12-5-2016

Faculty's Knowledge, Pedagogy, and Integration Levels in the Implementation of Ipads as an Instructional Tool

Xin Wang

UNIVERSITY OF NORTHERN COLORADO

Greeley, Colorado

The Graduate School

FACULTY'S KNOWLEDGE, PEDAGOGY, AND INTEGRATION LEVELS IN THE IMPLEMENTATION OF IPADS AS AN INSTRUCTIONAL TOOL

A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Philosophy

Xin Wang

College of Education and Behavior Sciences
Department of Educational Technology

December, 2016

This Dissertation by: Xin Wang

Entitled: *Faculty's Knowledge, Pedagogy, and Integration Levels in the Implementation of iPads as an Instructional Tool*

has been approved as meeting the requirements for the Degree of Doctor of Philosophy in College of Education and Behavioral Sciences in Department of Educational Technology

Accepted by the Doctoral Committee

____
Mia Kim Williams, Ph.D., Research Advisor

____
Christine Kyser, Ed.D., Committee Member

____
Heng-Yu Ku, Ph.D., Committee Member

____
Michael Phillips, Ph.D., Faculty Representative

Date of Dissertation Defense____

Accepted by the Graduate School

____
Linda Black, Ed.D.
Associate Provost and Dean
Graduate School and International Admission

ABSTRACT

Wang, Xin. *Faculty's Knowledge, Pedagogy, and Integration Levels in the Implementation of iPads as an Instructional Tool.* Published Doctor of Philosophy dissertation, University of Northern Colorado, 2016.

Current literature showed there is a need to help faculty improve their iPad integration practices. Using a sequential mixed-methods design, the researcher explored the relationship among faculty's iPad integration levels, their teachers' knowledge (TPACK), and pedagogy among faculty members who had integrated iPads into their teaching for at least two semesters. The data were collected with a cross-section questionnaire, follow-up interviews and artifacts. Responses were collected respectively with the three sections of the questionnaire: iPad Usage (N=160), TPACK (N=151), and demographics (N=147). Eight participants were interviewed after the survey. The results indicated TPACK and learning-centered pedagogy were necessary but insufficient conditions for the transformation levels of iPad integration. Technology itself might not bring a pedagogical shift. Learning to teach with technology could be a catalyst that triggers changes in teaching practices. However, the teacher must act as the agent for these changes. The results of this study could be informative to faculty who hope to improve their own iPad integration levels, or faculty developers and administrators to determine more effective ways to support iPad integration in their institutions.

ACKNOWLEDGEMENTS

First, I would like to thank my advisor, Dr. Mia K. Williams, for her continuous support during my Ph.D. study and research. Her guidance helped me in the research and writing of this dissertation.

I would also like to thank the rest of my dissertation committee--Dr. Michael Phillips, Dr. Christine Kyser, and Dr. Heng-Yu--for their insightful comments and encouragement, which helped improve my dissertation research from various perspectives.

I am extremely grateful to my father--Shi-Ying Wang, my mother--Gui-Zhen Yu, and my husband--Jose Ferrer. I could not have accomplished all these without their love, support, encouragement, and understanding.

Last but not least, thanks must also go to all participants whose cooperation and input made this research possible.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Although core ideas and goals of education have not been changed, the way of communication and collaboration, the way of acquiring and synthesizing knowledge, and even the nature of some disciplines have been changed fundamentally because of the extensive and intensive use of technology in the 21st century (Kereluik, Fahnoe, & Karr, 2013). New generations of citizens need to change to keep up with these developments. Educators of new generations need to adapt their teaching to meet the needs of new millennium learners. The rapid development of technology creates opportunities as well as challenges for education at all levels.

To address the needs of 21st century learning, educational institutions across the world have invested millions of dollars in hardware and software, infrastructure development, and teacher training. Various technologies have been introduced and experimented in classrooms. The past decade witnessed an increasing growth of mobile device adoption among educators and students. Among all mobile devices, tablets and iPads appear to have been adopted into education at the speed few previous innovations have ever succeeded in doing. Research shows mobile technology, including iPads, provides great potential for enhancing learning if used properly (Cochrane& Bateman, 2010; Cochrane, Narayan & Oldfield, 2013; Sharples, 2000; Traxler & Wishart, 2011). However, current literature indicated iPad integration appears to remain at low levels in higher education. Thus, despite time and money universities have invested into mobile device implementation, it seems the devices have not been used to their full potential in transforming learning. How to improve mobile device integration levels is a question higher education institutions are facing. Faculty members play a critical role as implementers of technology integration. One way to improve mobile device integration levels is to equip faculty with the necessary knowledge and skills. To be able to improve knowledge and skills, the relationship between teachers' knowledge and their iPad integration levels needs to be explored and understood. Currently, little research has been found to address this topic.

This study focused on the experience of faculty who have integrated iPads as an instructional tool in their teaching for at least two semesters. Using a mixed-methods research design, the researcher explored how the iPad was used as an instructional tool, current integration levels as defined by the Substitution Augmentation Modification Redefinition (SAMR) model, the relationship between teachers' knowledge and integration levels, the impact of iPad integration on pedagogical practices, and factors that might facilitate a pedagogical shift during the implementation process in higher education in the United States. This chapter introduces the background of the problem, statement of the problem, purpose of the study, research questions, research design, rationale and significance of the study, research assumptions, and definition of terms.

Background of the Problem

The release of the iPad in 2010 became the symbol of the birth of a new technology and a new category of mobile devices---tablets, which are distinct from other existing mobile devices such as smartphones, ultra-small laptops, e-readers, or other kinds of portable devices (Johnson et al., 2013). Tablets provide a large touch screen, portable size, are light weight, have a high computing ability, multimedia production capability, long battery life, instant-on, easy transition between apps, and internet connectivity. These features have encouraged the rapid adoption of tablets by people of all walks of life, especially young people. Since the invention of tablets, their popularity among college students has continuously increased. The 2013 EDUCAUSE report (Dahlstron, Walker, & Dziuban, 2013) revealed at least 31% of college students own tablets and 75% of college students own a smartphone. Tablet ownership among college students increased 15% in only a year (compared to that in 2012; Dahlstron et al., 2013). Also noted was 58% of students own three or more internet-capable devices (Smith & Caruso, 2010). A Pearson Student Mobile Device Survey (2015) showed up to 51% of college students in the sample claimed to use a tablet regularly in their daily life. Thus, just like college students in 2010 do not remember the time when the Internet was not around, students in 2030 will not remember a time without mobile devices. For the iGeneration born after the mid-1990s (Rosen, Carrier, & Cheever, 2010), mobile devices will be just as natural and common as desktop computers are now.

