps to identify the fundamental constructs and terms in support of the process of learning by using the TPCK (or TPACK) framework (Koehler, Mishra, & Yahya, 2007). The TPACK framework is built on earlier work of Shulman (1987) who developed a framework for teaching and learning focused on the two primary types of knowledge required for instruction: content knowledge (CK) and pedagogical knowledge (PK) resulting in the PCK framework (Shulman, 1987). As this research considered how technology could enable change in the classroom, the addition of technology knowledge (TK) into the conceptual framework by using the TPACK framework (Koehler et al., 2007) helps to tie the three types of knowledge necessary to enable change in the classroom into one model (*Figure 1*).

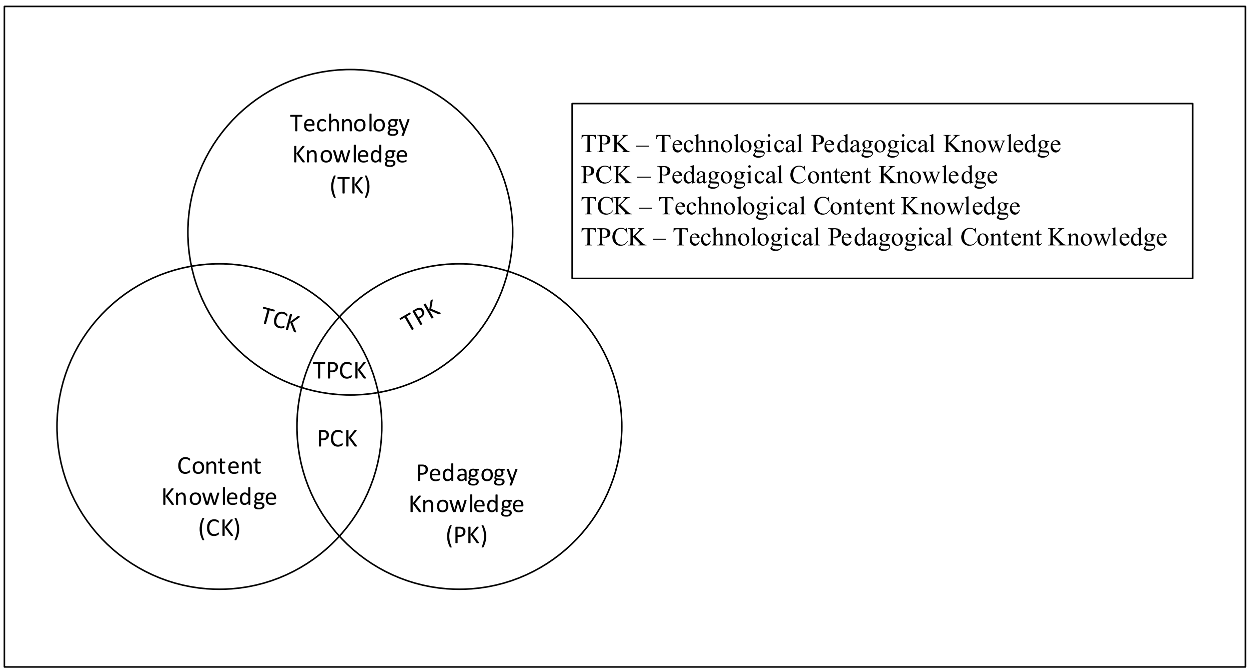


Figure 1: Representation of the interrelated components of the TPACK framework (Koehler et al., 2007)

The TPACK framework (Koehler et al., 2007) was initially developed to provide teacher-educators with a framework and language to understand and advocate for the skills necessary to be successful in deploying technology-enabled learning (Archambault & Barnett, 2010; Brantley-Dias & Ertmer, 2013; Polly & Brantley-Dias, 2009). The consequent goal of TPACK (Koehler et al., 2007) was to enable a move to active learning environments (Dron, 2012), which is in alignment with the goal of this research in improving the technology used to enable change in the classroom. While TPACK's (Koehler et al., 2007) use has primarily been that of a literal model for teacher education and even training (Archambault & Barnett, 2010; Brantley-Dias & Ertmer, 2013) this research uses TPACK as a theoretical model (Archambault & Barnett, 2010) to describe the interrelatedness of the specific constructs of pedagogical knowledge (PK) and content knowledge (CK) alongside technology knowledge (TK). It is through the study of the inter-relatedness of the three constructs of CK, PK, and TK that this researcher gained insight to improve the creation of pedagogical strategies and enable change centered on emerging technologies (Cox & Graham, 2009), which is of interest to the researcher as an educational leader in a technology organization.

Assumptions

Throughout the undertaking of this research, certain assumptions were accepted as true. The identification of assumptions was both necessary and expected as part of research design. When assumptions for this research were made, they were in alignment with current research on the relevant topics. While these assumptions are believed to be true based on prior research, this study or future studies on the topic could identify that certain assumptions were incorrect or failed to adequately describe the phenomena upon which this research is based.

In evaluating faculty beliefs about the use of technology in the classroom environment, certain assumptions were made about the research. It is assumed that in using TPACK (Koehler et al., 2007) as a theoretical framework, the interrelation between the three primary components of pedagogical knowledge (PK), content knowledge (CK) and technology knowledge (TK) are balanced and necessary in developing curricula that serve the continuing needs of the students. In concurrence with this assumption is that TPACK (Koehler et al., 2007) as a framework provides a reasonable theory to describe the framing of technology in the classroom for enabling change (Angeli & Valanides, 2009). This study assumed that Technology-Enabled Learning enables changes in the classroom environment meant to improve individual student performance (Shelton, 2013, 2018). Also assumed by the researcher is that the use of technology is beneficial in most academic environments, which is supported by several studies on similar technologies, including lecture capture (Hadjianstasis & Nightingale, 2016; Zhu & Bergom, 2010), Learning Management Systems (Turney, Robinson, Lee, & Soutar, 2009), and mobile technologies (Marinagi, Skourlas, & Belsis, 2013; Traxler, 2010). The majority of results from these studies rely on data that is self-reported as opposed to observed behavior or quantitative analytics, leaving them open to error (Archambault & Barnett, 2010), which may impact the validity of the benefit to essentially more perception than science.

Significance

As research studies have identified, the deployment of technology in higher education classrooms does not by itself lead to the development of new methods or enable significant change in the classroom environment (Abrams, 2010; Ertmer & Ottenbreit-Leftwich, 2010; Fung & Yuen, 2006; Stains et al., 2018). In driving critical changes as identified by many educational leaders, approaches such as Learning Analytics (Aguilar, 2017; EDUCAUSE, 2018) or the ideologies of the active classroom environment (Long, Cummins & Waugh, 2016; NMC Horizon Project, 2018), we must not treat technology as just another tool in the classroom. In many cases, technology is used as a replacement for an existing aspect of the passive educational environment analogous to using YouTube to replace the reel-to-reel projector (Davies et al., 2016). To enable change "effective technology integration for teaching subject matter requires not just of content, technology, and pedagogy, but also of the relationship to each other" (Koehler et al., 2007, p.740).

The proper integration of technology into the classroom environment can enable a multitude of changes specifically concerning individualization and collaboration. As an example, learning analytics offers the promise of providing data-driven guidance on individuals who may be struggling with understanding specific content (Aguilar, 2017) or may identify students with specific interests, allowing teachers to provide direction. Technology can also provide additional assistance for specific student groups, such as those with learning disabilities (Watt et al., 2014) or international students (Hadjianastasis & Nightingale, 2016), and encourage peer learning which has proved more effective than traditional lecture (Hadjianastasis & Nightingale, 2016; McNally et al., 2016). Further improvements with technology gathering data from a variety of wearable sensors including smartwatches or mobile devices and other Internet-enabled technologies may improve learning analytics and enable targeted learning to specific cultural or ethnic needs (Bartlett, 1996). For many schools, the driver for learning analytics is improved opportunities for student retention and success.

Higher education organizations invest significant money and effort in the deployment of new technologies. In 2015, spending on educational technology topped $6.5B in the United States and is expected to continue to increase (Niederhauser et al., 2018). While drivers for this technology are based on economies of scale, many changes are driven by the consumers of the service (Woodall et al., 2012) and other constituents including employers (Spence, 2001). An increase in globalization across many disciplines has many organizations seeking to hire students who are better prepared to take on the challenges of this new environment (Baytiyeh, 2017). As the pace of technology adoption has increased over time from other technological advancements such as electricity, the telephone, PC, and the Internet (Kurzweil, 2005, p. 50) the adoption rate of emerging technologies will continue to increase, posing specific challenges to organizations that are slow to adapt. Given the significant costs of technology deployment, training, and support across most higher education institutions, avoiding either a technology miss-step or failing to keep up with technological demands could have significant monetary or brand implications, yet rarely are the deployments of technology analyzed post-deployment.

A 2016 meta-analysis of research articles published in a leading research journal that exclusively covers the use of technology in education identified a lack of articles researching the theory development and synthesis of "research focused on explaining how education works through the logical analysis and synthesis of theoretical knowledge and principles derived from research related to teaching, learning, and performance" (Reeves & Oh, 2016, p. 326) as it relates to the use of technology. In this meta-analysis, the researcher classified articles from the journal *Educational Technology Research and Development* from 2009 through 2014 and identified no articles from either a theory development/synthesis or critical/postmodern analysis on the use of technology in the classroom. The findings from the Reeves & Oh study mimic the findings from an earlier study covering the years of 1989–1994. Without a critical eye to the challenges of existing technology use and deployment, opportunities to improve the process are limited. Through a better understanding of the use of technology in the classroom environment and the underlying beliefs of faculty, higher education institutions can develop a process or processes that allow them to react to new technology at a much quicker pace (Abrams, 2010).

Definition of Key Terms

Artificial Intelligence: Ability for a computer system to think like a human.

Augmented Reality: Augmentation of a real-world environment with computer-based information or graphics.

Content Knowledge: Knowledge of information relating to a specific topic (Cox & Graham, 2009).

Internet of Things: The combination of devices that are connected to a shared network such as the Internet that allows them to communicate with people, applications, and each other.

Inverted (or flipped) Classroom: Classroom environment where the lecture component of the class is moved outside of lecture-centric tradition time, allowing more time for discussion and exploration of ideas and topics under study (Lage, Platt, and Treglia, 2000).

Learning Analytics: Data that reflects various aspects of the learning process either as a whole or on an individual basis. Traditional analytics can consist of items such as grades or individual test results, whereas other possibilities exist with newer technologies which are based on best-fit learning styles, retention or application of learned information, or even student mood interaction.

Lecture Capture: At the most basic of capabilities, the capture of lecturer audio, video and multimedia of a lecture or presentation.

Pedagogical Knowledge: Activities used in the classroom to communicate and engage with students and parents including the presentation of information and management of the classroom environment (Cox & Graham, 2009).

Scaffolding: The nature of human learning to incorporate new ideas and concepts based on existing information or experience.

Socratic Method: One of the oldest teaching tactics to foster critical thinking. Focuses on giving students questions and not answers ("Socratic Teaching," 1997).

Technology Knowledge: Knowledge associated with emerging technologies that are "not yet transparent" in the classroom environment (Cox & Graham, 2009, p. 63)

Universal Design: The concept of integrating accommodations for individuals with special needs into the design of a system. Originally used as an architectural term and method of building ramps instead of stairs to improve mobility, the term has been adapted to serve other areas such as education to identify the integration of capabilities for students with various impairments into the overall platform instead of as an additional component.

Virtual Reality: Environment that is entirely computer generated that allows for a different type of reality.

Conclusion

While the use of technology in the higher education classroom of today is not unusual, the use of this technology to engender "innovative pedagogies" (Ling Koh & Chai, 2016, p. 244) has been a challenge. This research examined the effects of teacher beliefs and ideologies on the use of technology in the higher education classroom as one way to enable change, through the adoption of TPACK (Koehler et al., 2007) as a theoretical framework for better understanding and exploring the relationship between pedagogy, content, and technology. Chapter 2 is a literature review of relevant topics including technology, pedagogy, teacher beliefs, and the proposed research conceptual framework including TPACK (Koehler et al., 2007), and iTEaCH (Choy, 2013) and Schiro Curriculum Inventory (Schiro, 2013). Chapter 3 will identify the methodologies used in conducting research, specific research questions, and analytical techniques to be used in analyzing the data collected by the survey instrument. Chapter 4 addresses the findings from the study, and Chapter 5 presents conclusions and recommendations.

CHAPTER 2

LITERATURE REVIEW

This causal-comparative study seeks to understand the challenges of deploying technology in the classroom environment from the instructor's perspective. In examining this topic, this study explored instructors' use of technology in the classroom and their beliefs about pedagogy and ideology. In executing this research, it was necessary to conduct a review of literature that provided insight into the beliefs and actions associated with the use of technology in the classroom environment and the history of technology in the classroom. The literature review was conducted throughout the dissertation process from the initial proposal through data collection, analysis, and data triangulation.

The critical review included a multitude of subjects relating to the use of technology in the classroom environment. Multiple topics were reviewed including technology and pedagogical impacts in the classroom and the use of the TPACK framework (Koehler et al., 2007) in education. Through the TPACK framework (Koehler et al., 2007), which focuses on technology knowledge, pedagogical knowledge and content knowledge, an improved recognition of the learning process and drivers for change occurring within higher education was also explored. The benefits of technology in the classroom for specific disadvantaged constituencies such as individuals with learning disabilities and international students was also included in this literature review.

In conducting the literature review, multiple sources were examined to identify trends in technology in education and prior research on a variety of topics. This literature review includes content from books, journals, articles, and conferences as well as the Internet. These resources were identified by searching a variety of library databases including WorldCat, ERIC, and

ProQuest as well as general topic searches using the DuckDuckGo search engine. As this research is focused on the use of emerging technologies in the higher education classroom, the literature review for technology was limited to the past decade. Other research topics surrounding pedagogy and cognitive sciences had no limiting timeframe. However, as this study focuses on the use of technology in brick and mortar classrooms, articles exploring the use of technology in online environments were excluded from the literature review.

The Changing Face of Education

The term *pedagogy* relates to the skills required to assimilate content knowledge and utilize established strategies to communicate content and motivate students (Cox & Graham, 2009). Pedagogical theory has been developed over millennia and has changed from the one-on-one instruction of the Socratic Method to the increasingly larger and more diverse classroom of today. Computing technology comparatively has been available sporadically for the past three decades and only recently has reached a prolific nature for most U.S. based institutions where most students have access to a computer (Vongkulluksn, Xie, & Bowman, 2018). The advent of technology's arrival in the classroom combined with a growing desire for the use of technology by students and employers alike will continue to drive the need for technology in the classroom. Many institutions have adopted technology programs and provide instructor education to improve the adoption of technology, yet many lack the skills necessary to integrate technology into their curriculum (Angeli & Valanides, 2009). Researchers such as Dron (2012) and Maor (2016) relate the interaction between pedagogy and technology as a *dance* in which each influences the other. Technology as one of the many tools that can be leveraged in the educational environment to improve student understanding and engender interest in a subject should be planned as part of the curriculum to maximize technologies' use and success. Just as is possible with any tool, "pedagogies may be used well or badly to create great learning or piles of scholarly rubble" (Dron, 2012, p. 26). However, many institutions fail to adequately prepare faculty for the integration of technology into the classroom environment or do so with inadequate methods (Johnson, Wisniewski, Kuhlemeyer, Isaacs, & Krzykowski, 2012).

One of the significant challenges for instructors is preparing students for a future which will be vastly different for today's students than were the experiences of their educators (Ertmer, 1999). Where many of today's faculty were educated with the three R's—reading, writing, and arithmetic—the skills required by today's students focus on the ability to think for themselves, problem solve, and produce knowledge as opposed to just reciting facts and figures (Angeli & Valanides, 2009; Brantley-Dias & Ertmer, 2013; King, 1993). This change is being driven as the major economies of the world transform from the industrial economy of the past to a knowledge-based economy (Fung & Yuen, 2006). As the vast majority of human knowledge becomes readily available through the Internet, the focus of learning will shift from just knowing information to understanding and application (Kaku, 2017).

By the 1990s, faculty and educational leaders started looking for better methods of instruction, specifically with burgeoning class sizes and a better understanding of how individuals learn in the classroom environment (King, 1993). The proposed change in teaching methodologies from the traditional approach or *sage on the stage* (King, 1993) to a more active learning style termed "*guide on the side*" (King, 1993) was based on the constructivist theory of learning. In constructivism, students use existing knowledge and experience to integrate new ideas and concepts into preexisting knowledge through interactive experiences that are student-centered. A core concept of constructivism is the idea of *scaffolding* which describes how an individual learner integrates new ideas with existing knowledge to create a better understanding and deeper connection to new knowledge (Fung & Yuen, 2006). This scaffolding approach aligned with active learning often provides a deeper understanding of the topic being taught (Gross-Loh, 2016). Active learning also places the responsibility on the student and away from the teacher, who encourage students to be better consumers of an increasingly vast amount of knowledge and technological advancement (Nicol, Owens, Le Coze, MacIntyre, & Eastwood, 2017).

With a driving need to change the dynamics of the traditional lecture-based class to enable more time for student engagement and new content, the concept of the flipped or inverted classroom was first introduced in 2000 by Lage et al. The goal of the flipped classroom was to create a more inclusive learning environment versus the lecture-centric traditional classroom. In the inverted classroom, the lecture component is done mostly outside the classroom and involves either reading or video components completed before exploring and discussing the ideas and concepts in the classroom (Frydenberg, 2012). Lage et al. (2000) identified various modalities used in the classroom (such as lecture, labs, PowerPoint, and others) and described how these might support various student learning styles and how various learning methods can assist students to better understand the content.

Building on the concepts of the flipped classroom and using the increasing capabilities of technology, instructors can create an active learning environment. Whereas in the flipped classroom much of the initial learning takes place outside of the classroom, additional instructional approaches using different types of technology address different styles of student learning (Lage et al., 2000). The active learning classroom provides an environment where the instructor builds a closer synergy between the pedagogy and technology to further improve student success. Zhu & Bergom (2010) suggest that the introduction of emerging technologies such as lecture capture can help smaller institutions transform the educational environment and prepare future generations by not only providing a better understanding of content, but also allowing schools to improve student success (Gross-Loh, 2016).