The increase of tablet ownership has led to the rapid growth of academic use of these mobile devices. Among all the tablet brands, the Apple iPad appears to be the one that has been adopted into education at a speed no other tablets have succeeded in doing. Apple (Etherington, 2013) confirmed it had sold more than eight million iPads directly into educational institutions worldwide up to March of 2013. More than half of them (4.5 million) had been sold to U.S. education institutions (Paczkowsky, 2013). Apple's CEO also confirmed its global share of tablets in education was about 94% (Cheng, 2013) including both K-12 and higher education sectors.

To explore the potential of iPads to support teaching and learning in higher education environments, a number of initiatives and pilots have been conducted across the World, especially in the United States. From these iPad deployments, initiatives, and pilots, many studies have provided valuable information on how iPads have been used in supporting teaching and learning in higher education. A literature review showed the majority of current research studies were exploratory and focused on capturing students' perceptions about using iPads to support their learning either with or without guidance (Nguyen, Barton, & Nguyen, 2014). While used individually, students often reported iPads increased their engagement with content (Fisher, Lucas, & Galstyan, 2013; Giunta, 2012; Johnston & Marsh, 2014; Mang, Wardley, & Bay, 2012), improved learning efficiency through ubiquitous access to digital course materials and web-based information (Alyahya & Gall, 2012; Archibald, Macdonald, Plante, Hogue, & Fiallos, 2014; Compomizzi, 2013; Hahn & Bussell, 2012; Lewis, 2013; Kinash, Brand, Mathew, & Kordyban, 2011; Mang et al., 2012), saved costs on textbooks and printing (Alyahya & Gall, 2012; Geist, 2011; Hesser & Schwartz, 2013), and enhanced personal productivity (Geist, 2011; Morrone, Gosney, & Engel, 2012). When used to support group work, iPads were perceived to enhance student interaction, engagement, and collaboration (Davies, 2014; Geist, 2011; Lewis, 2013; Mang et al., 2012; Morrone et al., 2012; Rossing, Miller, Cecil, & Stamper, 2012; Wakefield & Smith, 2012). The mobility and portability of iPads make the device easier to be carried for on-site training or situated learning during field trips (Sachs & Bull, 2013). The multimedia functions and various apps that run on iPads provide students the chance to capture learning moments and generate content (e.g., notes, reports, presentation, assignments) with this one single device anywhere and anytime (Davies, 2014; Deaton, Deaton, Ivankovic, & Norris, 2013; Hesser & Schwartz, 2013; Lys, 2013; Mang et al., 2012; Sachs &Bull, 2013; Youm et al., 2011). Besides the affordances, some constraints as a learning tool were also identified such as heavily depending on Wi- Fi connections (Kinash et al., 2011; Maloney & Wells, 2012; Mang et al., 2012; Tualla, 2011), no keyboard (Faris & Selber, 2013; Rossing et al., 2012; Sloan, 2013), and lack of relevant apps (Faris & Selber, 2013; Sloan, 2013; Tualla, 2011). Some of the constraints have already been addressed in the new generation of iPads.

Current literature also exposed the limitations of iPad integration in higher education. An early review of iPad pilot programs across the United States showed 83% of iPads were primarily used to deliver learning content (Murphy, 2011). The potential of mobile devices to support more active learning (e.g., social learning, situated learning) as recommended by experts (Cobcroft, Towers, Smith, & Bruns, 2006; Melhuish & Falloon, 2010; Traxler, 2011) has been largely neglected. The trend identified by Murphy (2011) had not been changed three years later when Nguyen et al. (2014) conducted their comprehensive literature review. Instead, Nguyen et al. confirmed current research reflected the lack of innovation in using iPads for instructional purposes.

Faculty play an irreplaceable role in the technology integration process. Previous research (Ertmer, 1999; Hannafin & Savenye, 1993; Kruger-Ross, 2014; Mcgowan, 2012; Pierson, 2001) identified both extrinsic and intrinsic barriers that might influence faculty adoption and integration of technology for teaching in general. Universities have invested millions of dollars to increase the availability of hardware and software, provide trainings, fund resources, and extend administrative supports to encourage technology integration into teaching and learning. These efforts have largely reduced the extrinsic barriers of technology integration in higher education sectors. Although extrinsic barriers should still be continuously taken into consideration, many researchers suggested it was time to shift the focus to reducing intrinsic barriers (teacher's beliefs and knowledge). These intrinsic barriers were found to be more fundamental reasons for whether and how teachers used technology for teaching.

The continuing integration of iPads in higher education implies a favorable environment and positive beliefs for using the device to support teaching and learning. However, current literature showed iPads have been used mainly at enhancement levels (Cavanaugh, Hargis, Kamali, & Soto, 2013), which are less effective in promoting deep learning (Bloemsma, 2013). Research showed lack of knowledge was one of the key intrinsic factors that hindered faculty adoption and integration of technology into teaching (Georgina & Hosford, 2009). Knowledge is not equal to skill and the mastery of knowledge does not always translate to effective teaching. However, the lack of knowledge definitely hinders teaching effectiveness including technology integration. iPads have been used in higher education for five years. Integration is still lingering at a low level in spite of favorable environments and positive beliefs toward the integration. Studies are needed to examine the relationship between teacher's knowledge and iPad integration levels in order to develop strategies to support and improve iPad integration. Research also showed teaching with technology provided faculty the opportunity to critically reflect on their pre-existing pedagogical knowledge and teaching routines and might result in a shift or even a transformation of their pedagogy and teaching practices (King, 2002a, 2004; Kitchenham, 2006). Therefore, it is also important to understand the faculty iPad integration process, examine how this experience might impact pedagogy, and determine factors that could facilitate the pedagogical shift with the goal of leveraging mobile device integration to transform the faculty's pedagogy and teaching practices.

This study made a step forward from the exploration of affordance and constraints of iPads to investigate iPad integration levels in higher education and the relationship among teachers' knowledge, pedagogy, and iPad integration levels. Understanding the relationship could help identify what pedagogy is needed to integrate iPads more effectively and what knowledge faculty might need to improve their integration levels. No current research was found to present the national landscape of iPad integration levels in higher education in the United States or to investigate the relationship among integration levels, knowledge, and pedagogy during iPad integration. This study contributed to the body of iPad integration research through the examination of these topics.

Statement of the Problem and Research Questions

As indicated in the literature, significant numbers of iPad initiatives have been implemented in U.S. higher education in the past five years. iPad integration, however, still remains at a low level (substitution and augmentation). Schools and students have not maximized the benefits the tool could offer despite huge investments in time and money. How to improve the integration levels to enhance deeper learning are common questions these institutions face. Clearly, schools can go only so far in encouraging technology use. The actual take-up depends largely on faculty's knowledge and skill of iPad integration. A clearer understanding of the relationship among teachers' knowledge, pedagogy, and iPad integration levels could provide insights for faculty developers and administrators supporting iPad integration. Little research has been done to explore this topic.

The purpose of this mixed-methods study was to understand the use of iPads in higher education in the United States, the relationship between faculty iPad integration levels and teachers' knowledge, and the degree to which the implementation of iPad as an instructional tool has influenced faculty's pedagogy.

The following research questions guided this study:

Q1 How have iPads been used as an instructional tool by faculty in higher education settings in the United States?

Q2 What is the relationship between faculty iPad integration levels as defined by the SAMR model and TPACK knowledge?

Q3 What are the pedagogical differences between faculty members who integrate iPads as an instructional tool?

Q4 Has faculty's pedagogy been shifted because of iPad integration? If there is a shift in pedagogy represented from the research, what are the factors that facilitated the pedagogical shift?

The Research Design

A mixed-method research design was used to answer the research questions. The target population was faculty who had used iPads as an instructional tool for at least two semesters in postsecondary educational institutions in the United States. Data collection consisted of two phases. In Phase 1, a self-designed, cross-section questionnaire was administrated to collect both quantitative and qualitative data about iPad usage, TPACK knowledge, and demographic information. In Phase 2, two participants from each iPad integration level were interviewed. The interview results revealed participants' pedagogical considerations while using iPads and how iPad integration influenced their pedagogy. Artifacts such as course syllabi, iPad activity instructions, and assignment descriptions were also collected to further understand and triangulate the interview data.

Rationale and Significance

Current literature showed iPad research still remains at an exploratory level (Nguyen et al., 2014). The majority of the studies focused on students' perspectives of iPad's affordances and constraints for learning with or without guidance. A few studies focused on faculty's perceptions of iPad affordances and constraints as an instructional tool but did not explore the reasons why faculty were using iPads in particular ways or what could be done to improve their integration levels. Technology integration is not a solo responsibility of faculty but the joint efforts of faculty, faculty developers, senior administrators, and IT specialists. To improve iPad integration levels, proper training and supports from joint teams are necessary. This study is believed to be the first among the few empirical studies that explored the relationship between TPACK knowledge and faculty iPad integration levels as defined by the SAMR model and investigated the relationship between faculty pedagogy and iPad integration levels. Close examination of the relationship among faculty iPad integration levels, TPACK, and pedagogy in this study has not only provided insights for faculty themselves on how to improve their integration levels but has also informed faculty developers, senior administrators, and IT specialists of how to provide more relevant and effective support and training for their faculty.

The results of this study could present a panoramic view of the current status of iPad integration in higher education in the United States; deepen the understanding of the relationship among TPACK, pedagogy, and mobile device integration levels; and provide insights for all educational organizations, faculty, faculty developers, and administrators who are conducting or supporting iPad integration. Moreover, the results of the study might be able to transfer to a more general situation in which other mobile devices and technology are used.

The Researcher

The researcher currently works as an Instructional Designer at a medium-sized university in the Rocky Mountain area of the United States and is enrolled as a doctoral student majoring in Educational Technology. She has been teaching technology integration and instructional design courses for undergraduate teacher candidates and faculty in U.S. universities since 2011. Before that, she worked as an English instructor and Instructional Designer in China for six years. The research topic of this study was derived from her research interests and experience in modeling iPad integration for teacher candidates at the undergraduate level. She is a constructivist and believes in student-centered pedagogy. The researcher played different roles in this study. In the survey research, she was the designer and implementer of the instrument. In the qualitative data collection phase, she was also the primary instrument to collect data as a non-participant observer. The researcher employed various strategies to minimize the bias she might bring to the research as mentioned in the study rigor section in Chapter III.

Assumptions

The researcher operated under three assumptions while conducting this study. First, technology (e.g. iPads) has the potential to enhance learning if used properly. This assumption was based on the results of nine meta-analysis studies covering articles published in the past four decades (Dede, 2004; Hsu, 2003; Schenker, 2007; Schmid et al., 2009; Schmid et al., 2014; Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011;

Timmerman & Kruepke, 2006). These nine meta-analysis studies all concluded technology did have the potential to enhance student learning and help realize instructional goals more efficiently and/or effectively if used in a pedagogically sound way. Second, technology could enhance deeper learning when used at higher levels (moderation and redefinition). This assumption was based on Puentedura's (2006) SAMR model and supported by the meta-analysis studies mentioned above. The SAMR model classifies technology integration into four levels, suggesting the higher levels of integration (moderation and redefinition) actually promote active student-centered learning and potentially improve student achievements; lower levels of integration (substitution and argumentation) are necessary and can enhance the efficiency of the learning process.

Finally, college students are using mobile devices inside or outside of schools for academic purposes. The Pearson and EDUCAUSE national reports (Dahlstrom et al., 2013) indicated increased ownership and use of the mobile devices for academic purposes among college students. College students show more interest and expectations in using mobile devices for learning as their ownership of and familiarity with them increase. The second annual report conducted by McGraw-Hill Education (Communications Team, 2015).) found 81% of college students use portable mobile devices, such as smartphones and tablets, to study. Chen and Denoyelles (2013) found 82% of students who owned a tablet had been using it for academic purposes. College students believed tablets will transform the way they learn in the future (83%), make learning more fun (79%), help them learn more efficiently (71%), and help them perform better in class (68%; Pearson Student Mobile Device Survey, 2015). Forty percent of students would like to use mobile technologies more often than they do now (Pearson Student Mobile Device Survey, 2015).

Definition of Terms

Mobile device. A portable, wireless computing device small enough to be used while held in the hand, e.g., smartphones, tablets.

Mobile learning. Learning with mobile devices (Traxler, 2011, p. 4).

Pedagogy. "The process and practice or methods of teaching and learning including the purpose(s), values, techniques or methods used to teach, and strategies for evaluating student learning" (Koehler, Mishra, & Yahya, 2007, p. 743).

SAMR model. A framework developed by Dr. Ruben Puentedura (2006) to guide the planning and evaluation of technology integration. In this model, technology integration is classified into two categories and four levels: substitution and augmentation level in the enhancement category and modification and redefinition in the transformation category. The model is presented by the creator as a form of a ladder that indicates the levels of student learning outcomes and engagement by doing the learning tasks.

Teachers' knowledge. Knowledge a teacher needs to conduct effective teaching including technological, pedagogical, and content knowledge (TPACK).

Technology integration. Use of information and communication technologies (ICTs) to support planned and structured educational activities to enhance teaching and learning.

Summary

The past decade witnessed a tremendous growth of mobile device adoption at all levels of educational sectors. Research shows mobile technology provides great potential to enhance active learning if used properly. However, current literature also indicated mobile device integration appears to mainly remain at low levels in higher education. Studies show that the continuous reduction of extrinsic barriers has not increased mobile device integration levels; the intrinsic factors, such as teacher's knowledge and beliefs, appear to play a more important role in impacting how mobile devices were used for teaching and learning in classrooms. Using a mixed-methods research design, the researcher explored how the iPad, a representative of mobile devices, was used as an instructional tool by higher education faculty members in the United States. This chapter introduces the background of the problem, statement of the problem, purpose of the study, research questions, research design, rationale and significance of the study, research assumptions, and definition of terms. Next chapter presents a thorough literature review and the theoretical framework that guided the implementation of this study.