Today, as more instructors include various learning modalities in the classroom environment (Vongkulluksn et al., 2018), the effectiveness of technology as an enabler for the active classroom is often called into question by school administrators looking to justify the expense (Njenga & Fourie, 2008) due to increasing scrutiny and the rising costs of higher education. Evidence of the benefits of the active-classroom is significant; in 2013 a meta-analysis of 225 studies identified that active learning in STEM-related classes increased grades by as much as one-half letter grade compared to similar lecture-based classrooms, and in return, a 36% drop in class failure rates (Freeman et al., 2014).

While the benefits of engaging students in a more active learning environment have been shown both anecdotally and scientifically, the concept of the active learning environment is "also very much an elite-institution idea" (Gross-Loh, 2016, p. 7). In most higher education organizations, ranging from the smallest to the largest, the lecture-based class format is used pervasively as many times faculty "have not fully realized the potential of these methods, are often reluctant to abandon the lecture approach" (Missildine, Fountain, Summers, & Gosselin, 2013, p. 598). A 2018 study across twenty-five institutions bolsters the idea that moving to an active learning environment is challenging as only 18 percent of the 2000 STEM classes observed included an emphasis on active learning activities (Stains et al., 2018).

Whether from the one-on-one relationship of mentoring from the Socratic Method or the move to a more learner-centered educational environment with small class sizes and active learning, one common piece of the puzzle for improved outcomes is that of social interaction.

Whether between the teacher and the student or between students, social interaction is an essential component for improved student engagement (Lo, 2018). Opportunities for providing this necessary component of learning through technology or an active-learning classroom environment will improve student outcomes. Other researchers have found that the use of active-learning concepts versus passive learning leads to improved learning outcomes of about 0.5, or less than one standard deviation (Streveler & Menekse, 2017).

Beliefs and Barriers to Technology in the Classroom

Faculty resistance to new technology, especially in higher education, has been researched extensively (Johnson et al., 2012). In researching the primary reasons for a lack of technology adoption among faculty, some of the earliest work in understanding the challenges of implementing technology in the classroom led to the identification of a set of extrinsic or first-order barriers and a set of intrinsic second-order barriers (Ertmer, 1999; Ertmer, Ottenbreit-Leftwich, 2013; Ling Koh, Chai, & Tay, 2014). Ertmer (1999) identified the first-order barriers as those that are external to the teacher and include resources, training, and support, which generally can be overcome.

Second-order barriers are those that are internal and tied to a teacher's beliefs, knowledge, or skills. (Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2013). It is these *intrinsic* barriers that are harder to overcome and strongly influence the success or failure of any technology. Rarely does any economic or administrative driver overcome these challenges (Ertmer, 1999). For many teachers, these beliefs may tie directly to the role technology should play in the classroom and may impede implementing authentic change, where the focus is on the student rather than the instructor (Ertmer & Ottenbreit-Leftwich, 2013). For school leaders looking to increase technology usage, changing an individual's beliefs is the hardest part of technology implementation (Njenga & Fourie, 2008).

Analogous to the ideology of Ertmer (1999) that the deployment of technology is based on a variety of extrinsic and intrinsic factors such as beliefs, knowledge, or skills, other technology implementation models also focus on these concepts. The Technology Acceptance Model or TAM (Davis, 1989) focuses on the perceptions of perceived usefulness and perceived ease of use which can drive the behavioral intention to use technology (Davis, 1989). Still, other models such as the Multi-Motive Information Systems Continuance Model or MISCM (Lowry, Gaskin, & Moody, 2015) focus on the need for information system design to meet the expectations of the consumer. While both the TAM and MISCM focus primarily on the deployment of technology and not necessarily the use of technology, they both advocate for the importance of addressing the intrinsic beliefs of faculty for its successful implementation.

The reluctance to implement technology on any significant scale for many teachers can be tied to a variety of intrinsic beliefs; the primary challenge to technology adoption is not understanding the reasons for incorporating technology in the classroom to enable change and further engage the student (Johnson et al., 2012). Some faculty even question why higher education needs the "redemptive power of technology" (Njenga & Fourie, 2008, p. 202) or see no concerns with the current use of lecture-based instruction. Other faculty believe that technology will one day replace them, which is contrary to current research (Njenga & Fourie, 2008). Some faculty are challenged by the perceived diminished role taken in the student-centered classroom where the faculty member serves as more of a guide than sitting at center stage (Frydenberg, 2012).

For many faculty members, the specific beliefs of their peers or discipline on educational ideologies can prevent them from engaging with technology (Palak & Walls, 2009; Shelton, 2013; Vongkulluksn et al., 2018). Innovative technological approaches were far less likely to be adopted when they were in opposition to the practices of fellow departmental faculty or school administration (Ertmer & Ottenbreit-Leftwich, 2010) and are very much driven by their "cultural, social, and organizational contexts" (Brantley-Dias & Ertmer, 2013, p. 116). Even when the institution drives technological change, technology usage can fall prey to the individual's loyalty to their academic discipline, which comes first (Shelton, 2013).

Institutionally, other challenges further complicate the implementation of technology in the classroom environment. For most institutions with tenure programs, there is greater focus and therefore greater reward on research rather than improved teaching and learning (Dron, 2012; Gross-Loh, 2016; *Horizon Report,* 2017). With constraints on time from teaching workloads and administrative demands, it can often be challenging for faculty to integrate technology into coursework retroactively or design entirely new courses with technology as one of the central components. Without a clear, demonstrable outcome on how technology can improve the learning process, many faculty will choose to continue down the path of least resistance based on perceived institutional drivers (NMC *Horizon Report,* 2017).

Likely limitations of the institution related to technology adoption called *extrinsic drivers* can be easier to address. Extrinsic drivers frequently focus on a lack of resources such as training, technical support, or time (Shelton, 2013). In the deployment of new technologies and training faculty to use those technologies, institutions frequently use the same pedagogical standards for training academic staff as they do students, which research demonstrates is not the ideal environment, as adults learn differently from their students (Johnson et al., 2012). Even worse may be a complete lack of training due to resource constraints in the hope that faculty will just use the technology available to them. Other resource constraints, including a lack of technology availability due to the costs of deployment across multiple classrooms, can also lead to a lack of adoption due to the inability of faculty to familiarize themselves with new technologies outside of the classroom environment (Abrams, 2010). A crossover from the intrinsic challenges is the perceived ease of use, which must be addressed by the institution in the deployment of technology. Many of today's technologies do not consider the needs of the instructor when teaching, requiring them to focus on the technology instead of the pedagogy (An, Bakker & Eggen, 2016). For technology to be successfully integrated into the classroom, its intrusion on the educational process must be as minimal as possible and readily available.

Addressing any one of these barriers will not necessarily improve or even encourage faculty to adopt technology in the classroom, let alone change their instruction to create a more student-centered environment (Ertmer & Ottenbreit-Leftwich, 2013). In addressing these fundamental barriers, it is necessary to not only improve the skills of the faculty in using technology and the creation of new content (NMC Horizon Project, 2018) but also to educate them on the benefits of technology integration in alignment with pedagogy and content knowledge. To improve the classroom experience specifically with faculty who hold a more traditionalist view of the classroom, encouraging the use of newer methods based on the needs of today's learner is essential if they are to engage students. Newer methods based on cognitive science and concepts such as constructivism tend to be more adaptive to a deeper pedagogical engagement or student-centered activities (Ertmer & Ottenbreit-Leftwich, 2013; Ling Koh et al., 2014; Niederhaueser, 2018; Palak & Walls, 2009).

As pedagogy and technology are intertwined, a critical piece of integrating technology in relation to pedagogy is to use verbs that describe learning such as understanding, communicating, presenting, and persuading versus the actual tools being used due to the rapid changes with technology (Ertmer & Ottenbreit-Leftwich, 2013). Whereas the tools will change, the actions associated with pedagogical needs will not likely change in the foreseeable future. Understanding the goals of learning and the proper use of technology in meeting those goals is the key to how technology can encourage change.

How Technology Can Effect Change

As many individuals were becoming acquainted with computers, one individual in the early 90s prognosticated about the technological journey of today's classroom. Mark Weiser, Chief Technology Officer of Xerox PARC, suggested there would be four major trends in computing, including the mainframe, personal computer, Internet, and what he referred to as Ubiquitous Computing. (Weiser & Brown, 1997). His ideas surrounding the future of technology and the move to Ubiquitous Computing centered not on the use of technology, but its relation to each of us (Weiser & Brown, 1997). In Weiser's vision, his ideology is best summed up as "the most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it" (Weiser, 1995, para. 1).

For almost twenty years, the integration of modern technology and its place in education has been discussed and researched (Ertmer, 1999; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur & Sendurur, 2012). Technology use in the classroom environment has yet to find its theoretical roots perhaps due to the rapid pace of technological change (Graham, 2011) and frequent lack of alignment with pedagogical goals (Turney et al., 2009). While there is little doubt that faculty have increased their use of technology over the past three decades (Ertmer & Ottenbreit-

Leftwich, 2013; Vongkulluksn et al., 2018), much of their use of technology tends to serve as a replacement for traditional instructional methods or focuses on improving student technical skills in preparation for careers (Ertmer & Ottenbreit-Leftwich, 2010). A focus on Web 2.0 technologies for teaching including blogs, wikis, video sharing sites, and social media (Maor, 2016) typically does little in furthering the engagement of students.

Initial models of technology such as the Apple Classrooms of Tomorrow in education suggested that change would naturally occur if teachers had sufficient access to technology equipment in the classroom environment (Ertmer, 1999). More recent research, however, suggests that improving access to technology does not automatically equate to greater use of technology or, more importantly, changes in educational practices (Vongkulluksn et al., 2018). While many institutions offer opportunities for workshops with technology for new faculty or even remedial workshops to fix what technologists perceive is broken, most of this type of education falls short (Johnson et al., 2012). Research has demonstrated that despite efforts to educate faculty on the uses of new technology, many do not have the prerequisite skills to integrate it into the curriculum (Angeli & Valanides, 2009) let alone improve student outcomes through its use (Palak & Walls, 2009).

Students, on the other hand, are generally not afraid to try out new technology as is demonstrated by their rapid adoption of mobile applications. This can lead to an interesting dichotomy for faculty, as especially industrious students use technological tools to create content and collaborate with other students either inside or outside of the classroom, pushing the faculty member to take on a different role (NMC *Horizon Report,* 2017). The use of technology in the classroom driven by students specifically in understanding new concepts may be one of the best drivers for change among faculty who are resistant (Ertmer & Ottenbreit-Leftwich, 2013). The availability of information via electronic resources such as the Internet has likewise challenged the traditional lecturer's role as a keeper of knowledge.

There is an ongoing skepticism in higher education about the use of technology due to the continuing rhetoric and failures of technology deployments that have fallen short (Njenga & Fourie, 2008). This skepticism, however, provides an opportunity for institutions to evaluate their technological plans and question whether the focus on technology is on that of technology itself or, as the research suggests, a more appropriate focus on how technology can enhance learning with a specific focus on technology-enabled learning (Brantley-Dias & Ertmer, 2013; Graham, 2011; Njenga & Fourie, 2008). To properly enable change in the educational environment, it is critical for central technology or pedagogical organizations to develop a vision of how to use technology in conjunction with the faculty who use it (Ertmer, 1999). With a goal of achieving technology-enabled learning, technologists and their pedagogical counterparts should focus on how technology can support proper instruction and how it can support the "contextual, cognitive, and affective factors that exist in their school environment" (Ertmer & Ottenbreit-Leftwich, 2013, p. 180). To successfully implement technology-enabled learning requires not only the alignment of technology with the pedagogy (Turney et al., 2009), but also the invisibility of the technology in relation to the pedagogical mission (An, Bakker, & Eggen, 2016; Sulecio de Alvarez & Dickson-Deane, 2018). This requires a close collaboration with faculty and students using educational technology to understand their needs and expectations during technology conceptualization (Sulecio de Alvarez & Dickson-Deane, 2018).

Learning Analytics

At the top of almost every university's wish list is the ability to better serve their students' needs with data enabled measurements or learning analytics (NMC *Horizon Report,* 2017). Learning analytics is the combination of multiple data sources from individual learners and learning environments that allow institutions to improve educational outcomes through the use of business intelligence to analyze important trends. Yet, while the use of technology has increased in higher education, many organizations still use little data to improve instruction (Davies et al., 2016). Although the collection of data on an individual level may provide insight into their specific successes or challenges that can be gathered via other pedagogical tools, the analysis of data of larger groups and multiple systems can help identify important trends that can be acted upon (Mah, 2016). These trends can influence the macro-scale of the university or the micro-scale of an individual class or classroom.

At the macro-scale, learning analytics can aid in the retention of students and completion rates by identifying groups of students who may have a variety of risk factors that increase their susceptibility for failure. A 2008 study by Yorke and Longden of 462 students in the UK identified the top reasons students leave higher education programs. Among the top reasons were "a poor quality of learning experience, not coping with academic demands, and wrong choice of field of study" (as cited in Mah, 2016). These three reasons accounted for more than one-third of students who dropped out of programs. Through the identification of at-risk student groups, specialized programs can be created to help improve their ability to succeed. Other areas where data analytics may prove beneficial include the identification of services that are of value to various constituencies by analyzing information gathered from web page accesses to learning management systems.

At the classroom level, data gathered by technology-enhanced learning can be used by institutions to resolve myriad challenges, including the ability to identify the struggling or disengaged student (Aguilar, 2017) or even direct students to careers based on their interest in specific topics. While some faculty may scoff at the idea that data can do a better job than they can in identifying student's needs, ever-growing class sizes and auditorium-sized classrooms require many faculty to teach for the average student (Aguilar, 2017). Unfortunately, designing for the average student may pose the challenge that in fact, the average student does not exist (Aguilar, 2017) and the one-size-fits-all method of lecturing can be too slow for some students, yet too fast paced for others (Osamnia, Okada, Berena, Ueno, & Chunwijitra, 2016).

Through technology integration into the educational environment, ubiquitous learning environments may eventually allow tailoring of learning to the needs of the student in the moment (Marinagi et al., 2013). Real-time responses based on feedback from a variety of systems or individual devices may adjust the difficulty of the lesson to meet student needs through automated interventions, increased interactions, or other modalities of learning such as visual vs. textual (Ifenthaler, 2016). Other concepts, such as universal design, in which support for individuals with disabilities is natively built into solutions, reducing the support costs for individuals requiring accommodations and enabling others who may have undiagnosed learning disabilities to succeed. The ubiquitous learning environment can support the needs of all students, enabling the educational environment to be socially just and meet the individual needs of each and every student, thereby increasing the opportunities for success (Aguilar, 2017).

Conceptual Framework

This research focuses on the beliefs of faculty and their use of technology in the classroom environment. Foundational to this research is how technology can enable change and the ideology of constructivism to improve grades and encourage a deeper understanding of particular topics (Gross-Loh, 2016; Long et al., 2016; Missildine et al., 2013). Comparatively, the Socratic Method of lecturing, still used in large sections of higher education (Hadjianastasis

& Nightingale, 2016), is assumed to address learning of the average student (Aguilar, 2017), which can leave advanced students feeling bored or slower learners completely lost (Osamnia et al., 2016). Tranditional approaches to instruction may not serve students with learning styles different from the instructor (Lage et al., 2000).

Technology use in higher education classrooms has increased dramatically over the years with the use of technologies such as electronic whiteboards, video projectors, and the Internet (Vongkulluksn et al., 2018). These uses of technology tend to be more aligned with the traditional Socratic Method (Ertmer & Ottenbreit-Leftwich, 2010), with the teacher as the center of the classroom compared to a constructivist ideology with technology-enabled learning. Early models of pedagogical development developed by L. Shulman (1987) focused on two areas of knowledge that were key to building a class curriculum included content knowledge (CK) and pedagogical knowledge (PK). In Shulman's model, he proposed that the combination of these two types of knowledge created a new type of knowledge referred to as PCK or pedagogical content knowledge, which was critical for developing a curriculum and successful teaching (Brantley-Dias & Ertmer, 2013).

With the increasing amount of technology used in the classroom, Koehler et al. (2007) extended the PCK model developed by Shulman (1987) to integrate a new construct based on technology on an even basis with pedagogical knowledge (PK) and content knowledge (CK) referred to as technology knowledge (TK). The relationship among these three is typically exemplified as a Venn diagram with the three knowledge types intersecting in the middle to form the new TPCK construct reflecting the combination of technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK) into a single construct. The new TPCK construct is a "form of situated knowledge about the affordances of technology on teaching specific subject matter in a certain context" (Boschman, McKenney & Voogt, 2015, p. 251).

While TPACK (Koehler et al., 2007) has been used in studying technology's impact in higher education (Dron, 2012; Shelton, 2018) it is admittedly a necessarily incomplete model as identified by Mishra, Koehler, and Yaya (Kimmons, 2015). This is due to the complexity of any model that can be applied across multiple contexts and content (Archambault & Barnett, 2010). Where the TPACK framework (Koehler et al., 2007) plays an important role, however, is in providing educators and pedagogical specialists with a theoretical model and a vocabulary for discussing emerging technologies used in the classroom environment (Archambault & Barnett, 2010; Brantley-Dias & Ertmer, 2013). Contrarily, TPACK (Koehler et al., 2007) has also been used in a more prescriptive manner for addressing training programs and teacher readiness, which is where the lack of a validated model creates challenges (Brantley-Dias & Ertmer, 2013; Porras-Hernandez & Salinas-Amescua, 2013). This research focuses on the use of TPACK (Koehler et al., 2007) as a theoretical model to guide the integration of technology into the classroom environment to avoid these challenges.

iTEaCH Implementation Model

The iTEaCH Implementation Model (Choy, 2013) explores the dimensions relating to technology, pedagogy, and collegiality in the implementation and adoption of ICT (Information Communication Technologies) in a classroom environment. Building on the early works of Rogers Diffusion of Innovation Theory (1995) and Sandholtz, Ringstaff, and Dwyer's (1997) work on the implementation of ICT in the Apple Classrooms of Tomorrow project, Choy (2013) identifies five types of teachers' use of technology in the classroom. The five categories of technology use in the classroom include: 1) Interactive Learning; 2) Collaboration, Research and Learning Guidance; 3) Reflection, Production, and Revision of Work; 4) Presentation of Information; and 5) Motivational Learning. Choy's (2013) developed a multidimensional survey instrument to identify an instructor's current use of technology in the classroom environment as well as how they would like to use technology in the classroom. Choy & Ng (2015) suggest that this information helps to identify gaps in learning or skills that can then be further developed on an individual basis.