CHAPTER II

LITERATURE REVIEW

The goal of research is to contribute to the knowledge base of the field. To achieve this goal, a thorough review of what has been done and what needs to be done is crucially important. A literature review provides the foundation for a problem to be studied, presents the current status of the research on the problem, and demonstrates why the present study deviates from what has already been done (Merriam, 2009). The purpose of this study was to investigate current iPad integration levels in higher education sectors in the United States and explore the relationship among iPad integration levels, teachers' knowledge (TPACK), and pedagogy. This chapter presents factors that influence technology integration in higher education; current research on the relationship among faculty's knowledge, pedagogy, and technology integration; and the current status of mobile learning, especially iPad integration in higher education. Based on the literature review, the researcher discusses how this study could contribute to the body of current research and provides a theoretical framework to guide the research design, data collection, and analysis.

Factors That Influence Technology Integration in Higher Education

For the purpose of this study, technology integration is defined as the use of information and communication technologies (ICTs) to support planned and structured educational activities to enhance teaching and learning. Although technologies have been introduced to higher education sectors for several decades, their adoption and integration in the post-secondary institutions remain slow and inconsistent (Hora & Holden, 2013). Faculty are found to have high levels of proficiency in using personal productive computer applications, e.g., word processing software and emails, but the level of instructional computer use in general is still low (Georgina & Olson, 2008; Kalonde, 2014; Sahin &Thompson, 2006). Faculty often express positive attitudes toward using technology in teaching (Anderson, Varnhagen, & Campbell, 1998; Lehman, 2014). However, those positive attitudes do not necessarily translate into actual adoption or high level integration. The majority of faculty were found to use technology mainly for replicating or supplementing existing teaching practices rather than radically changing them (Kirkup & Kirkwood, 2005). When Georgina and Olson (2008) surveyed faculty of 15 colleges of education, they found 33.4% faculty still preferred to teach in a traditional classroom with no technology integration at all, 16.1% of faculty preferred lecture-based teaching methods, and only 25% of faculty preferred to teach blended learning courses in which some technology was used. Georgina and Hosford (2009) found almost 40% of faculty they surveyed ($N = 237$) seldom or never attended any technology integration trainings offered by their institutions. A national survey among American college and university faculty showed only 28.4% of faculty ($N = 16{,}112$) reported they ever engaged in technology integration activities (Eagan et al., 2014). These studies showed a large gap between faculty's attitudes and actions. Extensive research has been conducted to determine factors that influence faculty adoption and integration of technology into their teaching practices. Both extrinsic and intrinsic factors have been identified.

Extrinsic Factors

Availability of appropriate equipment (e.g., hardware, up-to-date software) is often reported to be a major barrier to technology adoption and integration by many faculty, especially in early studies (Anderson et al., 1998; Groves & Zemel, 2000; Jude, Kajura, &Birevu, 2014; Keengwe, Kidd, & Kyei-Blankson, 2009). Time was also found to be a critical extrinsic factor. Technology has the potential to increase the efficiency and effectiveness of teaching in general but it often requires faculty to invest more time at the beginning stage to learn about the tool and even redesign existing classes (Eynon, 2008). With the pressure of teaching, research, and service commitments, faculty reported they lacked time to learn how to integrate technology into their current teaching practices (Ellis, 2000; Eynon, 2008; Hayes & Jamrozik, 2001; Keengwe et al., 2009; Rockwell, Schauer, Fritz, & Marx, 1999).Administrative support has also been often cited as an important factor influencing faculty's motivation to integrate technology (Allison & Scott, 1998; Eynon, 2008; Keengwe et al., 2009; Olcott & Wright, 1995). Support includes but not limited to stipends, assigned time, awards, recognition, and professional development (Allison & Scott, 1998). Faculty often expressed they would be more likely to use technology if there was more favorable policy and support from administration (Keengwe et al., 2009), proper rewards programs were in place (Surry & Land, 2000), and relevant trainings were provided (Georgina & Hosford, 2009; Lacey, Gunter, & Reeves, 2014; Rienties, Brouwer, & Lygo-Baker, 2013).

Institutions in higher education have attempted to address these extrinsic barriers for some time. Millions of dollars have been spent to update technological infrastructures in distance education, traditional classrooms, as well as students' independent study (Selwyn, 2007). Incentives and rewards for technology innovation have been provided in direct and indirect ways including but not limited to stipends, assigned time, awards, recognition, and staff development (Allison & Scott, 1998). Special offices are established and instructional design professionals are hired to support faculty instructional use of technology through numerous workshops, professional development programs, or one-on-one consultation. The underlying assumption behind these institutional efforts is the elimination of extrinsic barriers (e.g., equipment, time, training, support) will naturally follow the integration of technology (Ertmer, 2005). However, even though there appears to be increasingly favorable environmental conditions for technology integration, faculty's willingness to engage into the technology integration activities still remains low (Eagan et al., 2014; Ebert-May et al., 2011). Some researchers suggested intrinsic factors could be the more fundamental reasons hindering the adoption and adaption of technology for teaching (Ertmer, 2005; Kim, Kim, Lee, Spector, & DeMeester, 2013).

Intrinsic Factors

Besides extrinsic factors, some intrinsic factors influencing faculty technology integration have also been identified: attitudes toward technology adoption or/and integration (Ajjan & Hartshorne, 2008), self-efficacy regarding technology proficiency (Georgina & Olson, 2008), perceived value of technology for instruction (Cooper-Fisher, 2015), and proficiency in using technology for teaching (Georgina & Olson, 2008). These factors fall into two bigger categories: teachers' beliefs and teachers' knowledge.

Teachers' beliefs. There is no standard definition about what beliefs are due to the complexity and multifaceted construct of "belief." This study used Calderhead's (1996) definition and considered beliefs as "suppositions, commitments, and ideologies," which are socially constructed (p.715). People all have their own beliefs about everything and hold different beliefs toward the same thing, e.g., beliefs about religion, beliefs about freedom, and beliefs about marriage. So does every teacher.

When talking about teachers' beliefs, researchers actually mean teachers' educational beliefs (Pajares, 1992) instead of their non-educational beliefs, e.g., religious beliefs. Inevitably, there is no agreed upon definition of teachers' educational beliefs due to their complex and multifaceted nature (Fives & Buehl, 2011; Pajares, 1992). In general, researchers tend to agree that teachers' educational beliefs refer to "teachers' attitudes about education—about schooling, teaching, learning, and students" (Pajares, 1992, p. 306) formed and shaped by his or her personal identity and experience. Fives and Buehl (2011) summarized six areas of teacher's beliefs: teachers' beliefs about self (e.g., identity, role as a teacher), context or environment (e.g., school climate or culture, perceived relationships with colleagues, administrators, and parents), content or knowledge (e.g., mathematics, social studies), specific teaching practices (e.g., cooperative learning), teaching approach (e.g., constructivism), and students (e.g., diversity, language differences). Research on teachers' beliefs about technology integration have multiplied exponentially in the past two decades with the increased adoption of technologies into teaching and learning. While studying teachers' beliefs in relation to technology integration, researchers usually specify these beliefs as attitudes toward technology adoption or/and integration (e.g. Ajjan & Hartshorne, 2008), self-efficacy regarding technology proficiency (e.g. Georgina & Olson, 2008), or perceived value of technology for instruction (e.g. Cooper-Fisher, 2015).