The iTEaCH (Choy, 2013) survey questions have been incorporated into the survey instrument for this research as a component of a concurrent triangulation in mapping the iTEaCH (Choy, 2013) instrument to the TPACK framework (Koehler et al., 2007). Within the iTEaCH instrument, Choy (2013) suggests three new terms that closely identify with sections of the TPACK framework (Koehler et al., 2007). The first term, "teachnology" (Choy & Ng, 2013, p. 7), references the technology knowledge (TK) component of the TPACK framework (Koehler et al., 2007) providing introspect into the individual teacher's technology knowledge. The second term, "technogogy" (Choy & Ng, 2013, p. 7), references the combination of technology knowledge (TK) and pedagogical knowledge (PK) or TPK (technological pedagogical knowledge). The final term identified by Choy & Ng (2013) is "collegiality" (Choy & Ng, 2013, p. 7), which measures "the support from management, colleagues, and students to use ICT in teaching and learning" (Choy & Ng, 2013, p. 7). As was established by Brantley-Dias & Ertmer (2013) and Shelton (2013), individual teachers' desire to use technology-enabled learning can be influenced by the viewpoints of colleagues, institutional leadership, and individual academic disciplines. Given the combination of technology knowledge (TK) and content knowledge (CK) associated with the collegiality measure, this research equates "collegiality" from the iTEaCH instrument (Choy, 2013) to the TCK (technological content knowledge) of the TPACK framework (Koehler et al., 2007).

Schiro Curriculum Ideology

The Schiro Curriculum Ideology is based on Schiro's work on Curriculum Theory (2013) and addresses the competing viewpoints that have both promoted change in American school curricula, and introduced conflict on which is the best methodology over the past 100 years. While the names over the years may have changed, the fundamental beliefs of the four types have changed little. Through a historical analysis of the various beliefs, Schiro (2013) proposes four visions for curriculum beliefs: 1) Scholar Academic, 2) Social Efficiency, 3) Learner-Centered, and 4) Social Reconstruction.

Schiro's Curriculum Theory (2013) impacts the pedagogical knowledge (PK) construct of the TPACK framework primarily, but also impinges on the content knowledge (CK) construct as

> Each of the four visions of curriculum embodies distinct beliefs about the type of knowledge that should be taught in schools, the inherent nature of children, what school learning consists of, how teachers should instruct children, and how children should be assessed. (Schiro, 2013, p. 2)

As would be expected, the four curriculum ideologies span various methods of instruction and content:

> *The Scholar Academic Ideology*: "The purpose of education is to help children learn the accumulated knowledge of our culture: that of the academic disciplines" (Schiro, 2013, p. 4).

The Social Efficiency Ideology: "Social Efficiency advocates believe the purpose of schooling is to efficiently meet the needs of society by training youth to function as future mature contributing members of society" (Schiro, 2013, p. 5).

The Learner-Centered Ideology: "Learner-Centered proponent focuses not on the needs of society or the academic disciplines, but on the needs and concerns of the individual" (Schiro, 2013, p. 5).

The Social Reconstruction Ideology: "The purpose of education is to facilitate the construction of a new and more just society that offers maximum satisfaction to all of its members" (Schiro, 2013, p. 6).

While there are numerous dimensions to each of the ideologies, of interest to this research is the primary medium used during teaching. Ranging from the didactic approach (Scholar Academic) to programmed instruction (Social Efficiency), environment interaction (Learner-Centered) and group dynamics (Social Reconstruction). Situating the four ideologies within the previously discussed methods of teaching, the Socratic Method is most similar to the Scholar Academic ideology and the ideas of constructivism more closely aligned to the Learner-Centered ideology.

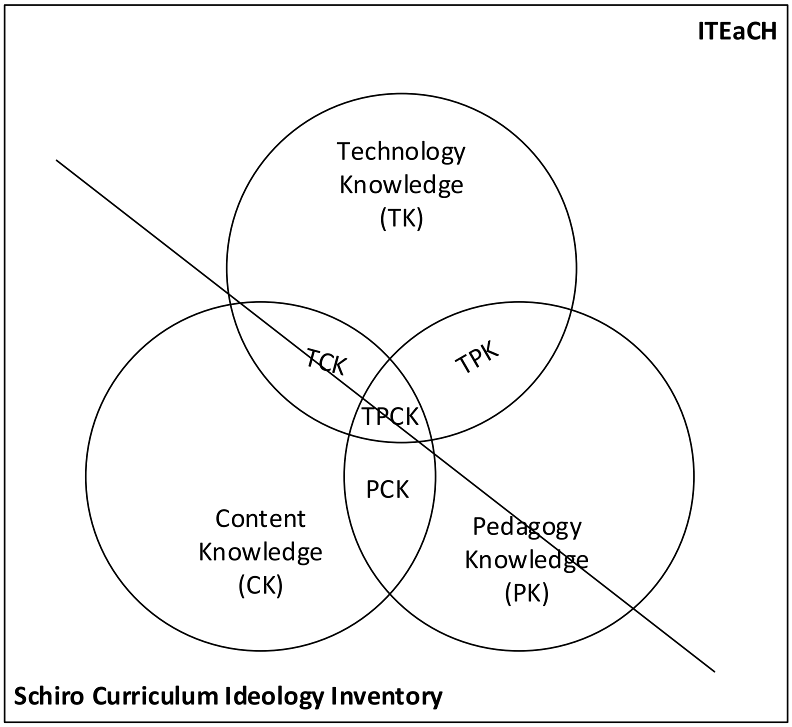


Figure 2: iTEaCH & Schiro TPACK relationship model

The Curriculum Ideologies Inventory (Schiro, 2013) is included in the survey instrument for this research to provide insight into primarily the pedagogical knowledge (PK) and content knowledge (CK) component of the TPACK framework (Koehler et al., 2007). Appurtenant to TPACK is the impact on the technical content knowledge (TCK) construct and the pedagogical content knowledge (PCK) construct.

Conclusion

The use of technology in the classroom environment has definitively increased over the last decade (Vongkulluksn et al., 2018), yet faculty continue to face challenges in the adoption of technology to enable innovative pedagogies (Abrams, 2010; Angeli & Valanides, 2009; Ling Koh & Chai, 2016). While many higher education institutions have pedagogical development organizations that are either tightly coupled with a central information technology organization or the provost’s office, technology in the classroom is often made available with only basic training, often resulting in a lack of use and undoubtedly not enabling the use of technology for innovative pedagogies (Archambault & Barnett, 2010; Fung & Yuen, 2006).

To improve opportunities for the successful deployment and integration of technology into the higher education classroom, this research examined the factors that challenge educators in adopting emerging technology. Leveraging the TPACK framework (Koehler et al., 2007), iTEaCH Implementation Model (Choy, 2013) and Schiro Curriculum Inventory (2013) this research gained a better understanding of how individual teachers' beliefs can impact the use of technology in the classroom. Through a better understanding of the dynamic between teacher beliefs and technology, it is expected that methodologies can be developed to overcome these challenges and encourage the deployment of technology-enabled learning.

The benefit of technology-enabled learning is apparent in the immediate results offered in improved understanding and grades through the enablement of innovative learning (Dron, 2012). Technology-enabled learning also has longer-term implications of technology's potential to offer better insight into many of the facets of the educational process through data analytics (Aguilar, 2017; Osamnia et al., 2016), specifically for many types of marginalized students, including international students, minorities, and those with learning disabilities (Aguilar, 2017; Owston, Lupshenyuk & Wideman, 2011; Shaw & Molnar, 2011). More importantly, facilitating a technology-enabled curriculum helps to better prepare students for their future careers in a rapidly changing world that requires them to be able to collaborate and solve the unique problems of a world driven by technological change (Angeli & Valanides, 2009; Brantley-Dias & Ertmer, 2013; Ertmer, 1999).

CHAPTER 3

METHODOLOGY

This causal-comparative study sought to examine the relationship between pedagogical knowledge (PK) and content knowledge (CK) as they relate to the use of technology in the classroom. Through an understanding of faculty beliefs and their use of technology, organizational leaders can better prepare for the deployment of emerging technologies, leading to a proactive rather than reactive approach to rapidly advancing technologies. Through use of a planned technology deployment strategy that addresses the relationship among the various variables within the TPACK framework, educational leaders may create more opportunities for innovative change leading to better student outcomes.

This chapter identifies the reasoning behind the choice of the causal-comparative study methodology as well as the data that was collected in support of the planned analysis. A review of the overall research design, participants, data collection, and analysis is presented. The methodology chapter concludes with a review of ethical considerations, including participant rights and study limitations associated with this research.

A causal-comparative study methodology was selected for this research as the preferred methodology so the researcher could examine the relationship between the use of technology and a faculty member's curriculum ideology (Brewer & Kuhn, 2010). The use of causal-comparative as a methodology for this study is also appropriate as an ex-post facto study in that this study sought to evaluate events that have occurred in the past (faculty members' use of technology) based on a group membership and based on their individual curricular ideology. For this research study, multiple survey instruments were combined to gather the necessary data points as opposed to conducting experimental or naturalistic observation. Through use of the two selected instruments, this researcher studied the relationship between technology use in the classroom and curriculum ideology.

As other researchers have pointed out (Brantley-Dias & Ertmer, 2013; Graham, 2011; Njenga & Fourie, 2008) technology is not in and of itself an answer to improving teaching. Technology-enabled learning is a proven method of effecting change in the classroom environment (Ertmer & Ottenbreit-Leftwich, 2013; Turney et al., 2009). In researching the relationship between technology use in the classroom and beliefs of faculty and their curricular ideology, this study gained insight into better methods of deploying technology to encourage change, not drive change.

Setting

The setting for this study is a single private liberal arts university located in the eastern United States. Over 3600 students attend the institution, taking courses in the College of Arts and Science, College of Engineering, and College of Management. As of 2018, the university has a 29 percent admission rate with an average GPA of 3.53 out of 4.0 and a middle 50 percent ACT composite score of 28–32 out of a possible high score of 36 for the incoming class. Supporting the academic goals of the institution are more than 400 faculty with 62% of the faculty being tenured and an additional 25% of faculty on tenure track within the institution. Over 96% of the faculty body holds terminal degrees.

All classrooms are equipped with digital projectors, a teacher workstation with a computer and wireless Internet. The campus consists of 76 classrooms of various sizes with small classrooms of less than 30 seats accounting for 37% of the classrooms, medium classrooms seating between 31 and 75 seats making up 55% of the classrooms, and large classrooms of greater than 75 seats 8% of the classrooms.

The researcher's position in the institution is that of a C-level executive within a centralized Library and Information Technology organization providing enterprise technology solutions including learning management systems, enterprise resource planning, and network connectivity. Support for classroom technologies including projectors, digital whiteboards, and teacher workstations is also included in the centralized Library & Information Technology organization. The researcher does not hold any responsibility for faculty within the institution other than that of developing information security strategies and education for the university. Within the Library and Information Technology division, there are no direct reporting lines between the researcher and classroom technology support staff or pedagogical staff who are responsible for developing technology and pedagogy strategy for the institution. The researcher had held this position for two years at the time of this study.

Participants and Sample

Participants in this study self-selected from the faculty of the research site. As participants individually opted to participate in the study, the study dataset is a convenience sample ("Convenience Sampling," 2009) for gathering the ideological and pedagogical views of faculty within the institution. The convenience sample was selected over other sampling methods due to the need to maintain the anonymity of the participants and for detecting relationships between the use of technology and the faculty beliefs as part of the proposed research. Other probabilistic sampling methodologies such as simple random sampling or systematic sampling were not selected for this research study due to the limited participant pool and necessary participation rates for validity as many faculty who could have been randomly selected to participate may choose not to participate. Alternatively, those who wished to participate may not have been able to participate. In both cases, the number of participants in the study would have likely been curtailed, and anonymity would have been harder to guarantee due to the necessary tracking of responses and followup.

A link to the survey tool in Appendix A was distributed to all faculty at the research site via email using the institutional faculty email list. The email was sent from the researcher to approximately 400 faculty members. Follow up emails to other subgroups within the faculty were sent to obtain a sufficient sample size. These groups included a faculty technology committee, new faculty members, and faculty members involved in the construction of a new education building.

Prior to conducting research, a power calculator was consulted to estimate the necessary population size for a one-way ANOVA analysis. Using the G*Power Calculator (Faul, Erdfelder, Buchner, & Lang, 2009) for ANOVA F tests and an A priori power analysis, the following values were used in calculating an appropriate sample size: 0.05 for significance (type I error), 0.80 for power (type II error) and an effect size of 0.50. Based on the recommended values, a sample size of 76 is required.

Data Collection

Data for this study were gathered via a customized survey instrument using two existing survey tools to collect quantitative data. The iTEaCH (ICT-Technogogy-and-Collegiality Holistic) instrument created by Choy (2013) and the Curriculum Ideologies Inventory (Schiro, 2013). Additional data regarding the challenges of using technology in the classroom were collected at the request of the research site and is based on related concepts of intrinsic vs. extrinsic challenges in approaching technology use in the classroom (Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2013). Additional data collected included necessary demographic information about gender, academic rank, tenure status, and whether primary course load is

STEM vs. Non-STEM. The survey instrument provides data on both the faculty's use of technology in the classroom and their beliefs about curriculum ideologies. The survey instrument used is attached as Appendix A.

The study, including a summary and link to the survey, was distributed by email to all faculty within the institution. The survey was administered electronically using the Qualtrics platform. The survey instrument began with a reiteration of the research project and reminder of participants' ability to opt-out of the survey and research study at any time. Survey participants were asked for consent to participate in the survey and confirmed consent by clicking on the appropriate button to continue. All data gathered via the electronic survey tool was stored in the Qualtrics platform during data acquisition and then exported to Microsoft Excel for further processing. It is essential to protect the privacy of individual responses, which makes the use of an electronic survey instrument ideal. Data gathered via the survey instrument is also easier to analyze, preventing possible transcription errors that could occur if the survey were administered via paper.

The survey instruments were selected to gather data on the three aspects of the TPACK framework (Koehler et al., 2007). The first component of the survey instrument is based on the iTEaCH implementation model (Choy, 2013) and how the faculty members, school, and colleagues support the use of technology. This survey element consists of 24 questions on technology use and support of technology using a Likert scale of 1 (strongly disagree) to 5 (strongly agree) creating a quantitative data set. The questions from the iTEaCH instrument (Choy, 2013) are arranged to identify the survey participant's technology usage pattern and specific responses in alignment with components of the TPACK framework (Koehler et al., 2007) including technology knowledge (TK), technological pedagogical knowledge (TPK) and technological content knowledge (TCK). Specific questions give examples of how technology is used in the classroom environment, the types of technology that the survey respondent is keen to use and the pedagogical skills, which they have related to the use of technology. This survey is Open Access and being used within the guidelines of the Open Access agreement.

The second instrument used in the development of the research instrument is the Schiro (2013) Curriculum Ideologies Inventory, which gathers information on the pedagogical knowledge (PK) component of the TPACK framework (Koehler et al., 2007). This instrument consists of six groupings of four statements to which the respondent ranks the statements from those that are most in agreement with their views on the goals of curriculum development to those that are the least in alignment. The results of this survey provide qualitative data on the individual pedagogical curriculum beliefs of survey participants. Schiro's Curriculum Theory (2013) typifies respondent's curriculum beliefs as primarily being that of a scholar academic, learner-centered, social reconstruction, or social efficiencies. The publisher approved permission to use this instrument (Appendix C).

The third primary component of the TPACK framework (Koehler et al., 2007) is content knowledge (CK). Whereas it is an equally important component of the TPACK framework (Koehler et al., 2007), the researcher has chosen to limit this aspect of the study to STEM versus non-STEM primary subject areas to generalize the survey responses across the entire university. Given the high number of faculty members within the home institution with terminal degrees, it is assumed for this study that the faculty participants have adequate content knowledge.

While these instruments have been used in other studies primarily in the original authors' research, the instruments have rarely been combined to look at the various components of the TPACK framework (Koehler et al., 2007) from a pure technology, pedagogy, and content correlation. Choy and Ng (2015) specifically reference the TPACK framework (Koehler et al., 2007) in their published works in discussing technology as it pertains to the classroom environment. Choy & Ng (2015) in their research included a single question on general teacher motivation; this research alternatively used Schiro's (2013) work on Curriculum Theory as a correlation marker to the pedagogical knowledge (PK) construct to explore possible correlations between technology use and curriculum ideologies. For purposes of this study only surveys that complete at least the questions related to the iTEaCH (Choy, 2013) and Curriculum Ideologies Inventory (Schiro, 2013) were used in the data analysis.

Participant Rights

As part of the planning for this study, attention was given to participant rights and ethical issues that may have occurred from participation in the study. Participation was voluntary, and individuals were reminded their participation was voluntary and they may opt out of participation in the survey at any time. The survey instrument provided a reminder of their voluntary participation on the first page of the survey as part of their informed consent. The introductory email sent to request survey participation also included an overview of the goal of the study, which is to study the relationship between pedagogy and ideology related to technology use. The introduction to the survey also reminded participants that limited information would be collected that might personally identify them based on years of service and other demographic level data. Demographic information was reported only in the aggregate to protect individual privacy. Specific identifying information such as computer name or network address was not collected as part of the Qualtrics anonymization feature, which generates a single web address for all individuals to use to complete the survey. Responses to questions in the survey were downloaded and stored on the researcher's laptop for additional processing. All computers used contained multiple precautions against data exposure in accordance with university policy, including password protection, hard drive encryption, and antivirus software.

Adverse outcomes can be difficult to anticipate for survey instruments. Participants in this survey were not expected to have any adverse outcomes through their participation or lack thereof in the survey. This survey was conducted electronically, allowing participants in the survey to complete it at their leisure and time/place of their choice, removing any peer pressure to complete the survey as part of a larger group setting.