A consistent finding derived from the previous studies was faculty's educational beliefs strongly influenced their teaching practices as indicated by their preference for pedagogical methods and different teaching styles (Entwistle &Walker, 2002; Lucas, 2005; Northcote, 2010). It is not unusual for teachers with similar training and teaching environment to teach very differently. Researchers suggested the fundamental reason for this phenomenon was the difference between teachers' beliefs about effective ways of teaching and learning (Entwistle &Walker, 2002).

Teacher's beliefs in higher education. Higher education faculty members' conceptions of teaching and learning (or their pedagogical beliefs) are usually developed from their understanding of the subject and based on their personal experiences as a student, a teacher, and a researcher due to little formal teacher training. Faculty members' conceptions of teaching and learning are usually described as teacher-centered and student-centered approaches to instruction (Entwistle & Walker, 2002; Kember & Kwan, 2002; Samuelowicz & Bain, 1992; Trigwell, Prosser, & Taylor, 1994; Van Driel, Verloop, van Werven, & Dekkers, 1997). These conceptions tended to be a continuum rather than clear-cut categories (Kember & Kwan, 2002).

Entwistle and Walker (2002) summarized five conceptions of teaching in higher education sectors:

1. Teacher-focused, content oriented: the purpose of teaching is to prepare students for examinations--students should follow the teacher's instruction strictly on what to learn.
2. Student-focused, learning oriented: teaching is to develop students' conceptual understanding--teachers should enhance this learning goal by

confronting and questioning students' perceptions and encourage and provide chances for knowledge application and transfer.

3. Teacher-centered: teachers see themselves as the experts on subject matters teaching is a transmission of knowledge and usually not supported by scaffolding or activities.
4. Student-directing: students learn through engagement in different activities carefully planned and controlled by teachers for the purpose of covering designed learning objectives and curriculum--teachers usually support students through direct instruction such as presentation, demonstration, and providing feedback.
5. Student-centered: teaching is a realization of the learning goal of individual learners. Generally speaking, teachers with more teacher-centered beliefs tend to use more direct instruction, e.g., teacher presentation, demonstration, and lecturing, while those with more student-centered beliefs incline more to employing a variety of approaches to encourage knowledge construction, e.g., discussion, collaborative learning, and project-based learning.

Most faculty tend to combine elements from teacher-centered and student-centered approaches. Depending on the degree of elements adopted from these two ends, some might be more teacher-centered than others.

Teachers' beliefs and technology integration. An extensive amount of research has been conducted to investigate the relationship between teachers' beliefs and technology integration, suggesting teachers' beliefs strongly influence technology integration (Ertmer, 2005; Lucas, 2005; Spotts, 1999). For example, Lucas (2005) conducted a phenomenological study to examine how faculty pedagogical beliefs and teaching styles were correlated with adopting technology to their teaching practices. Lucas (2005) used a purposeful sampling technique and interviewed three groups of faculty classified as leaders, aspirers, and resisters in terms of their attitudes and practices using technology for teaching. She found

> the use of instructional technologies is tied not to a particular teaching style, but to beliefs about teaching, which can be manifest through various teaching styles and methods (i.e. pedagogy), and those beliefs stem from who that faculty member is as a teacher, and how he or she views teaching. (p. 117)

She also concluded the perceived value of technology for instruction was the most important factor that distinguished leaders from resisters among her participants. In an earlier study, Spotts (1999) also found perceived value of technology for instruction was the most influential factor that distinguished faculty who were frequent users from infrequent users. He argued faculty had to realize the value of using instructional technology to be motivated to use it. “Even if equipment and facilities are available, these will not be used if faculty members do not see a benefit to using the technologies” (Spotts, 1999, p. 98).

The perceived value of using technology for instruction also strongly influences faculty’s perception of institutional supports, their commitment to overcome environmental barriers, and continuing engagement in using technology. Anderson et al. (1998) found early adopters and mainstream faculty all rated the lack of time as a barrier for technology integration. However, early adopters rated the lack of time significantly less than mainstream faculty despite early adopters using computers significantly more than mainstream faculty. Early adopters often perceived high value of using technology for teaching so they were more willing and committed to overcoming barriers (Anderson et al., 1998; Zayim, Yildirim & Saka, 2006). In other words, if faculty did not believe using technology was beneficial for their teaching, they were less likely to look for training, less likely to make efforts to use it, and held more negative attitudes toward environmental barriers.

On the other hand, active learning and using technology for teaching can be a catalyst to change or even transform teachers' beliefs about teaching and technology integration. King (2002a) conducted a survey among instructors who were enrolled in a graduate professional development program. Most of the 205 participants stated they had experienced perspective transformation in instructional use of technology by shifting from a teacher-centered to a more student-centered pedagogy after taking educational technology integration courses. King (2002b) also studied 17 professors from 12 universities across the United States about how they developed their skills of technology integration and how that experience influenced their beliefs of technology integration, pedagogy, and teaching style. The majority of professors stated their pedagogy and teaching styles shifted to more student-centered constructivist perspectives because of the experience of learning and using technology in their teaching. Whitelaw, Sears and Campbell (2004) investigated whether and to what extent the experience of learning to teach with technology facilitated a transformation in faculty's teaching philosophies and practices. The results showed faculty members significantly expanded their existing pedagogy and technology use in a more student-centered direction. McQuiggan (2011) conducted an action research investigating how training to teach online influenced faculty's beliefs of teaching and learning and how this experience influenced their face-to-face classroom teaching. She also found there was a move to more learner-centered pedagogy and less reliance on lectures.

Teachers' knowledge. Another key intrinsic factor that influences technology integration is teachers' knowledge. Calderhead (1996) defined knowledge as "factual propositions and understandings" (p. 715). Knowledge is considered to be more independent of feelings, which is different from beliefs that have strong affective and evaluative components (Pajares, 1992). Teachers have been expected to master two types of knowledge--subject matter content knowledge and general pedagogical knowledge--for a long time in the history of teacher education (Shulman, 1986). These two knowledge components are considered independent from each other and taught separately (Shulman, 1986). However, research on expert teachers' practices showed the existence of a third type of knowledge: pedagogical content knowledge (PCK; Shulman, 1986). Pedagogical content knowledge is different from a simple addition of subject matter content knowledge and general pedagogical knowledge. Instead, PCK is knowledge of the most effective ways of representing and formulating a particular subject to make it comprehensible to students (Shulman, 1986).