Data Analysis

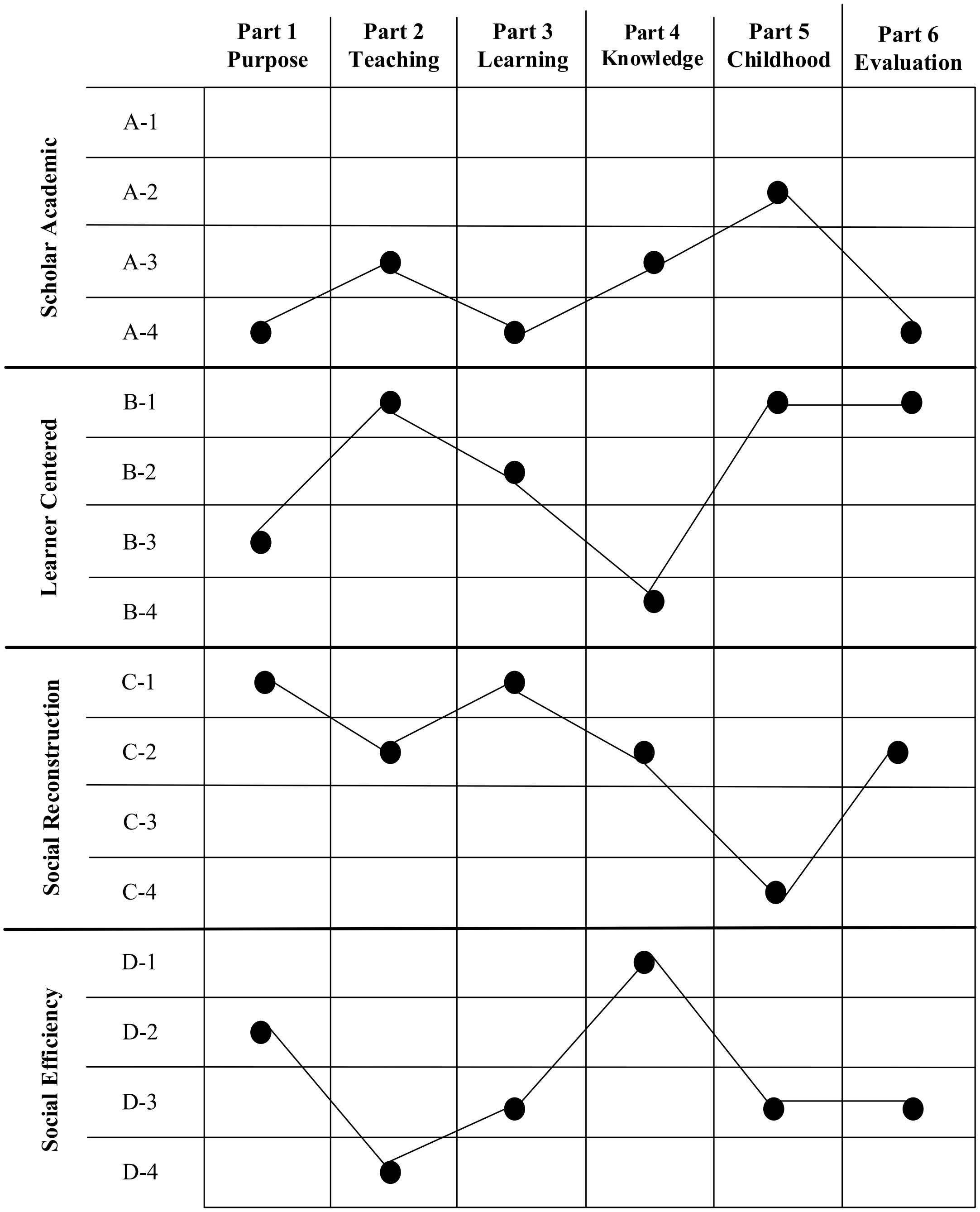
The combined survey instrument generated quantitative data for use in conducting the correlational research via a one-way ANOVA analysis. Quantitative data were used to generate descriptive statistics based on survey responses. For this study, there was one quantitative variable, which was created from the iTEaCH instrument (Choy, 2013). This quantitative variable was a summation of the numerical responses from the iTEaCH instrument using Likert scale responses from questions #9–#31 that were then transposed into numerical values using the scale of 1 through 5 with a “strongly disagree” response being 1 and “strongly agree” response being 5. Once the responses were calculated, the total responses from questions #9–#31 resulted in a new numeric value (*iTEACHALL*). An additional descriptive categorical variable was generated out of questions #34–#39 of the survey instrument as part of the Curriculum Ideologies Inventory (Schiro, 2013) and included the following categories: Scholar Academic Ideology, Social Efficiency Ideology, Learner-Centered Ideology, and Social Reconstruction Ideology.

Questions #40 and #41, included at the request of the research site, were manually coded as either extrinsic or intrinsic to identify further significant challenges within the education environment that may be technology based, pedagogy based, or belief based.

Creating Descriptive Categorical Variables

The categorical variable for pedagogical knowledge (PK) from the Curriculum Ideologies Inventory (Schiro, 2013) questions involved the use of a sorting form (Appendix B) to chart individual responses. Each of the six questions in the survey relate to a component of the overall curriculum ideology, specifically Purpose (question #34), Teaching (question #35), Learning (question #36), Knowledge (question #37), Childhood (question #38) and Evaluation (question #39). For each of these questions, the survey participant was asked to rank the prepopulated responses in order of statements that were liked the most to the least by ordering the questions in the survey via a drag and drop method. Statements were not listed in any particular order; as an example, a statement demonstrating the Scholar Academic ideology might be the first item listed in Learning (question #36) but may be the last item listed in Knowledge (question #37). The individual responses provided a ranked list by preferences for each question, which was then entered into the sorting form located at the bottom of Appendix B.

Once the data were entered onto individual forms for each completed response, individual sorting data was then transcribed onto the corresponding ideology matrix based on the responses. As an example, if in question #34, the individual ranked the statements in the following order: 3,2,4,1, then these numbers would be entered into Part 1 of the sorting form resulting in the following sequence: C-3, D-2, A-4, and B-1 according to the sorting key provided by Schiro (2013). These entries would then be entered into the graphing form by placing dots in the corresponding boxes and drawing a graph line between the dots. To identify the preferred ideology type for each individual, the number of data points in the first row of each ideology type were counted. If one of the ideologies had a higher number of marks in the first row than any other ideology, it was marked as the preferred ideology. If multiple ideologies had the same number of marks in the first row, then subsequent rows were counted between those ideologies until a preferred ideology was identified. A sample completed plot for an individual curriculum ideology can be found in *Figure 3*.



Sorting Form

Part 1	Part 2	Part 3	Part 4	Part 5	Part 6
C _1__	D _4__	D _3__	A _3__	D _3__	D _3__
D _2__	C _2__	A _4__	B _4__	A _2__	B _1__
A _4__	B _1__	B _2__	D _1__	B _1__	C _2__
B _3__	A _3__	C _1__	C _2__	C _4__	A _4__

Figure 3: Curriculum ideology map (completed)

Analysis Methods

To answer research question #1, a one-way ANOVA was performed comparing the categorical variable *CITYPE* to the numerical variable *iTEACHALL*. Use of a one-way ANOVA has several prerequisites that were evaluated prior to and as part of the one-way ANOVA analysis which requires one dependent variable (*iTEACHALL*) measured on a continuous level (scale of 24–120) and one independent variable (*CITYPE*) consisting of two or more categorical groups, which for this study includes the four curriculum ideologies (Schiro, 2013) including: Scholar Academic, Learner-Centered, Social Reconstruction, and Social Efficiency. A final initial assumption for the one-way ANOVA is that there must be independence of observations. In this case, each observation from a categorical perspective of the variable (*CITYPE*) had only one preferred type. Due to the construction of this study using a convenience sample, it was unlikely that within the *CITYPE* variable there would be equal numbers of the four curriculum ideology types, leading this one-way ANOVA to be unbalanced.

As part of the preparation of data and analysis of the one-way ANOVA, additional assumptions that are required for the use of ANOVA were evaluated. These additional assumptions included the removal of any significant outliers as identified in a box plot, an approximately normally distributed dependent variable (iTEACHALL) as evaluated via a Shapiro-Wilk test for normality, and homogeneity of variances evaluated by Levene's test for equality for the independent variable (CITYPE).

Limitations and Delimitations

Limitations of this study include the lack of generalization to higher education as the data gathered via this correlational study was from a single institution, which may not adequately reflect other populations. Limitations in the data gathered via the survey instrument also exist as survey participation was on a voluntary basis, resulting in a non-probability sample. Due to the topic and title of the survey, respondents may already have a definite bias toward the use of technology in the classroom. A final limitation exists in the possible bias of the researcher as this is the researcher's home institution, where the researcher is viewed as a leader within the organization. While this leadership role is not academically focused, the potential for bias in either reporting on the success of technology (researcher bias) or faculty not responding with their true viewpoints for fear of repercussion from university leadership exists.

Delimitations of this study include researching only the use of technology in a traditional brick and mortar classroom, as well as a focus on technologies in general and not on emerging technologies such as mobile applications, virtual reality, or lecture capture. The choice to limit the proposed research to only brick and mortar classrooms as opposed to online education was to ensure feasibility and is in alignment with the predominant teaching facilities used within the research site. Focusing on the use of emerging technologies as opposed to existing technologies serves as a delimiting factor as we look to establish opportunities for technology to enable change in the institution, which has not occurred through existing technologies. This researcher also chose not to conduct other types of methodological research such as phenomenology to gain insight into teacher's beliefs on the use of technology versus the actual use of the technology.

Conclusion

This correlational study examined the relationship between pedagogical knowledge and ideologies and the use of technology in the traditional classroom. In collecting data for this study, an electronic survey instrument was used to collect data on faculty technology use and faculty beliefs on curriculum development. The research site's Institutional Research Board and Institutional Research and Assessment have approved this study to be conducted within the institution. Where this study sought to identify how teacher beliefs impact the use of technology in the classroom, the researcher hopes that the knowledge gained in this study may be used to improve technology deployments, with the goal of continuing to improve the educational opportunities for all students. Although the results may not be generalizable across other institutions, similar studies could be conducted providing specific insight into faculty beliefs and technology use that could then be extrapolated to provide improved services.

CHAPTER 4

RESULTS

A causal-comparative study was undertaken to better understand the relationship between faculty members' pedagogical knowledge or ideology and their use of technology in the classroom. Data for this research was gathered via a survey instrument sent to all faculty of a single liberal arts institution with approximately 400 faculty members. The survey instrument (Appendix A) collected four primary data points including basic demographic information, questions from two established survey instruments including iTEaCH (Choy, 2013) to measure individual faculty members' use of technology in the classroom and the Schiro Curriculum Ideologies instrument, which measures the ideology of faculty members based on their expected outcomes to the educational process. The survey instrument also included a question on the biggest challenge facing them in increased use of technology in the classroom. In total, the survey included 39 questions and was estimated to take 13 minutes to complete. Faculty members self-selected to participate in the research study based on an email that was sent to all faculty members within the institution (*n=412*).

Data gathered via the survey instrument provided data that were then further processed. This included calculating the total score for technology use based on responses to the iTEaCH questions, resulting in a scale-based variable referenced as *iTEACHALL* and mapping responses to the curriculum ideology survey questions to assign a specific curriculum ideology *CITYPE* to each survey response. The results were then evaluated for statistically significant differences between the curriculum ideologies through a one-way Analysis of Variance (ANOVA) to either confirm or disprove the hypothesis of the research, which was that specific ideologies had an impact on the use of technology in the classroom.

Analysis Methods

Survey data was collected using the Qualtrics survey platform. To begin the data analysis phase of the research, the complete dataset was download from the Qualtrics website in a *.csv* format. The CSV dataset was then imported into Excel for further processing in preparation for the next phase of data analysis. Records downloaded from Qualtrics and imported into Excel included fully complete datasets in which survey participants had been presented all questions in the survey, and partially completed result sets where participants were not presented all survey questions (n=107). Of the records downloaded, only completed datasets were included for further analysis (n=89).

iTEaCH Technology Use

The iTEaCH instrument (Choy, 2013) consists of 4 sets of six questions in which survey respondents identified their affinity toward certain statements surrounding technology and technology use in the classroom using a five-point Likert scale. When downloaded, Qualtrics provided the textual selections made by the participant in the .csv file. To allow for the performance of data analysis on the iTEaCH results, a script was executed on the entire dataset that converted the Likert scale responses to their predefined numerical values of 1 through 5, with 1 representing “strongly disagree” and 5 representing “strongly agree.” The script properly converted these values, which then allowed for further numerical processing.

Initial processing of the iTEaCH dataset included calculating the total value of each technology type. For example, all the questions associated with the six types of technology use in the classroom were calculated into discrete values providing a numerical representation of each technology use type including interactive learning, research, collaboration, production, presentation, and motivation. Then, as per the methodology, the highest technology use type dataset among the six was identified and codified into a new variable for identification and analysis. Although this did provide a technology use type, during the processing of the data, it was suspected that this variable may not provide the best insight into how participants used technology in the classroom, due to the great variability between the participants from multiple high scores in each type of technology use to extremely low scores in technology use leading to individuals who used significant technology and little technology being included in the same overall technology use type.

As part of the processing of the iTEaCH dataset, a new variable was added, which included the total numerical values of each technology use type for each participant (*iTEACHALL*). This created a numerical value which represented the use of technology in the classroom across all participants and appeared more representative of the individual's use of technology in the classroom compared to the previously identified single type as identified by a histogram analysis with a normal curve (*Figure 4*). The initial analysis of the iTEaCH dataset did not further reduce or eliminate any of the survey responses resulting in a dataset of *n*=89.

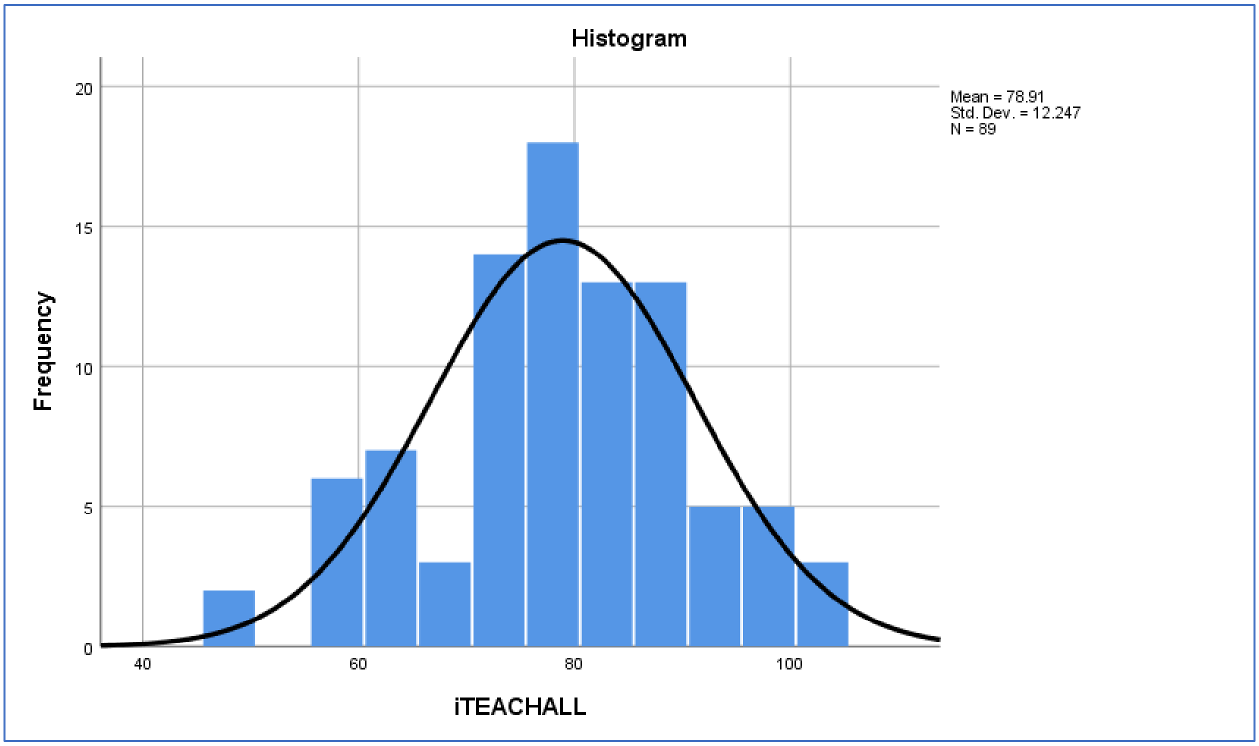


Figure 4: Distribution of *iTEACHALL* scores

Schiro Curriculum Ideology

To identify the curricular ideology of survey participants, the Schiro Curriculum Ideology, consisting of six sets of four questions each, in which the respondents were expected to rank the order of the ideological statements from best representing their viewpoint, to least representing their viewpoint. This provided a set of numerical values included in the Qualtrics .csv file which were then manually transcribed onto individual graphing sheets (see Appendix B) and then graphed accordingly. Once graphed, each sheet was reviewed to identify the preferred curriculum ideology for each participant. This was completed by counting the number of responses (dots) in each portion of the graph from top to bottom. If a particular curriculum ideology, for example, had 3 dots in the top part of a chart and no other chart had an equal or greater number of marks, then that was the preferred ideology. In the event of a tie among ideologies in the first row of the chart, the successive rows were also calculated until one ideology had a higher instance of marks. In processing the Schiro Curriculum Ideologies worksheets, one individual participant had two similar preferred ideologies with equal numbers of marks on two ideologies on all rows. As no specific ideology could be identified, this response was excluded from further data analysis as it would break the independence of observations assumption required for an ANOVA test. With the removal of this case, the data set used for analysis was n = 88.

Statistical Analysis

In preparation for data analysis using SPSS, a new data set was extracted from the primary dataset with only the necessary fields included for statistical analysis. The new dataset consisted of the variables included in Table 1 below. The dataset was created by copying entire columns of data from one Excel spreadsheet to a new spreadsheet. Where the values being copied were the results of a calculation such as *iTEACHALL*, the copy function used was the Excel *paste values* function instead of the standard paste function.

Table 1

Variables exported for statistical analysis

Variable Name	Variable Type	Variable Measure
CITYPE	Numeric	Nominal
iTEACHALL	Numeric	Scale
CHALLENGETYPE	Numeric	Nominal

To provide increased clarity for data analysis within SPSS, all nominal variables were appropriately labeled for easier identification. These labels included the appropriate mappings for *CITYPE* being 1=Scholar Academic, 2=Learner-Centered, 3=Social Reconstruction, and 4=Social Efficiency; for GENDER being 1=male, 2=female; and for STEMvsNonSTEM being 1=STEM and 2=Non-STEM. The Scale variable *iTEACHALL* did not have additional coding added as it is a scale-based variable.

The selected test to identify any differences in the use of technology (*iTEACHALL*) based on the four specific curricular ideologies (*CITYPE*) was a one-way ANOVA (Analysis of Variance). The one-way ANOVA test is used to determine if there are any statistically significant differences between the means of two or more groups that are independent in nature. The one-way ANOVA statistical test is an omnibus test in that it identifies if there are statistically significant differences in the means between at least two of the groups. Given that *CITYPE* contains four groups, additional post hoc tests will need to be conducted to identify where the statistically different results are present.

The use of a one-way ANOVA is appropriate in this case as this study sought to identify differences in the use of technology based on four independent groups with the independent group being the curricular ideology (*CITYPE*). For a one-way ANOVA, there are six assumptions that must be met for the one-way ANOVA results to be valid. These assumptions include: 1) a continuous dependent variable, which in the case of this study is the value representing the use of technology in the classroom (*iTEACHALL*); 2) a categorical independent variable which is represented in this study by the variable *CITYPE* that represents the four curricular ideology types; 3) independence of observations, meaning that individual responses within the *CITYPE* variable can represent only one of the four ideology types; 4) there should be no significant outliers in the independent variable (*CITYPE*) in relation to the dependent variable (*iTEACHALL*); 5) the dependent variable (*iTEACHALL*) should be approximately normally distributed for each curricular ideology type (*CITYPE*); and 6) variance is equal in each group of the independent variable. The data set used met all requirements for the use of a one-way ANOVA and will be presented in more detail in the following sections.

In preparation for running a one-way ANOVA calculation and having met the first three assumptions for the one-way ANOVA test including a continuous dependent variable, a categorical independent variable with two or more groups, and independence of observations, a box plot was generated to identify any outliers within the *iTEACHALL* variable. To generate the box plot, the SPSS *Explore* function was utilized with the dependent variable *iTEACHALL* added to the *Dependent List* and the independent variable added to the *Factor List*. Within the *Plots* section of the *Explore* function, the Factor levels together under Boxplots and Normality plots with tests were selected and the *Explore* function executed. One data row was identified as an outlier in the Scholar Academic *CITYPE* (row 54) and was removed prior to further processing of data leaving a total number of test cases of n=87 (*Figure 5*).

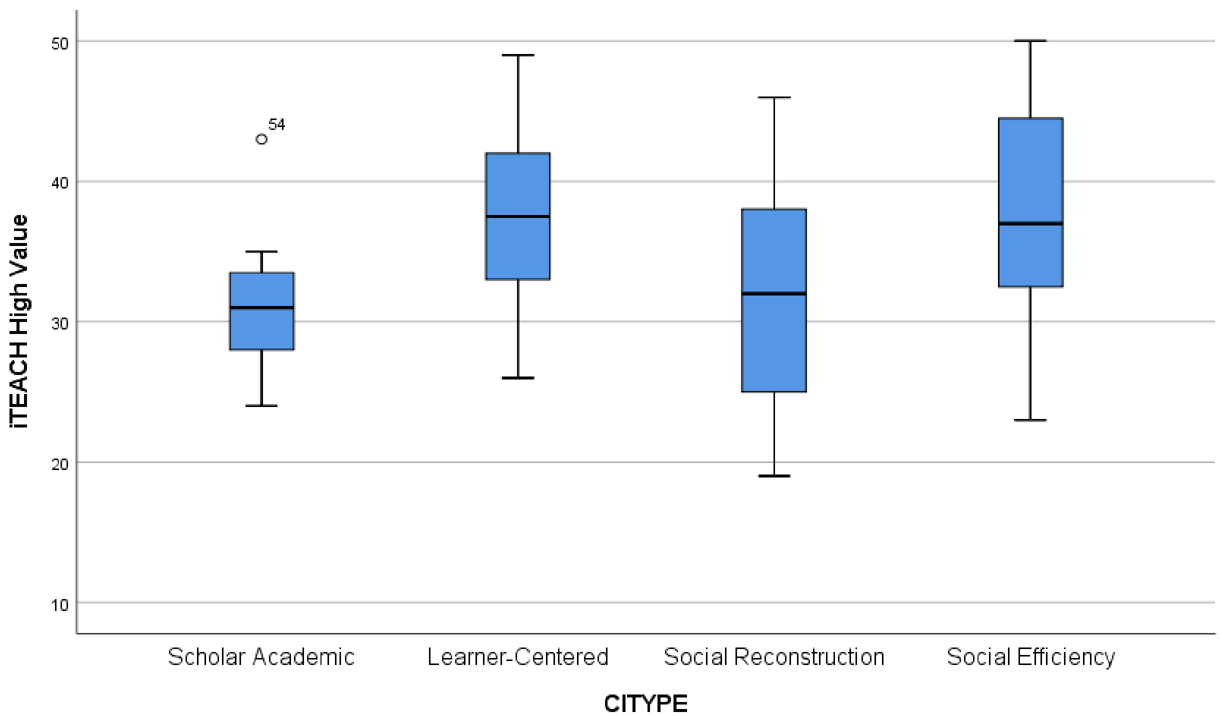


Figure 5: Boxplot of *iTEACHALL* scores by *CITYPE*

The next assumption needing to be tested for the use of a one-way ANOVA is to check if data points within the data set are normally distributed. The test for normality was tested using the Shapiro-Wilk test for normality and was conducted as part of the previous SPSS *Explore* function when the *Normality plots with tests* was selected. For the dataset being used, the Shapiro-Wilk test for normality of the independent variable (*CITYPE*) was met, as the values for the specific *CITYPE* categories as identified in the Shapiro-Wilk SPSS output (Table 2) in the Sig. column were all greater than .05 ($p > .05$) with values of .414 for Scholar Academic, .627 for Learner-Centered, .979 for Social Reconstruction, and .304 for Social Efficiency. If data points were not normally distributed, one or more of the sig values for Shapiro-Wilk would have been less than .05 identifying that the data was not normally distributed.

Table 2

Shapiro-Wilk Test for Normality

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	CITYPE	Statistic	df	Sig.	Statistic	df	Sig.
iTEACH ALL	Scholar Academic	.165	8	.200*	.918	8	.414
	Learner-Centered	.085	46	.200*	.981	46	.627
	Social Reconstruction	.145	13	.200*	.980	13	.979
	Social Efficiency	.106	20	.200*	.946	20	.304

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The final assumption to be tested is the homogeneity of variances or that the variances in each category of the independent variable (*CITYPE*) are similar in size. The test used to evaluate this assumption for this study is the Levene test of equality and is normally run as part of the ANOVA test within SPSS, described later on as part of the statistical analysis, but the results will be presented here as part of meeting the assumptions required for the use of the one-way ANOVA. As identified in the Test of Homogeneity of Variances (Table 3) the p-value for the

Levene test of equality is .339 as identified in the Sig. column meaning that the data set being tested had homogeneity of variances.

Table 3

Test for Homogeneity of Variances

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
iTEACH ALL	Based on Mean	1.136	3	83	.339
	Based on Median	1.120	3	83	.346
	Based on Median and with adjusted df	1.120	3	78.384	.346
	Based on trimmed mean	1.143	3	83	.337

With all assumptions being met for the use of a one-way ANOVA, the final number of test cases used for analysis represented 21% (n=87) of faculty within the institution's total faculty (n=412). Conducting a frequency analysis within SPSS provided the following summary of the demographics of the data set used in this research. Representation of faculty by gender was a near even split at females (n=43) and males (n=44) as represented in *Figure 6*.

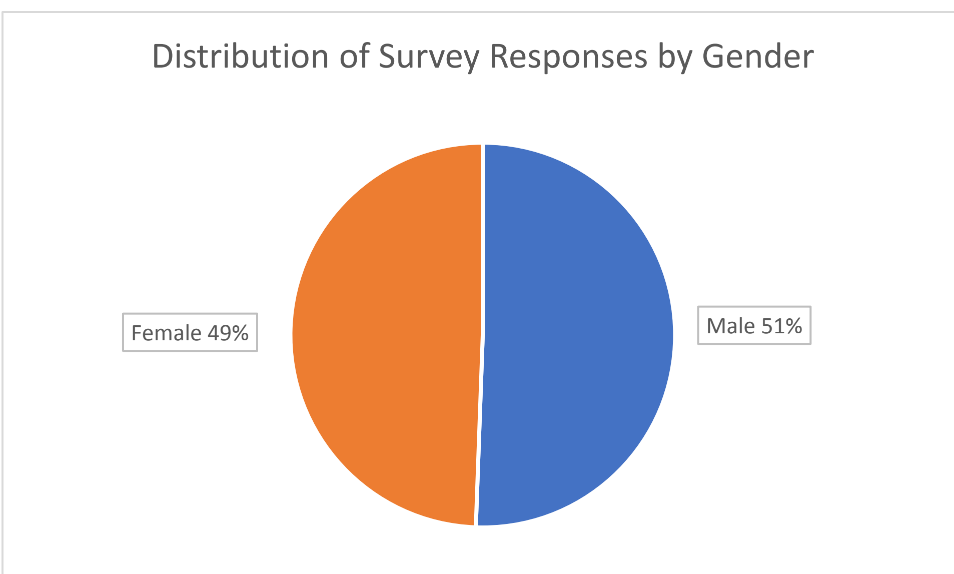


Figure 6: Distribution of survey responses by gender

Academic Rank of survey participants was Assistant Professor, 31 percent (n=27); Associate Professor, 27.6 percent (n=24); Instructor, 4.6 percent (n=4); Lecturer, 4.6 percent (n=4); and Professor, 32.2 percent (n=28) as represented in *Figure 7*.

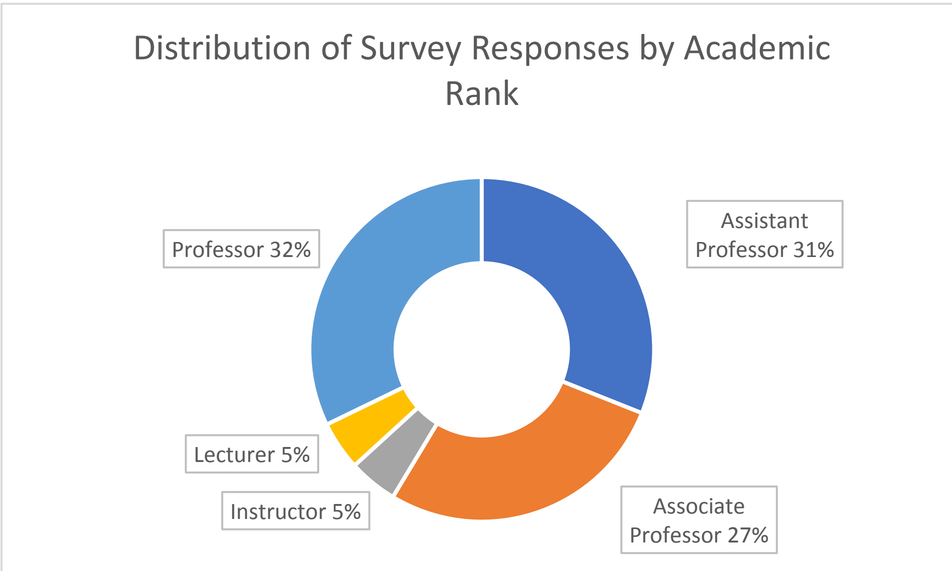


Figure 7: Distribution of survey responses by academic rank

Tenure status of data set was: Tenured, 57.5% (n=50); On tenure track, 24.1% (n=21); and Not on tenure track, 17.2% (n=15) with one response not recorded (*Figure 8*).

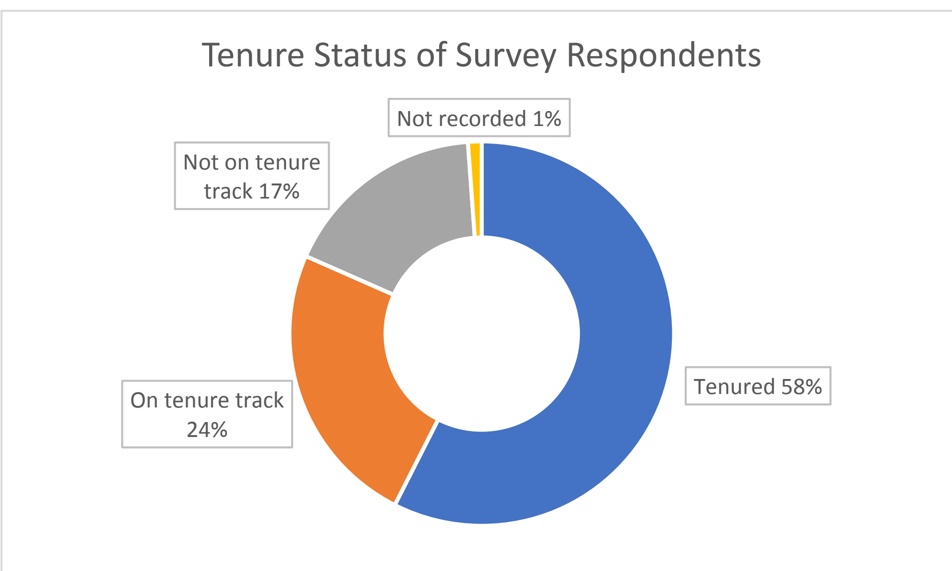


Figure 8: Tenure status of survey respondents

STEM vs. Non-STEM from a primary course load was identified as: Non-STEM, 54% (n=47) and STEM, 46% (n=40) as represented in *Figure 9*.

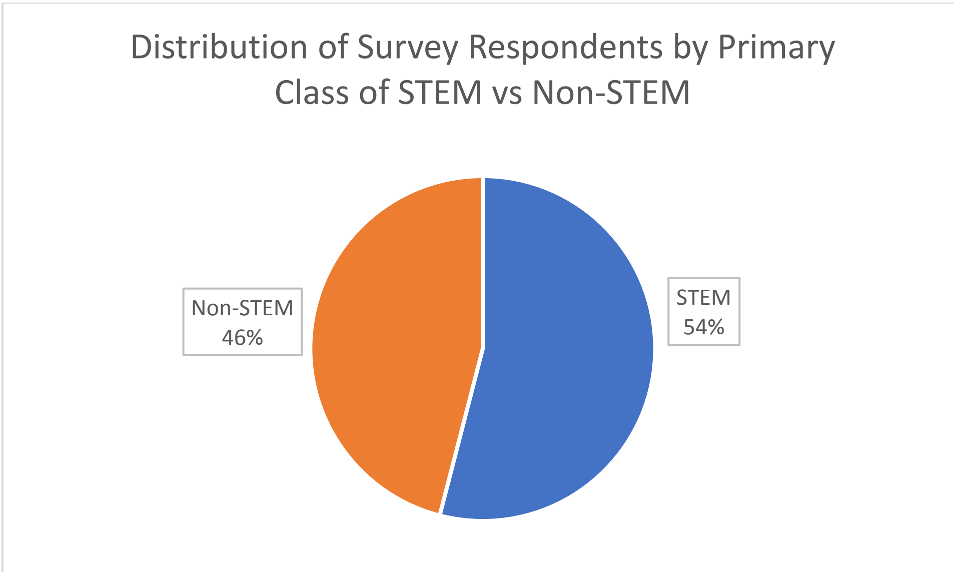


Figure 9: Distribution of survey respondents by primary class type

CITYPE for the dataset included Scholar Academic, 9.2% (n=8); Learner-Centered, 52.9% (n=46); Social Reconstruction, 14.9% (n=13); and Social Efficiency, 23% (n=20) as represented in *Figure 10*.

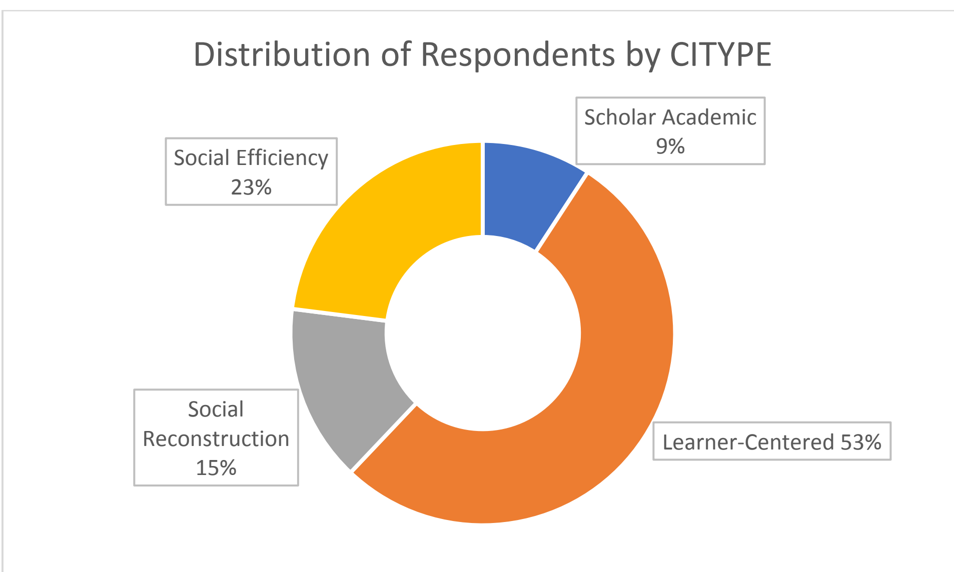


Figure 10: Distribution of respondents by *CITYPE*

To identify whether there were statistically significant differences in the use of technology (*iTEACHALL*) among the four curricular ideologies (*CITYPE*), a one-way ANOVA was conducted to determine if the use of technology in the classroom environment (*iTEACHALL*) was different for groups with different curricular ideologies (*CITYPE*). The use of a one-way ANOVA is an appropriate test to answer the research question as it "determines whether there are any statistically significant differences between the means of two or more independent groups" (Laerd Statistics, 2017, "One-Way ANOVA Introduction," para. 1). Here, this study is looking to identify any differences among the four curriculum ideologies (*CITYPE*) and technology use (*iTEACHALL*). As the one-way ANOVA does not identify where statistically significant differences may exist, a post hoc test will be conducted to test all possible pairings between the independent variable (*iTEACHALL*) to identify which groups' curricular ideologies (*CITYPE*) have statistically significant differences in the use of technology (*iTEACHALL*).