Two decades later, observing the intensive application and irreplaceability of technology in 21st century education, Mishra and Koehler (2006) suggested teachers should also have another type of knowledge: technological knowledge. Mishra and Koehler believed the interaction among content, pedagogy, and technology was not merely an addition of independent knowledge but generated new types of knowledge--technological pedagogical content knowledge (TPACK). They proposed a new framework to illustrate the complex relationships among these knowledge components (see Figure 1). In this framework, the three basic components are content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). Interaction of the three constructs derives four other components: pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological, pedagogical, and content knowledge (TPACK).

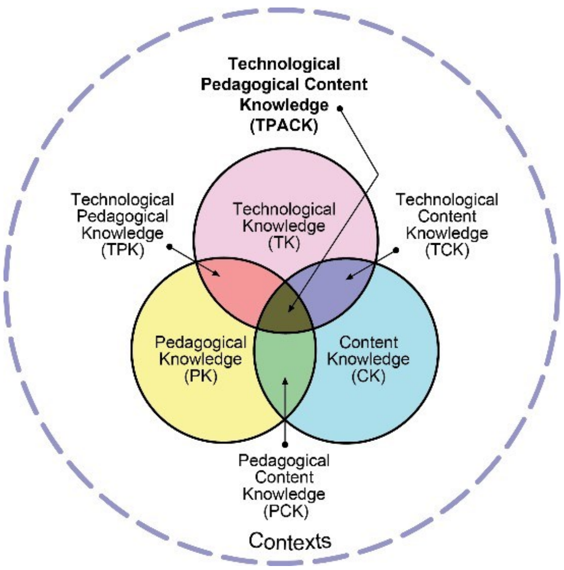

Figure 1. Technological, pedagogical, and content knowledge (image reproduced by permission of the publisher, © 2012 by tpack.org).

The TPACK framework presents a comprehensive picture of key knowledge components a teacher is expected to have in the 21st century as well as dynamic relationships between them. Since the TPACK framework was proposed, "it has inspired teachers, teacher educators, and educational technologists to reevaluate their knowledge and use of technology in the classroom" (Cox & Graham, 2009, p. 60). The framework has been widely used to design teacher education curricula, document in-service and pre-service teachers' technology integration processes, and evaluate learning outcomes. Its application in higher education is still limited in spite of the fact that the framework originated from studies with faculty in higher education.

The actual application of the framework appears to be not as intuitive as it looks. Although Mishra and Koehler (2006) articulated the core of these constructs, the definitions and boundaries of the constructs in TPACK framework are not clear enough for researchers to agree upon what is and is not an example of each construct as some researchers observed (Cox & Graham, 2009; Graham, 2011). This makes it hard to develop coherent research and methods to measure and assess the constructs in the framework (Cox & Graham, 2009; Graham, 2011). This study used the TPACK framework to examine faculty's knowledge. The researcher presents her understanding and examples of the TPACK constructs in the following table (see Table 1). These definitions are based on the researcher's synthesis of the definitions by Mishra and Koehler (2006) and Cox and Graham (2009) and served as the operational definitions for this research.

Table 1

Definitions and Examples of the Technological, Pedagogical, and Content Knowledge Constructs

Constructs	Definition	Examples
CK	Knowledge about the actual subject matter without considering how to teach it	Knowledge about plant biology
PK	Knowledge about the processes, practices, methods or theories of teaching and learning without considering subject content.	Knowledge about how to create authentic learning activities
TK	Knowledge of operating technologies	Knowledge about how to use iPad to take note and shoot videos
PCK	Knowledge about what teaching approaches fit the content, and likewise, knowing how elements of the content can be arranged for better teaching.	Use concept maps to compare and contrast similar plants
TCK	Knowledge about how technology can be used to represent the content in different ways	Use iPad to present pictures of plants
TPK	Knowledge of the affordance of various technologies as they are used in teaching and learning settings and how teaching might change as the result of using particular technologies	Use iPad in a field trip to facilitate authentic learning
TPACK	Knowledge of using technologies to facilitate and support various content teaching and learning	Use iPad in a field trip to facilitate the learning of local plants in an authentic environment

Research on teacher's knowledge in higher education. Application of the TPACK framework in studying higher education faculty's knowledge has been very limited (Benson & Ward, 2013). Only a few studies were found. Garrett (2014) conducted a survey study to investigate higher education faculty's self-assessed TPACK knowledge at a southern university in the United States and found a majority of participants strongly agreed or agreed they had high levels of TPACK. Garrett's study did not explore whether the self-assessment of TPACK was consistent with participants' actual technology integration levels. The author warned the positive results might have been due to the participants' overestimation of their TPACK. Chang, Jang, and Chen (2014) used TPACK as the framework to examine the effects of a professional development program on two higher education physics instructors. They concluded the two professors' TPACK was significantly improved. Benson and Ward (2013) created TPACK profiles of three professors from a school of education through interviews and observations with the goal of understanding the relationship between their TPACK and teaching practices. They concluded the construction of the overlapping areas of TPACK knowledge was free of the development of individual basic knowledge components (i.e., CK, PK and TK); a high level of TK did not ensure the adoption or integration of technology integration; a high level of PK was more important than TK to influence the formation of larger overlapping areas of TPK and further larger TPACK. This case study suggested TPACK levels were related to whether or how much technology was used in teaching but did not explore the relationship between the levels of technology integration and TPACK.

Using a case study approach, Scott (2009) closely compared how an experienced online instructor and a novice online instructor integrated their CK, TK, and PK into the design of learning activities before and after a professional development workshop that introduced the best practices of online teaching. She concluded the mastery of technology skills and the confidence in using technology were key factors that helped achieve the integration of TPACK in an online teaching environment, which was contrary to conclusions Benson and Ward (2013) drew from their study. Rienties, Brouwer, Bohle Carbonell, et al. (2013) used a TPACK survey as an evaluation tool to determine the effect of professional development programs on improving faculty's online teaching skills and TPACK. They observed the participants were more confident about their abilities to integrate technology into their content teaching and the participants' TPACK was improved after training. They believed that to emphasize using technology the participants were familiar with the reasons for their success. No observations were conducted to determine whether the improved confidence actually translated into the actual integration of technology or improved their technology integration skills or levels in real teaching situations. These studies showed more research regarding higher education faculty's TPACK and its influence on their technology integration was needed. Currently, no study has been found that investigates the relationship between higher education faculty's TPACK and their technology integration levels in terms of the SAMR model.