Setting up the one-way ANOVA, the *One-way ANOVA* function was selected in SPSS. For the Dependent List, the dependent variable *iTEACHALL* was selected, and for the Factor, the independent variable *CITYPE* was selected. Under the *Options* section of the one-way ANOVA test, for statistics, the Descriptive, Homogeneity of Variance test and Welch tests were selected as was the *Means Plot*. Under the Post Hoc section of the One-Way ANOVA SPSS test, the Tukey test was selected to conduct the comparisons among the curricular ideology types for post hoc analysis.

Extrinsic versus Intrinsic Challenges

As the final step in the statistical analysis of the survey data, two additional data calculations were conducted in Excel focusing on the variable *CHALLENGETYPE*. The first calculation was to count the frequency of occurrence of each specific *CHALLENGETYPE* using an Excel CountIf function. This resulted in the following number of occurrences: Lack of time (n=31), Lack of training (n=29), Availability of resources (n=6), Access to technical support (n=1) and Lack of pedagogical impact (n=20) as represented in *Figure 11*.

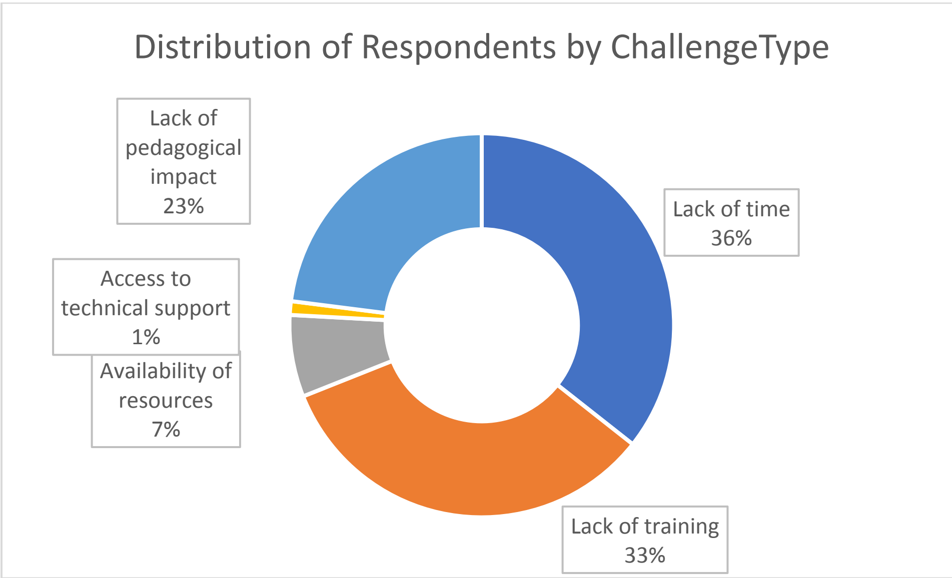


Figure 11: Distribution of respondents by *CHALLENGETYPE*

The second data calculation in Excel was a frequency analysis conducted to count the occurrences of the five *CHALLENGETYPE* by *CITYPE*. The frequency analysis was conducted in Excel by first sorting the data results including all data columns first by *CITYPE* and then by *CHALLENGETYPE* in ascending numerical order. This created a sorted dataset upon which the Excel count function could then be executed against to identify how many participants of a *CITYPE* viewed one of the five identified challenges (*CHALLENGETYPE*) to the deployment of technology.

Presentation of the Results

Comparing the use of technology (*ITEACHALL*) across the *CITYPE* independent variable, the one-way ANOVA analysis indicated statistically significantly different means for the different types of ideologies, $F(3,83) = 5.036$, $p = .003$ (Table 4).

Table 4

One-way ANOVA Results

ANOVA

iTEACH ALL

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1879.629	3	626.543	5.036	.003
Within Groups	10325.360	83	124.402		
Total	12204.989	86			

The group means between the groups analyzed (*CITYPE*) as part of the one-way ANOVA were statistically different ($p < .05$) with a value of .003 representing a statistically significant difference, allowing us to reject the null hypothesis that there is not a difference in the use of technology (*iTEACHALL*) based on curricular ideology (*CITYPE*). This suggests that based on the survey data gathered from this single institution, there is a correlation between ideology/pedagogy and the use of technology in the classroom.

As part of the one-way ANOVA analysis, a post hoc test was conducted to evaluate the mean differences among all possible combinations of the variable *CITYPE* to identify where statistically significant differences occurred. In the initial setup of the one-way ANOVA, the post hoc test selected to accomplish this was the Tukey post hoc test, which is a recommended (Kirk, 2013) test when homogeneity of variances has been met, as it has in this case. The basic Tukey test, however, requires a balanced test design meaning that the number of data points for each of the independent variable groups must be equal. For this analysis the groups were not equal, representing an unbalanced design. In this instance, SPSS will automatically run a variation of the Tukey post hoc test (Tukey-Kramer) which takes the unbalanced dataset into account.

The Tukey Kramer test indicated significant differences in the use of technology between the Learner-Centered and Social Efficiency curricular ideologies. The use of technology in the classroom environment increased comparatively between Social Reconstruction (n=13, M = 70.15, SD = 11.27) and Learner-Centered (n=46, M=80.87, SD = 10.55) with a mean difference of 10.71 and p = .016 (10.71, 95%CI [1.53, 19.90]. The Tukey-Kramer post hoc analysis also identified a statistically significant increase in technology use between the Social Reconstruction group and Social Efficiency group with a mean increase of 13.80 and p = .004 (13.80, 95% CI [3.38, 24.21]. No other group comparison were identified as being statistically significant (Table 5).

Table 5

Tukey-Kramer post hoc Analysis

Multiple Comparisons

Dependent Variable: iTEACHALL

Tukey HSD

(I) CIType	(J) CIType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Scholar Academic	Learner-Centered	-7.120	4.273	.348	-18.32	4.08
	Social Reconstruction	3.596	5.012	.890	-9.54	16.74
	Social efficiency	-10.200	4.666	.136	-22.43	2.03
Learner-Centered	Scholar Academic	7.120	4.273	.348	-4.08	18.32
	Social Reconstruction	10.716*	3.503	.016	1.53	19.90
	Social efficiency	-3.080	2.987	.732	-10.91	4.75
Social Reconstruction	Scholar Academic	-3.596	5.012	.890	-16.74	9.54
	Learner-Centered	-10.716*	3.503	.016	-19.90	-1.53
	Social efficiency	-13.796*	3.974	.004	-24.21	-3.38
Social efficiency	Scholar Academic	10.200	4.666	.136	-2.03	22.43
	Learner-Centered	3.080	2.987	.732	-4.75	10.91
	Social Reconstruction	13.796*	3.974	.004	3.38	24.21

*. The mean difference is significant at the 0.05 level.

With the data presented that there were statistically significant differences in the use of technology within two of the curricular ideology comparisons, this study sought to identify any possible relationship among the groups and what faculty felt were the primary challenges to their use of technology in the classroom environment. A frequency analysis of technology challenges (*CHALLENGETYPE*) by curriculum ideology (*CITYPE*) identified a similarity in the perceived challenges that mimic the results from the Tukey post hoc test with both the Learner-Centered and Social Efficiency curriculum ideologies identifying a lack of time as the biggest challenge.

The pairwise comparison between these two ideologies that appeared as being statistically significant was the Social Reconstruction curricular ideology, which identifies a lack of pedagogical impact as the primary challenge to the deployment of technology (*Figure 12*).

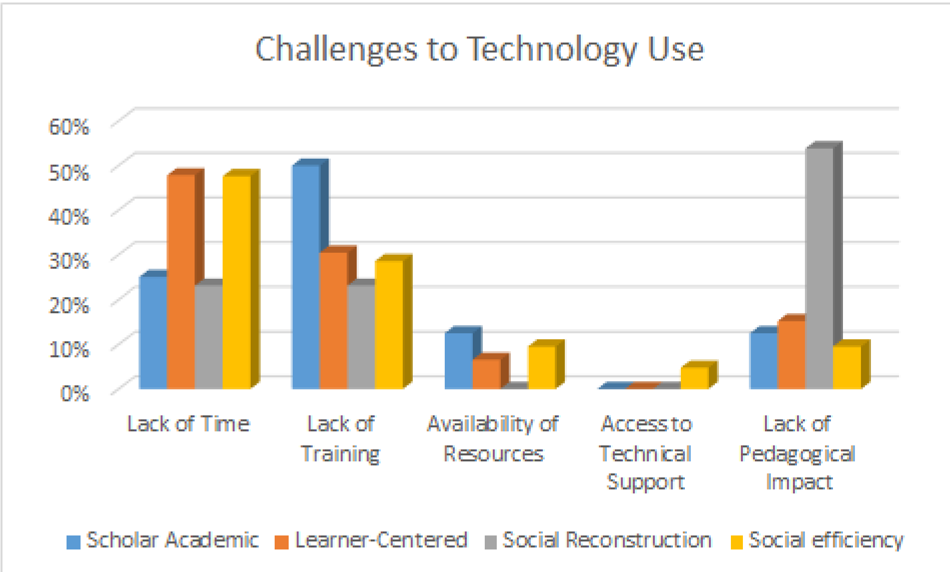


Figure 12: Correlation analysis of *CHALLENGETYPE* versus *CITYPE*

Summary

Higher Education organizations spend considerable amounts of money and personnel resources on implementing and maintaining technology solutions that enable the organization to serve its educational mission. With considerable challenges facing higher education institutions from an enrollment and budget perspective, to meeting the ever-changing needs of employers, it is in an organization's best interest to leverage investments in technology, where appropriate, in enabling change without significant disruption to the core activity of education. Through a better understanding of the relationship between curricular ideologies and the use of technology, technology organizations can better plan the implementation and support of new technologies that are better aligned to the educational mission with an opportunity to improve adoption and use.

The researcher's goal was to look at the interaction between individuals' curricular ideology and their use of technology to better understand the relationship between the two. To accomplish this, a survey instrument was created using questions from the Schiro Curriculum Ideologies (2013) and iTEaCH Instrument (2013), which were designed to gather data from a single institution's faculty members on their curricular ideologies and corresponding use of technology. To identify if there was a significant difference in the use of technology among the four curriculum ideologies identified by Schiro (2013), a one-way ANOVA was conducted with a Tukey-Kramer post hoc test to identify where variations existed among the groups.

Results from the one-way ANOVA indicated there was a statistically significant difference between the various curricular ideologies (*CITYPE*) and technology use (*iTEACHALL*) of $p < .003$. The Tukey-Kramer post hoc test identified that differences existed between the Learner-Centered curriculum ideology and Social Reconstruction ideology as well as a significant difference between the Social Efficiency and Social Reconstruction ideologies. Further analysis of the data set identified no significant difference in the use of technology by gender but did identify a statistically significant difference based on primary course load being STEM or Non-STEM, with faculty teaching primarily STEM classes having a higher mean in their use of technology compared to their Non-STEM counterparts.

Technology organizations that support the use of technology in the classroom can utilize the difference by *CITYPE* to provide targeted instruction and support to address specific ideologies or focus resources on those groups that are either predisposed to the use of technology or those who have ideological beliefs that are counter to the use of technology. Within the survey responses, 81% of respondents identified challenges that were extrinsic in nature to their use of technology, with the two largest groups from a curricular ideology perspective in the study sample reporting a lack of time as being the primary challenge, offering one training opportunity as an outcome from this study.

While the data gathered in this study represents only one institution, the data does provide a better insight into actions that may be undertaken to improve technology adoption. This knowledge can provide increased time to deployment as new technologies advance and become critical to employers, or enhance the ability to provide a competitive advantage in recruiting students. This, in turn, provides technology support organizations with the ability to be more thoughtful in the deployment of new technologies, better custodians of the technology infrastructure, and in prioritizing budget and personnel resources.

CHAPTER 5

CONCLUSION

The introduction and support of technology in educational environments is often challenging not only from an implementation perspective but also from acceptance and engagement by various faculty. While technology has been lauded as an important tool for the delivery of innovations in pedagogy, technology-enabled learning continues to face challenges in adoption, use and most importantly encouraging change (Abrams, 2010; Angeli & Valanides, 2009; Niederhauser et al., 2018). With an estimated $6.5B spent on education technologies in the United States in 2015 (Niederhauser et al., 2018), and most institutions of higher education seeking ways to both reduce costs and provide differentiation in recruiting incoming students, technology-enabled learning is frequently seen as a solution to the challenges facing higher education (Ling Koh & Chai, 2016).

Yet with significant investments in technology, the change brought about in the classroom pales in comparison to the expectations of technology deployments, with many faculty members continuing to use lecture-based activities in the classroom as opposed to increased engagement with students through a more active-learning based pedagogy (Stains et al., 2018). While there are likely many reasons for technology not driving change in the classroom as it has in many other verticals, the biggest challenges in encouraging change are likely within the deployment of technology itself (An, Bakker, & Eggen, 2016) or teachers' beliefs as to how technology should be used in the classroom (Ertmer & Ottenbreit-Leftwich, 2013).

Proficiency in the deployment of technology is important to higher education due to the resources involved in deployment and support from not only a monetary perspective but also a personnel resource perspective. Consumers of higher education likewise have a vested interest in the successful deployment of technology from both a learning and an employment perspective, with many graduates being required to meet the needs of a 21st-century service-based economy requiring communication, collaboration, and problem-solving skills that are increasingly based on technology.

Understanding the challenges of technology use in the classroom is one of the first steps technology organizations within higher education must undertake to improve technology adoption. This study sought to better understand the correlation between technology use in the classroom and pedagogical ideologies as a step toward improving technology implementation. While study results are applicable to only the single institution from which this data was collected, similar studies at other institutions can enable technologists to provide targeted learning opportunities for certain ideologies that may be based on intrinsic beliefs, which may be more difficult to overcome. The improved understanding of faculty views on technology should, in any case, help higher education technology organizations in maximizing their technology budget in being better educated about how faculty perceive the use of technology in the classroom, thereby benefitting faculty and the institution.

Interpretation of Findings

The study sought to answer this question: To what extent does pedagogical knowledge (PK) and Curricular Ideology (CI) predict technology usage in the classroom?

To understand the relationship between technology use in the classroom (*iTEACHALL*) and curriculum ideology (*CITYPE*) a One-Way ANOVA and Tukey-Kramer post hoc testing was conducted using SPSS. The One-Way ANOVA and Tukey post hoc test indicated a statistically significant variation among Learner-Centered ideology and Social Efficiency ideology versus the

Social Reconstruction ideology, indicating that within the institution being researched that curriculum ideologies may likely have an effect on the use of technology in the classroom.

A frequency analysis of the challenges to increased technology use in the classroom compared to the curriculum ideology types (Figure 1) identified specific issues that can be addressed to improve technology use by curriculum ideology. The data in Figure 1 identify that the lack of time is the biggest perceived challenge to both the Learner-Centered ideology and the Social Efficiency ideology. A lack of training was the biggest challenge viewed by the Scholar Academic ideology, and lack of pedagogical impact was the most significant challenge from the perspective of the Social Reconstruction ideology.

Based on the analysis of data from the survey instrument, readers can ascertain that there is likely a difference in technology use based on different curriculum ideologies. Through a previous frequency analysis of the challenges to technology use for each ideology, Learner-Centered (n=46) and Social Efficiency (n=20) ideologies both identified a lack of time as a considerable constraint to the use of technology, providing insight into where perhaps additional efforts could significantly improve the use of technology in the classroom. Conversely, the Social Reconstruction ideology (n=13) sees the main challenge being a lack of pedagogical impact, which is an intrinsic challenge requiring a different approach to improve the use of technology by these faculty, who among the four groups are the most technology averse.

Implications

The goal of research is to produce new knowledge through improved insights and understanding of a specific topic. This research project sought to identify how faculty members' ideology or pedagogical beliefs may affect their use of technology in the classroom. Improving understanding of perceived and real challenges by faculty in using technology in the classroom provides additional insight for technologists who are planning for or deploying new technology types. This research study provides insight into the challenges of deploying technology in the classroom and an understanding of the different ideologies at work in a single liberal arts institution. As new technologies become available, diverse approaches can be planned to increase the uptake and adoption of technology in the classroom based on this research.

At the individual level, this research can help higher education administrators and technologists in improving the adoption of technology within the classroom environment. Through a better understanding of how particular ideological types perceive challenges to the use of technology in the classroom, differentiated training can help address the challenges, whether they are based on people, process, or technology. The improved deployment of technology can, in turn, benefit the entire institution through reduced labor or monetary expenses of technology deployments that take increasingly long adoption periods or projects that fail. The improved use of technology in the classroom can also significantly impact students by enabling more faculty to engage students in active-learning, which has been demonstrated to have a positive impact on student learning versus the traditional lecture (Long et al., 2016). An added benefit to the active-learning method of instruction is that it better prepares students for their future careers, where they will need to adapt and learn throughout their lifetime (Frydenberg, 2012).

The increased use of technology in the classroom environment also has a significant impact from a diversity perspective. Engaging students in a technology enabled learning environment can help individuals who come from a variety of backgrounds and different learning styles (Lage et al., 2000). The active-learning methodology supported by technology is specifically beneficial for those individuals who are challenged in the traditional classroom, such as those who do not speak the native language or have learning disabilities. While supporting these disadvantaged students, the active-learning classroom also encourages more participation among all students who are no longer focused on the taking of notes or learning new concepts (Hadjianstasis & Nightingale, 2016).

At the institutional level, the improved deployment and adoption of technology based on this research can reduce the overall cost of technology deployments. Technology deployments that continue for multiple years drain valuable personnel and monetary resources from the organization. Understanding how faculty view technology in the classroom can be beneficial to reducing the deployment and adoption timeframe for new technologies. Increasing faculty participation in the decision to deploy new technology can also have greater benefits as faculty can become champions of new technology, increasing the potential for adoption. Understanding that not all faculty will use technology the same way is important in planning for deployment. Approaching new technology as a tool and not a solution is critical, as some domains within academia may use technology in the classroom in a very specific way (Voet & De Wever, 2017).