Teacher's knowledge and technology integration in higher education. Higher education faculty are usually recruited due to their academic achievements instead of teaching competencies. This practice decides the special characteristics of higher education faculty's TPACK in general. Faculty members' content knowledge is usually the strongest among the three knowledge components of TPACK because of decades of systematic study and research in their subject areas. Faculty's pedagogical knowledge is often developed through the process of "learning by doing," e.g., through observing their teachers and their peers, interactions with their students, reflection of their own practices, and personal experiences (McAlpine & Weston, 2000). This pedagogical knowledge gained from practice is also often called “craft knowledge” (Grimmett & MacKinnon, 1992; Van Driel et al., 1997). Faculty’s craft knowledge guides their teaching practice and is usually resistant to change (Grimmett & MacKinnon, 1992). This partially explains why two faculty with similar content knowledge training might teach using dramatically different methods (Entwistle & Walker, 2002).

Most current faculty in higher education were born before the advent of digital technology. As digital immigrants, their adoption and integration of technology are not as intuitive as digital natives who were born and grew up in a technologically-intensive environment, especially when learning and using new and emerging technology. Technological knowledge is usually another weak chain in faculty’s knowledge system that prevents them from adopting and integrating technology into teaching. A number of studies suggested faculty’s self-efficacy of technology competence is one of the major factors that influences their intention of using technology for instruction (Cooper-Fisher, 2015; Georgina & Olson, 2008). For faculty who actually use technology for instructional purposes, those with a higher technology proficiency tend to integrate technology more frequently and use a larger range of technology than those who do not (Georgina & Olson, 2008; Zayim et al., 2006). Some researchers found faculty who had fewer teaching years or ranked lower than professor were more likely to use technology during teaching (Lehman, 2014; Zayim et al., 2006). This is understandable considering younger generations of faculty are more likely to be exposed to digital technology in their personal and academic lives. Because of this, they gained more technological knowledge and had higher levels of confidence, comfortableness and competence when using it.

It should be noted that high technological proficiency or rich pedagogical knowledge alone do not guarantee faculty will readily use technology effectively. Teacher educators who had a systematic pedagogical training and K-12 teaching experiences before teaching at college levels were often found to lack technology knowledge or had low integration levels (Georgina & Olson, 2008; Kalonde, 2014; Sahin &Thompson, 2006). Earlier professional training models that focused solely on improving faculty's technological knowledge usually failed to change faculty technology adoption or integration significantly (Benson & Ward, 2013). These findings indicated the key to effective technology integration lies in a deep understanding of the dynamic relationship and interaction of the three types of knowledge as a holistic system and the ability to employ this systematic knowledge when addressing a particular teaching situation. Technological, pedagogical, and content knowledge is a new, comprehensive knowledge rather than a simple addition of three individual knowledge concepts (Mishra & Koehler, 2006). Higher education faculty usually need to improve the two weak chains (PK and TK) in their knowledge system to balance the three circles (CK, PK, and TPK) and enlarge the overlapping areas.

Pedagogy

Pedagogy is "the process and practice or methods of teaching and learning, including the purpose(s), values, techniques or methods used to teach, and strategies for evaluating student learning" (Koehler et al., 2007, p. 743). Scholars and educators usually associate the term *pedagogy* with some particular teaching approach (e.g., problem-based learning) or learning theory (e.g., constructivist pedagogy). The formation and development of pedagogy are heavily influenced by teachers' beliefs and knowledge as well as the teaching environment. Pedagogy is a bridge that connects what faculty believe and know with what they actually do.

The Formation and Development of Pedagogy in Higher Education

It is a generally accepted fact that faculty in higher education have little formal training on how to teach (Brownell & Tanner, 2012; Sunal et al., 2001). The majority of faculty in higher education are trained exclusively as researchers instead of teachers. Even though a certain amount of faculty gained some teaching experience by working as teaching assistants during their graduate study, their teaching practices were usually "given no direction about what or how to teach, no assistance or supervision during the process, and no feedback about how they had done" (Mertz & McNeely, 1990, pp. 12-13). Due to the lack of systematic formal study or on-the-job training, professors' pedagogy is usually limited by their conceptualization of teaching and learning developed from personal experiences as students, researchers, and instructors within a certain content area. As some researchers observed, a traditional teacher-centered teaching style remained remarkably stable in higher education across the world in the past decades (Feixas & Zellweger, 2010; Watts & Schaur, 2011). Some major factors have been found to influence faculty's pedagogy formation and development.

Teachers' beliefs and pedagogy. Faculty's pedagogies are often influenced by their conceptualization of teaching and learning (teachers' beliefs), which are usually associated with teacher-centered and student-centered approaches to instruction (Entwistle & Walker, 2002; Kember & Kwan, 2002; Samuelowicz & Bain, 1992, 2001; Trigwell et al., 1994; Van Driel et al., 1997). According to Hancock, Bray, and Nason (2002), teacher-centered pedagogy means the teacher

> (a) is the dominant leader who establishes and enforces rules in the classroom; (b) structures learning tasks and establishes the time and method for task completion; (c) states, explains, and models the lesson objectives and actively maintains student on-task involvement; (d) responds to students through direct, right/wrong feedback, uses prompts and cues, and, if necessary, provides correct answers; (e) asks primarily direct, recall-recognition questions and few inferential questions; (f) summarizes frequently during and at the conclusion of a lesson; and (g) signals transitions between lesson points and topic areas. (p. 366)

For student-centered instruction,

> (a) teachers are a catalyst or helper to students who establish and enforce their own rules, (b) teachers respond to student work through neutral feedback and encourage students to provide alternative/ additional responses, (c) teachers ask mostly divergent questions and few recall questions, (d) students are allowed to select the learning task and the manner and order in which it is completed, (e) students are presented with examples of the content to be learned and are encouraged to identify the rule of behavior embedded in the content, (f) students are encouraged to summarize and review important lesson objectives throughout the lesson and at the conclusion of the activity, (g) students are encouraged to choose new activities in the session and select different topics for study, and (h) students signal their readiness for transition to the next learning set. (p. 367)

These conceptions tend to be on a continuum rather than clear-cut categories. For example, Kember and Kwan (2002) concluded there are two big groups of faculty conceptions or beliefs on “good teaching” in higher education: teaching as transmission of knowledge (teacher-centered) and teaching as learning facilitation (student-centered)., There are two levels within the transmission category: teaching as passing information and teaching as making it easier for students to understand. Within the facilitation category, there are also two levels: teaching as meeting students’ learning needs and teaching to facilitate students in becoming independent learners.

A consistent finding derived from previous studies was faculty’s conceptions of teaching and learning strongly influenced their preference of pedagogical approaches (Entwistle & Walker, 2002; Lucas, 2005; Northcote, 2010). Teachers with more teacher-centered beliefs tended to use direct instructional pedagogy more, e.g., teacher presentations, demonstrations, and lectures, while those with more student-centered beliefs were inclined to employ a variety of approaches to encourage knowledge construction such as collaborative learning and problem-based learning. Many faculty tended to combine elements from both teacher-centered and student-centered approaches. Depending on the degree of the elements adopted from those two ends, some might be more teacher-centered and some might be more student-centered.