Organizationally, as competition for the best students increases among institutions, many students are looking for more engaging classroom environments and opportunities to explore new ideas of interest to them individually. The ability to explore new ideas and concepts outside of the prescribed lecture is in alignment with technology-enabled learning (Woodall et al., 2012). As students become more accustomed to technology, they will continue to expect it in their everyday lives (Spence, 2001), and institutions or faculty that do not engage technology in support of the students will likely find challenges in future recruiting.

The results of this research indicate that there is a relationship between the use of technology in the classroom and individual faculty’s curricular ideologies. Understanding the possible drivers for use in the classroom will help to encourage technology use, which is beneficial to students. Although technology should not be viewed as a solution to all of academia's challenges, it can be leveraged as a tool in enabling change within an institution.

Recommendations for Action

Providing opportunities for success in the deployment of technology to enable change in the classroom environment can often be challenging due to a variety of issues both perceived and real by the faculty who are expected to integrate new technologies into an already full curriculum and in competition with many other demands on their time. Identification of the primary impediments to the implementation of technology within the classroom can then be specifically addressed.

The results of this research indicate that there is a relationship between the use of technology in the classroom and individual faculty's curricular ideologies. Understanding the possible drivers for its use in the classroom will help to encourage technology use, which is beneficial to students. While technology should not be viewed as a solution to all of academia's challenges, it can be leveraged as a tool in enabling change within the institution.

In this research study on the effects of pedagogy and ideology on the use of technology in the classroom, 37 of the survey respondents (43%) identified a *lack of time* as one of the biggest challenges to the increased use of technology in the classroom. Another 28 respondents (32%) identified *lack of training* as the leading challenge to increased technology use. While separate issues, these two challenges could be linked and approached simultaneously, addressing the challenges faced by 75% of the institution and three of the four curricular ideologies who identified these as their primary challenge based on this study. Addressing these two issues simultaneously focuses on the importance of the use of technology and why it is important to the faculty and students. In combination, technologists could work on deploying technology solutions that are easier to use and require less training by selecting solutions with easy to navigate/use interfaces. As technology use grows and becomes more mainstream, adoption by faculty who were once reluctant will increase, as identified by Rogers Diffusion of Innovation theory (2003).

The third-largest reason facing the increased use of technology in the classroom is a *lack of pedagogical impact* as identified in the study. Representing approximately 20% of respondents, this specific challenge will be difficult to address as it is an implicit bias and will require a different approach to encourage the increased use of technology in the classroom. Understanding that this implicit bias could be related to specific areas or subjects within the organization is important as certain subjects may not benefit from the increased use of technology, and due to the small size of the institution and survey participants, this was not explored as part of the survey to ensure anonymity of responses. Yet, this specific challenge was the highest rated amongst the *Social Reconstruction* curriculum ideology, and their use of technology in the classroom is often tied to the cultural and social context in which they work (Brantley-Dias & Ertmer, 2013) For pedagogical specialists this may provide some general insight into providing varied training that could address this particular challenge and constituency.

As previously identified in research by Dron (2012), tenure programs in universities primarily focus on research and publication in granting tenure and less on improved teaching and learning. It is therefore not surprising that faculty will focus on those activities that are most valued by the organization—such as scholarly research—given limited time and resources (Gross-Loh, 2016). Encouraging additional use of technology from an academic perspective and including improvements in teaching and learning as part of the tenure process could help encourage those faculty on the tenure track to look to technology to help improve their teaching.

Similarly, information technology organizations looking to deploy new technologies should use the *lack of time* reason as a guiding principle in deploying technology to identify ways to decrease the negative impact of technology use in the classroom. The simplification of technology deployments should be a primary driver in selecting technology for the classroom environment. Selecting technologies for deployment that are simple to use and take little effort to engage with while continuing to teach are critical to the adoption of technology. In combination addressing the *lack of training* through improved opportunities can result in improvements in technology adoption. Instructional design is based on our understanding of the cognitive structure in humans and how those structures are organized (Greer, Crutchfield, & Woods, 2013) and while many pedagogical technologists are adept at building instruction for students, they may not be as adept at andragogy or the learning styles of adults (Johnson, et al., 2012).

Technology use in education does not have to be limited to the classroom. Challenges already exist for classroom time (Brantley-Dias & Ertmer, 2013) and many technologies take teachers out of the moment (An et al., 2016) distracting from the primary mission of the classroom, which is learning. Allowing teachers to experiment with technology outside of the classroom can provide opportunities for experimentation that can lead to increased use of technology in the classroom, specifically newer technologies such as lecture capture and augmented or virtual reality, which many faculty members do not use in their daily lives. Providing opportunities to experiment with these technologies outside of the classroom environment provides a safe space for faculty to experiment with technology without impacting their class time.

Wherever possible, any new technology in which institutions are investing should be made as ubiquitously available as possible. Many of today's technologies, such as wireless Internet or digital video, are considered ubiquitous and are available in almost every classroom. Wherever possible, exploration of a site license for software and the use of common hardware elements in support of the academic mission should be leveraged. By making technology readily available, faculty will be more likely to share ideas and ways of using the technology in the classroom in support of the academic mission, which can lead to increased technology adoption (Palak & Walls, 2009; Shelton, 2013; Vongkulluksn et al., 2018). Training, identified as the second-largest challenge to the use of technology in the classroom by 31 percent of the survey respondents can also help address the challenges of time. By providing targeted short training opportunities through various modalities including in-person or prerecorded video, one-page training handouts, or spaces dedicated to training and experimentation; the challenge of time viewed by many faculty can be reduced. By reducing the barrier to entry and a steep learning curve by providing ample training opportunities, faculty are more likely to implement technology into the classroom.

A bigger challenge to the implementation of technology in the classroom is related to implicit biases. A lack of pedagogical impact as identified by 19 percent of survey respondents was the primary challenge identified by the Social Reconstruction *CITYPE*. While a variety of subjects taught within higher education may genuinely not benefit from the use of technology, limited amounts of technology may be required to better understand and address student failure rates, students who may be in distress due to a variety of personal issues, or in helping students who may have undiagnosed learning disabilities. In overcoming the concerns of ideology and pedagogy as it relates to technology, precise programming will need to be developed to encourage the adoption of technology. Identifying and communicating the benefit of any technology deployment will be critical to overcoming the implicit bias. In addition to education, this group would likely benefit from using technology leaders within the individual departments.

Recommendations for Further Study

This study, which focused on a single liberal arts school, may not be representative of all institutions in the United States or across the world. Comparison of the results of this study with other liberal arts institutions may reinforce the findings of this study or introduce new ideas on technology deployment within similar institutions. Similarly, other types of higher education institutions, such as large public or private institutions, may provide greater insight into the intersection of ideology and pedagogy. Larger institutions may be able to further divide faculty based on specific demographics such as department or terminal degree field of study, which was impossible with this study due to the need to maintain anonymity.

Evaluating student expectations in association with faculty reactions to the intersection of ideology/pedagogy and technology could provide additional insight into the expectations of students and the use of technology in the classroom environment. This data might help to drive the implementation of technology within the classroom based on student desires and provide more statistical information on their expectations than the frequent use of anecdotal evidence. Using student opinions to help drive innovation can also help with those individuals who have an implicit bias, such as technology not having a pedagogical impact.

Understanding and quantitatively measuring the use of technology in the classroom can be a challenging endeavor. The iTEaCH instrument (Choy, 2013) used in this study provided questions surrounding not only the knowledge and tools for technology use but also the collegiality of other academics within the institution encouraging and supporting the use of technology. Other instruments might provide better visibility into the use of technology in the classroom environment, which may provide more accurate statistical variations among the various *CITYPES*.

Conclusion

The deployment of technology in any environment can often be challenging and prone to failure. Technology deployments to the higher education classroom environment are just as, if not more susceptible to failure than their corporate counterparts in part due to a variety of issues that have been investigated in this research. At a time when most expenditures within the university are under scrutiny from a return on investment perspective, it is important for technologists, academics, and administrators to make every effort to gain the most value from their investments.

Through a better understanding of the challenges seen in the use of technology in the classroom environment and how the primary end users (faculty) perceive technology is critical to selecting and deploying technology that not only meets the needs of its users (faculty and students) but also sets the stage for enabling change within the educational environment. Whether from an increased time perspective allowing for more collaboration and engagement by faculty and students through a more active classroom environment to providing more opportunities for success across an increasingly diverse student body, technology offers many opportunities to help transform the educational environment to meet the changing needs of students and employers.

REFERENCES

Abrams, D. A. (2010). Technology adoption in higher education: A framework for identifying and prioritising issues and barriers to adoption of instructional technology. *Journal of Applied Research in Higher Education, 2*(2), 34–49. doi:10.1108/17581184201000012

Aguilar, S. J. (2017). Learning Analytics: At the nexus of big data, digital innovation, and social justice in education. *TechTrends, 62*(1), 37–45. doi:10.1007/s11528-017-0226-9

An, P., Bakker, S., & Eggen, B. (2016). Understanding teachers' routines to inform classroom technology design. *Education and Information Technologies, 22*(4), 1347-1376. doi:10.1007/s10639-016-9494-9

Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT–TPCK: Advances in technological pedagogical content knowledge (TPCK). *Computers & Education, 52*(1), 154–168. doi:10.1016/j.compedu.2008.07.006

Archambault, L. M., & Barnett, J. H. (2010). Revisiting technological pedagogical content knowledge: Exploring the TPACK framework. *Computers & Education, 55*(4), 1656–1662. doi:10.1016/j.compedu.2010.07.009

Bartlett, R. L. (1996). Discovering diversity in introductory economics. *Journal of Economic Perspectives, 10*(2), 141–153. doi:10.1257/jep.10.2.141

Baytiyeh, H. (2017). The flipped classroom model: When technology enhances professional skills. *International Journal of Information and Learning Technology, 34*(1), 51–62. doi:10.1108/ijilt-07-2016-0025

Boschman, F., McKenney, S., & Voogt, J. (2015). Exploring teachers' use of TPACK in design talk: The collaborative design of technology-rich early literacy activities. *Computers & Education, 82,* 250–262. doi:10.1016/j.compedu.2014.11.010

Brantley-Dias, L., & Ertmer, P. (2013). Goldilocks and TPACK: Is the construct "Just Right?" *Journal of Research on Technology in Education*, *46*(2), 103–128. doi:10.1080/15391523.2013.10782615

Brewer, E., & Kuhn, J. (2010). Causal-comparative design. *Encyclopedia of Research Design*. doi:10.4135/9781412961288.n42

Choy, M. (2013). The iTEaCH implementation model: Adopting a best-fit approach to implementing ICT in schools. *2013 IEEE 63rd Annual Conference International Council for Education Media (ICEM)*. doi:10.1109/cicem.2013.6820190

Choy, M., & Ng, Y. L. (2015). Mapping teachers perceptions on technology use using the iTEaCH implementation model: A case study of a Singapore school. *Cogent Education*, *2*(1). doi:10.1080/2331186x.2015.1035527

Convenience Sampling. (2009). Retrieved from https://explorable.com/convenience-sampling

Cox, S., & Graham, C. (2009). Diagramming TPACK in practice: Using an elaborated model of the TPACK framework to analyze and depict teacher knowledge. *TechTrends, 53*(5), 60–69. doi:10.1007/s11528-009-0327-1

Davies, R., Nyland, R., Bodily, R., Chapman, J., Jones, B., & Young, J. (2016). Designing technology-enabled instruction to utilize learning analytics. *TechTrends*, 61(2), 155-161. doi:10.1007/s11528-016-0131-7

Davis, D. F. (1986*). A technology acceptance model for empirically testing new end-user information systems: theory and results* (Doctoral dissertation, Sloan School of Management , Massachusetts Institute of Technonology).

Dron, J. (2012). The pedagogical-technological divide and the elephant in the room. *International Journal on E-Learning, 11*(1), 23–38. Retrieved from https://www.learntechlib.org/p/33288/

EDUCAUSE. (2018). Key issues in teaching and learning. Retrieved from https://www.educause.edu/eli/initiatives/key-issues-in-teaching-and-learning

Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development, 47*(4), 47–61. doi:10.1007/bf02299597

Ertmer, P. A., & Ottenbreit-Leftwich, A. (2013). Removing obstacles to the pedagogical changes required by Jonassen's vision of authentic technology-enabled learning. *Computers & Education, 64,* 175–182. doi:10.1016/j.compedu.2012.10.008

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change. *Journal of Research on Technology in Education, 42*(3), 255–284. doi:10.1080/15391523.2010.10782551

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education, 59*(2), 423–435. doi:10.1016/j.compedu.2012.02.001

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods, 41*(4), 1149–1160. doi:10.3758/brm.41.4.1149

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences, 111*(23), 8410–8415. doi:10.1073/pnas.1319030111

Frydenberg, M. (2012, December 14). The flipped classroom: It's got to be done right | *The Huffington Post* [Web log post]. Retrieved from http://www.huffingtonpost.com/mark-frydenberg/the-flipped-classroom-its_b_2300988.html

Fung, H. N., & Yuen, A. H. (2006). Utilization of e-learning technology in higher education. *International Journal of Cases on Electronic Commerce, 2*(2), 43–63. doi:10.4018/jcec.2006040103

Ginder, S., Kelly-Reid, J., & Mann, F. (2017). Enrollment and employees in postsecondary institutions, Fall 2016 (NCES 2018-002). Retrieved from U.S. Department of Education website: https://nces.ed.gov/pubs2018/2018002.pdf

Graham, C. R. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers & Education, 57*(3), 1953–1960. doi:10.1016/j.compedu.2011.04.010

Greer, D., Crutchfield, S., & Woods, K. (2013). Cognitive theory of multimedia learning, instructional design principles, and students with learning disabilities in computer-based and online learning environment. *Journal of Education, 193*(2), 41–50.

Gross-Loh, C. (2016, July 14). Should colleges really eliminate the college lecture? *The Atlantic*. Retrieved from https://www.theatlantic.com/education/archive/2016/07/eliminating-the-lecture/491135/

Hadjianastasis, M., & Nightingale, K. P. (2016). Podcasting in the STEM disciplines: The implications of supplementary lecture recording and "lecture flipping." *FEMS Microbiology Letters, 363*(4), fnw006. doi:10.1093/femsle/fnw006

Hartley, J., & Cameron, A. (1967). Some observations on the efficiency of lecturing. *Educational Review, 20*(1), 30–37. doi:10.1080/0013191670200103

The Horizon Report. (2017). Retrieved from NMC, the New Media Consortium website: http://cdn.nmc.org/media/2017-nmc-horizon-report-he-EN.pdf

Ifenthaler, D. (2016). Are higher education institutions prepared for learning analytics? *TechTrends*, 61(4), 366-371. doi:10.1007/s11528-016-0154-0

ITU. (2018). Number of internet users worldwide 2005–2017 | Statista. Retrieved from https://www.statista.com/statistics/273018/number-of-internet-users-worldwide/

Johnson, T., Wisniewski, M. A., Kuhlemeyer, G., Isaacs, G., & Krzykowski, J. (2012). Technology adoption in higher education: Overcoming anxiety through faculty bootcamp. *Online Learning, 16*(2). doi:10.24059/olj.v16i2.240

Kaku, M. (2017, November). The next 20 years in education and technology. *Educause Annual Conference*. Symposium conducted at Educause, Philadelphia, PA.

Kimmons, Royce. (2015). Examining TPACK's theoretical future. *Journal of Technology and Teacher Education, 23,* 53–77. Society for Information Technology & Teacher Education. Retrieved May 13, 2018 from https://www.learntechlib.org/primary/p/130072/.

King, A. (1993). From sage on the stage to guide on the side. *College Teaching, 41*(1), 30–35. doi:10.1080/87567555.1993.9926781

Kirk, R. E. (2013). *Experimental design: Procedures for the behavioral science*s (4th ed.). Waco, TX: Sage Publications.

Koehler, M. J., Mishra, P., Hershey, K., & Peruski, L. (2004). With a little help from your students: A new model for faculty development and online course design. *Journal of Technology and Teacher Education, 12*(1), 25–55.

Koehler, M. J., Mishra, P., & Yahya, K. (2007). Tracing the development of teacher knowledge in a design seminar: Integrating content, pedagogy and technology. *Computers & Education, 49*(3), 740–762. doi:10.1016/j.compedu.2005.11.012

Kurzweil, R. (2005). *The singularity is near: When humans transcend biology*. New York, NY: Penguin Books.

Laerd Statistics (2017). One-way ANOVA using SPSS statistics. *Statistical tutorials and software guides*. Retrieved from https://statistics.laerd.com/

Lage, M. J., Platt, G. J., & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *The Journal of Economic Education, 31*(1), 30. doi:10.2307/1183338

Ling Koh, J. H., & Chai, C. S. (2016). Seven design frames that teachers use when considering technological pedagogical content knowledge (TPACK). *Computers & Education, 102,* 244–257. doi:10.1016/j.compedu.2016.09.003

Ling Koh, J. H., Chai, C. S., & Tay, L. Y. (2014). TPACK-in-action: Unpacking the contextual influences of teachers' construction of technological pedagogical content knowledge (TPACK). *Computers & Education, 78,* 20–29. doi:10.1016/j.compedu.2014.04.022

Lo, C. K. (2018). Grounding the flipped classroom approach in the foundations of educational technology. *Educational Technology Research and Development, 66*(3), 793–811. doi:10.1007/s11423-018-9578-x

Long, T., Cummins, J., & Waugh, M. (2016). Use of the flipped classroom instructional model in higher education: Instructors' perspectives. *Journal of Computing in Higher Education, 29*(2), 179–200. doi:10.1007/s12528-016-9119-8

Lowry, P., Gaskin, J., & Moody, G. (2015). Proposing the Multimotive Information Systems Continuance Model (MISC) to better explain end-user system evaluations and continuance intentions. *Journal of the Association for Information Systems*, 16(7), 515-579. doi:10.17705/1jais.00403

Mah, D. (2016). Learning analytics and digital badges: Potential impact on student retention in higher education. *Technology, Knowledge and Learning, 21*(3), 285–305. doi:10.1007/s10758-016-9286-8

Maor, D. (2016). Using TPACK to develop digital pedagogues: A higher education experience. *Journal of Computers in Education, 4*(1), 71–86. doi:10.1007/s40692-016-0055-4

Marinagi, C., Skourlas, C., & Belsis, P. (2013). Employing ubiquitous computing devices and technologies in the higher education classroom of the future. *Procedia—Social and Behavioral Sciences, 73,* 487–494. doi:10.1016/j.sbspro.2013.02.081

McNally, B., Chipperfield, J., Dorsett, P., Del Fabbro, L., Frommolt, V., Goetz, S., … Rung, A. (2016). Flipped classroom experiences: student preferences and flip strategy in a higher education context. *Higher Education, 73*(2), 281–298. doi:10.1007/s10734-016-0014-z

Missildine, K., Fountain, R., Summers, L., & Gosselin, K. (2013). Flipping the classroom to improve student performance and satisfaction. *Journal of Nursing Education, 52*(10), 597–599. doi:10.3928/01484834-20130919-03

National Center for Education Statistics (NCES 2016-014). (2016). Retrieved from U.S. Department of Education website: https://nces.ed.gov/fastfacts/display.asp?id=60

Nicol, A. A., Owens, S. M., Le Coze, S. S., MacIntyre, A., & Eastwood, C. (2017). Comparison of high-technology active learning and low-technology active learning classrooms. *Active Learning in Higher Education*, 19(3), 253-265. doi:10.1177/1469787417731176

Niederhauser, D. S., Howard, S. K., Voogt, J., Agyei, D. D., Laferriere, T., Tondeur, J., & Cox, M. J. (2018). Sustainability and scalability in educational technology initiatives: Research-informed practice. *Technology, Knowledge and Learning, 23*(3), 507–523. doi:10.1007/s10758-018-9382-z

Njenga, J. K., & Fourie, L. C. (2008). The myths about e-learning in higher education. *British Journal of Educational Technology, 41*(2), 199–212. doi:10.1111/j.1467-8535.2008.00910.x

NMC Horizon Project. (2018). *NMC Horizon Report Preview 2018*. Retrieved from https://library.educause.edu/resources/2018/4/nmc-horizon-report-preview-2018

Osamnia, M., Okada, H., Berena, A. J., Ueno, H., & Chunwijitra, S. (2016). A novel automated course generation system embedded in the online lecturing platform for higher education. *Computer Applications in Engineering Education, 24*(4), 586–598. doi:10.1002/cae.21734

Owston, R., Lupshenyuk, D., & Wideman, H. (2011). Lecture capture in large undergraduate classes: Student perceptions and academic performance. *The Internet and Higher Education, 14*(4), 262–268. doi:10.1016/j.iheduc.2011.05.006

Palak, D., & Walls, R. T. (2009). Teachers' beliefs and technology practices. *Journal of Research on Technology in Education, 41*(4), 417–441. doi:10.1080/15391523.2009.10782537

Polly, D., & Brantley-Dias, L. (2009). TPACK: Where do we go now? *TechTrends, 53*(5), 46–47. doi:10.1007/s11528-009-0324-4

Porras-Hernandez, L. H., & Salinas-Amescua, B. (2013). Strengthening Tpack: A broader notion of context and the use of teacher's narratives to reveal knowledge construction. *Journal of Educational Computing Research, 48*(2), 223–244. doi:10.2190/ec.48.2.f

Reeves, T. C., & Oh, E. G. (2016). The goals and methods of educational technology research over a quarter century (1989–2014). *Educational Technology Research and Development*, 65(2), 325-339. doi:10.1007/s11423-016-9474-1

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York, NY: Free Press.

Roser, M., & Ortiz-Ospina, E. (2018). Global rise of education. Retrieved from https://ourworldindata.org/global-rise-of-education

Ruiz, N., & Radford, J. (2017, November 20). New foreign student enrollment doubled since recession in U.S. Retrieved from http://www.pewresearch.org/fact-tank/2017/11/20/new-us-foreign-student-enrollment-doubled-since-great-recession/?utm_content=buffere7f46&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer

Sandholtz, J. H., Ringstaff, C., & Dwyer, D. C. (1997). *Teaching with technology: Creating student-centered classrooms*. New York, NY: Teachers' College Press.

Schiro, M. S. (2013). *Curriculum theory: Conflicting visions and enduring concerns* (2nd ed.). Los Angeles, CA: SAGE.

Shaw, G. P., & Molnar, D. (2011). Non-native English language speakers benefit most from the use of lecture capture in medical school. *Biochemistry and Molecular Biology Education, 39*(6), 416–420. doi:10.1002/bmb.20552

Shelton, C. (2013). "Virtually mandatory": A survey of how discipline and institutional commitment shape university lecturers' perceptions of technology. *British Journal of Educational Technology, 45*(4), 748–759. doi:10.1111/bjet.12051

Shelton, C. (2018). An ecological model for university faculty members' thinking about technology. *Journal of Computing in Higher Education*. doi:10.1007/s12528-018-9168-2

Shulman, L. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1–23. doi:10.17763/haer.57.1.j463w79r56455411

Socratic Teaching. (1997). Retrieved June 5, 2018, from http://www.criticalthinking.org/pages/socratic-teaching/606

Spence, L. D. (2001). The case against teaching. *Change: The Magazine of Higher Learning, 33*(6), 10–19. doi:10.1080/00091380109601822

Stains, M., Harshman, J., Barker, M. K., Chasteen, S. V., Cole, R., DeChenne-Peters, S. E., … Young, A. M. (2018). Anatomy of STEM teaching in North American universities. *Science, 359*(6383), 1468–1470. doi:10.1126/science.aap8892

Streveler, R. A., & Menekse, M. (2017). Taking a closer look at active learning. *Journal of Engineering Education*, 106(2), 186-190. doi:10.1002/jee.20160

Sulecio de Alvarez, M., & Dickson-Deane, C. (2018). Avoiding educational technology pitfalls for inclusion and equity. *TechTrends*, 62(4), 345-353. doi:10.1007/s11528-018-0270-0

Top 10 IT issues, technologies, and trends. (2018). Retrieved February 10, 2018, from https://www.educause.edu/research-and-publications/research/top-10-it-issues-technologies-and-trends

Traxler, J. (2010). Students and mobile devices. *Research in Learning Technology, 18*(2). doi:10.3402/rlt.v18i2.10759

Turney, C., Robinson, D., Lee, M., & Soutar, A. (2009). Using technology to direct learning in higher education. *Active Learning in Higher Education, 10*(1), 71–83.

Voet, M., & De Wever, B. (2017). Towards a differentiated and domain-specific view of educational technology: An exploratory study of history teachers' technology use. *British Journal of Educational Technology, 48*(6), 1402–1413. doi:10.1111/bjet.12493

Vongkulluksn, V. W., Xie, K., & Bowman, M. A. (2018). The role of value on teachers' internalization of external barriers and externalization of personal beliefs for classroom technology integration. *Computers & Education, 118*, 70–81. doi:10.1016/j.compedu.2017.11.009

Watt, S., Vajoczki, S., Voros, G., Vine, M., Fenton, N., & Tarkowski, J. (2014). Lecture capture: An effective tool for universal instructional design. *Canadian Journal of Higher Education, 44*(2), 1–29.

Weiser, M. (1995). The Computer for the 21st Century. *Readings in Human–Computer Interaction*, 933-940. doi:10.1016/b978-0-08-051574-8.50097-2

Weiser, M., & Brown, J. S. (1997). The coming age of calm technology. *Beyond Calculation,* 75–85. doi:10.1007/978-1-4612-0685-9_6

Woodall, T., Hiller, A., & Resnick, S. (2012). Making sense of higher education: Students as consumers and the value of the university experience. *Studies in Higher Education, 39*(1), 48–67. doi:10.1080/03075079.2011.648373

World Internet Users Statistics and 2018 World Population Stats. (2018, September 25). Retrieved November 3, 2018, from https://www.internetworldstats.com/stats.htm

Yorke, M., & Longden, B. (2008). The first-year experience in higher education in the UK. *York: The Higher Education Academy*.

Zhu, E., & Bergom, I. (2010). *Lecture capture: A guide for effective use*. Retrieved from Center for Research on Learning and Teaching—University of Michigan website: http://www.crlt.umich.edu/op27

APPENDIX A

Survey Instrument

Exploring Ideology and Pedagogy Impact to Technology Use in the Classroom

Q1 Welcome.

Thank you for taking part in this brief survey.

The goal of this research is to learn more about the intersection of technology and curriculum within the higher education classroom.

This survey has four sections and will take approximately 10 minutes to complete. Your responses will help us better understand the use of emerging technology in the classroom as well as the opportunities for improving technology deployment in the classroom environment.

Your responses will be kept confidential, and all analyses and reports will reflect only aggregate results. Further protection of individual responses will be supported via the Qualtrics anonymization function preventing the collection of any identifying information such as your computers name or address on the network. Participation in this survey is voluntary, and you may refuse to take part in or withdraw from the study at any time. Participation or non-participation will not impact your relationship with Bucknell University.

Continuing past this section will be interpreted as your informed consent to participate in the survey. If you agree, please click on the continue button below.

If you have any questions about this research, please contact the Principal Investigator, Chris Bernard via email at chris.bernard@bucknell.edu. If you have any questions regarding your rights as a research subject, contact the Bucknell Institutional Review Board Chair at matthew.slater@bucknell.edu.

○ CONTINUE (1)

Q41 What is your gender

- ◯ Male (1)
- ◯ Female (2)
- ◯ Other (3)
- ◯ No response (4)

Q3 What is your present academic rank?

- ◯ Professor (1)
- ◯ Associate Professor (2)
- ◯ Assistant Professor (3)
- ◯ Lecturer (4)
- ◯ Instructor (5)
- ◯ Graduate Student / Teaching Assistant (6)

Q44 What is your tenure status at Bucknell University?

- ◯ Tenured (1)
- ◯ On tenure-track (2)
- ◯ Not on tenure track (3)

Q45 Do you primarily teach?

- ◯ STEM classes (1)
- ◯ Non-STEM classes (2)

Q6 In what year did you receive your first academic appointment? (4-digit year)

____

Q8 Typically when I use technology it is to promote active learning through online simulations and interactive games.

- ◯ Strongly disagree (1)
- ◯ Somewhat disagree (2)
- ◯ Neither agree nor disagree (3)
- ◯ Somewhat agree (4)
- ◯ Strongly agree (5)

Q9 Typically when I use technology it is to promote active learning by designing online activities for students to conduct self-directed research.

▼ Strongly disagree (1).. Strongly agree (5)

Q10 Typically when I use technology it is to facilitate online discussions and collaborations.

▼ Strongly disagree (1).. Strongly agree (5)

Q11 Typically when I use technology it is as a platform for students to produce work (e.g., write short essays, answer quizzes) and self-reflection.

▼ Strongly disagree (1).. Strongly agree (5)

Q12 Typically when I use technology it is to present information (e.g., slideshows).

▼ Strongly disagree (1).. Strongly agree (5)

Q13 Typically when I use technology it is to motivate students to learn a topic.

▼ Strongly disagree (1).. Strongly agree (5)

Q14 I am keen to use technology that comprises interactive games / computer simulations

▼ Strongly disagree (1).. Strongly agree (5)

Q15 I am keen to use technology that comprises research work by the students (e.g., searching for online journal articles / reviewing online courses for information).

▼ Strongly disagree (1).. Strongly agree (5)

Q16 I am keen to use technology that comprises forums or social media sites for discussions and reflections.

▼ Strongly disagree (1).. Strongly agree (5)

Q17 I am keen to use technology that comprises online or technology-based quizzes.

▼ Strongly disagree (1).. Strongly agree (5)

Q18 I am keen to use technology that comprises Powerpoint slides or teacher/student-made video clips.

▼ Strongly disagree (1).. Strongly agree (5)

Q19 I am keen to use technology that comprises motivating online talks (E.g., Ted Talks), pictures and articles.

▼ Strongly disagree (1).. Strongly agree (5)

Q20 I have the pedagogical skills to use authoring tools or programming to develop interactive learning objects.

▼ Strongly disagree (1).. Strongly agree (5)

Q21 I have the pedagogical skills to design learning for students through online research.

▼ Strongly disagree (1).. Strongly agree (5)

Q22 I have the pedagogical skills to facilitate discussions through the use of questions and topical triggers.

▼ Strongly disagree (1).. Strongly agree (5)

Q23 I have the pedagogical skills to set up online questions and quizzes to check students understanding.

▼ Strongly disagree (1).. Strongly agree (5)

Q24 I have the pedagogical skills to present information through multimedia.

▼ Strongly disagree (1).. Strongly agree (5)

Q25 I have the pedagogical skills to create and use multimedia to pique learner interest.

▼ Strongly disagree (1).. Strongly agree (5)

Q26 My colleagues/school support me in technology use by sending me for training to use/develop customized ICT resources (e.g., interactive games) for interactive learning.

▼ Strongly disagree (1).. Strongly agree (5)

Q27 My colleagues/school support me in technology use by sharing best practices on how I can get students to conduct online research.

▼ Strongly disagree (1).. Strongly agree (5)

Q28 My colleagues/school support me in technology use by sharing how to facilitate student discussions on forums or social media sites.

▼ Strongly disagree (1) ... Strongly agree (5)

Q29 My colleagues/school support me in technology use by circulating online questions and quizzes that they developed for use in teaching.

▼ Strongly disagree (1).. Strongly agree (5)

Q30 My colleagues/school support me in technology use by sharing their Powerpoint slides and teacher-made video clips with me.

▼ Strongly disagree (1).. Strongly agree (5)

Q31 My colleagues/school support me in technology use by sharing the e-resources (e.g., videos) which can stimulate interest or motivate students in a topic.

▼ Strongly disagree (1).. Strongly agree (5)

Q33 For each group of statements, place them in rank order with the first item best reflecting your pedagogical beliefs and the last item being least reflective of your pedagogical beliefs.

Q34 Curriculum Ideology Inventory #1

_______ Schools should provide children with the ability to perceive problems in society, envision a better society, and act to change society so that there is social justice and a better life for all people. (1)
_______ Schools should fulfill the needs of society by efficiently training youth to function as mature constructive members of society. (2)
_______ Schools should be communities where the accumulated knowledge of the culture is transmitted to the student. (3)
_______ Schools should be enjoyable, stimulating, student-centered environments organized around the developmental needs and interests of students as those needs and interests present themselves from day to day. (4)

Q35 Curriculum Ideology Inventory #2

______ Teachers should be supervisors of student learning, utilizing instructional strategies that will optimize student learning. (1)
______ Teachers should be companions of students, using the environment within which the student lives to help the student learn. (2)
______ Teachers should be aids to students, helping them learn by presenting them with experiences from which they can make meaning. (3)
______ Teachers should be knowledgeable people, transmitting that which is known to those who do not know it. (4)

Q36 Curriculum Ideologies Inventory #3

______ Learning best proceeds when the student is presented with the appropriate stimulus materials and positive reinforcement. (1)
______ Learning best proceeds when the teacher clearly and accurately presents to the student that knowledge which the student is to acquire. (2)
______ Learning best takes place when children are motivated to actively engage in experiences that allow them to create their own knowledge and understanding of the world in which they live. (3)
______ Learning best occurs when a student confronts a real social crisis and participates in the construction of a solution to that crisis. (4)

Q37 Curriculum Ideologies Inventory #4

______ The knowledge of most worth is the structured knowledge and ways of thinking that have to be valued in the culture over time. (1)
______ The knowledge of most worth is the personal meaning of oneself and of one's world that comes from one's direct experience in the world and one's personal response to such experience. (2)
______ The knowledge of most worth is the specific skills and capabilities for action that allow an individual to live a constructive life. (3)
______ The knowledge of most worth is a set of social ideals, a commitment to those ideals, and an understanding of how to implement those ideals. (4)

Q38 Curriculum Ideologies Inventory #5

______ Childhood is essentially a time of learning in preparation for adulthood, when one will be a constructive contributing member of society. (1)
______ Childhood is essentially a period of intellectual development highlighted by growing reasoning ability and capacity for memory that results in ever greater absorption of cultural knowledge. (2)
______ Childhood is essentially a time when children unfold according to their own innate natures, felt needs, organic impulses, and internal timetables. The focus is on children as they are during childhood rather than as they might be as adults. (3)
______ Childhood is essentially a time for practice in and preparation for acting upon society to improve both oneself and the nature of society (4)

Q39 Curriculum Ideologies Inventory #6

______ Evaluation should objectively indicate to others whether or not students can or cannot perform specific skills. Its purpose is to certify student's competence to perform specific tasks. (1)
______ Evaluation should continuously diagnose students needs and growth so that further growth can be promoted by appropriate adjustment of their learning environment, it is primarily for the student's benefit, not for comparing students with each other or measuring them against predetermined standards. (2)
______ Evaluation should be a subjective comparison of students' performance with their capabilities. Its purpose is to indicate to both the students and others the extent to which they are living up to their capabilities. (3)
______ Evaluation should objectively determine the amount of knowledge students have acquired. It allows students to be ranked from those with the greatest intellectual gain to those with the least. (4)

Q40 What do you see as the biggest challenge to the use of technology in the classroom?

- ○ Lack of time (1)
- ○ Lack of training (2)
- ○ Availability of resources (3)
- ○ Access to technical support (4)
- ○ Lack of pedagogical impact (5)

Q43 Is there any additional information you would like to add regarding the challenge of using technology in the classroom?

____

APPENDIX B

Curriculum Ideologies Inventory Graphing Sheet

	Part 1 Purpose	Part 2 Teaching	Part 3 Learning	Part 4 Knowledge	Part 5 Childhood	Part 6 Evaluation
Scholar Academic						
A-1						
A-2						
A-3						
A-4						
Learner-Centered						
B-1						
B-2						
B-3						
B-4						
Social Reconstruction						
C-1						
C-2						
C-3						
C-4						
Social Efficiency						
D-1						
D-2						
D-3						
D-4						

Sorting Form:

Part 1	Part 2	Part 3	Part 4	Part 5	Part 6
C _____	D _____	D _____	A _____	D _____	D _____
D _____	C _____	A _____	B _____	A _____	B _____
A _____	B _____	B _____	D _____	B _____	C _____
B _____	A _____	C _____	C _____	C _____	A _____

APPENDIX C

Schiro Curriculum Ideologies Inventory—License to Use

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Title of the article or chapter the portion is from	Curriculum Ideologies Inventory
Editor of portion(s)	N/A
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