Teachers' knowledge and pedagogy. Teachers' knowledge is another basis that influences the formation and development of pedagogy. As mentioned in previous sections, higher education faculty's teaching knowledge is usually gained through their experiences as a student and instructor. They often teach in the way they were taught. Due to the fact that teacher-centered methods are still dominant in higher education, the majority of faculty usually adopt the methods as well. Training before and during teaching is one of the most commonly cited methods to improve faculty's knowledge in order to develop student-centered pedagogy in higher education (Sunal et al., 2001). A review of literature showed ongoing professional development combining multiday workshops (seminars) with follow-up and monitoring could be critical strategies for promoting significant changes in faculty's pedagogical beliefs, knowledge, and teaching practices (King, 2002a; Kitchenham, 2006; Steinert et al., 2006; Sunal et al., 2001).

Worthy of note is faculty's beliefs are not always consistent with their actions. For example, Steinert et al. (2006) conducted a rigid literature review of studies that focused on professional development program evaluation. Almost all of the studies (N =303) included in the literature review indicated the participants perceived positive changes, either in knowledge or beliefs, after training. However, the results became inconsistent when more rigid research methods, such as class observation, were used instead of self-reports. Steinert et al. (2006) found nine studies had employed student ratings and class observations as additional data collection methods beside surveys and interviews; five studies yielded consistent results with the self-reported data and four were inconsistent. Brinkerhoff (2006) found two years of training on technology integration significantly changed faculty's beliefs, attitudes, and confidence of technology integration but did not affect their teaching practices. Ebert-May et al. (2011) found large discrepancies between what faculties said they did and what they actually did through a comparison of data obtained from self-reported questionnaires, interviews, and class observations after a large scale, multi-day professional development program designed to promote active learning pedagogy among faculty of science at universities across the United States. Inconsistent results reported from previous studies indicated a gap between what teachers believed and knew and what they actually did. Faculty's active pedagogy was not always consistent with their beliefs and knowledge.

Teaching environment, discipline culture, and pedagogy. Some researchers found teaching environments influenced teaching methods faculty actually used (Adler, Milne, & Stringer, 2000; Leveson, 2004; Prosser & Trigwell, 1997). University teachers' pedagogy was correlated to how they perceived their teaching context (Prosser & Trigwell, 1997). Teachers tended to adopt more student-centered teaching methods when they perceived high teaching autonomy, small class size, and department support for good teaching. Some major contextual obstacles to the shift from teacher-centered to learner-centered approaches were large class-size, lack of department incentive policy for good teaching, lack of student readiness, non-reflective teacher practices, and university culture (Adler et al., 2000; Ebert-May et al., 2011; Leveson, 2004). Elen, Lindblom-Ylanne, and Clement (2007) discovered two features of teaching in research-intensive universities: (a) research was emphasized more than student-centered teaching, and (b) the link between research and teaching was fundamentally based on and directed by faculty epistemological dispositions.

Discipline culture was also reported to influence faculty's pedagogy. Based on a 20-year longitudinal study, Watts and Schaur (2011) found economics faculty in the United States heavily depended on lecture as the main teaching method (83%)--about 32% higher than the national norm of 51% (Eagan et al., 2014). The 2013-2014 Higher Education Research Institute report (Eagan et al., 2014) also identified a large difference between disciplines in the ways of teaching and assessment. Faculty from science disciplines (e.g., math, statistics) used teacher-centered teaching methods and assessment methods more frequently than those from social science or arts (e.g., political science, fine arts, English; Eagan et al., 2014). This phenomenon was probably because of the years of training faculty received as students during subject learning. It might also be related to how faculty considered themselves as researchers and teachers. Brownell and Tanner (2012) found biology faculty's professional identities were situated in and framed by their discipline and might interfere with pedagogical change. The professional culture of sciences considers teaching to be of a lower status than research. To fit into the culture, faculty prefer to be considered as scientists rather than teachers. Thus, when faculty perceive their professional identities are not compatible with certain teaching methods or they feel adopting innovative teaching methods would put their professional identities at risk among the norms of their peers, they might keep their current teaching style.

McKissic (2012) found faculty members' integration of technology into the classroom was influenced by subject matter in the context of university and departmental cultures. Faculty who taught content in the sciences were most likely to integrate technology into classroom instruction while the arts and humanities disciplines reported a lower extent of integrating innovative technology into their teaching strategies. McKissic found some conflicted results between quantitative and qualitative data. Quantitative data reported individual motivators for faculty as a collective community were related to perceptions within the department although case studies of individual faculty members suggested the strongest influence on faculty members' personal beliefs about effective teaching and levels of technology use was the individual's disposition rather than department perceptions and expectations. Hora and Holden (2013) found adoption, adaptation, or rejection of technology-based innovations among math, biology and physics faculty was influenced by the alignment of technology with the cultural conventions of the disciplines.

Pedagogy and Technology Integration

Pedagogy influences technology integration. Research showed personal pedagogy influences technology integration. Kirkup and Kirkwood (2005) examined large-scale survey data collected over a decade among faculty at the United Kingdom Open University and concluded the majority of the faculty mostly used technology to replicate or supplement existing teaching practices rather than radically change them. They stated the reason why some technological innovations were adopted by the majority of these faculty was because they functioned as tools within the existing pedagogy (e.g., improved presentation quality or an online repository of course resources) or they offered an improvement on existing tools in the system (e.g., making external resources available in the classroom or enabling learners to access materials whenever they chose). They found even though late adopters' knowledge or beliefs might have been changed in the process of adopting or adapting to new tools, the nature of that change, i.e., their pedagogy and teaching practices, was seldom fundamental. An early study by Pierson (2001) on K-12 teachers also suggested teachers' general teaching expertise greatly affected their technology integration levels. Teachers with higher teaching abilities and more student-centered pedagogy tended to use technology in more innovative ways (Pierson, 2001). Early training that focused on improving faculty's technological skills was often unsuccessful in promoting adoption and adaption of technology for higher level integration due to the lack of connections with pedagogy and classroom practices. Some researchers also pointed out one main reason why technologies have not been seen to influence students' learning fundamentally was they were not used at levels that could bring about a positive transformation in learning (Ng'Ambi, 2013). These studies implied technology itself is hard to bring about fundamental changes in teaching and learning. To increase faculty technology integration levels, a significant change in faculty's pedagogy needs to take place.

Technology integration influences pedagogy. On the other hand, some research studies also showed teaching with technology might trigger the reconceptualization of ways in which teachers teach (Ertmer & Ottenbreit-Leftwich, 2010; Pierson, 2001; Schrum, 1999) and could serve as a catalyst for the shift or expansion of teachers' existing pedagogical beliefs and knowledge to further change their pedagogy and teaching practices (King, 2002a, 2002b; McQuiggan, 2011; Whitelaw et al., 2004).

It should be noted that although teaching with technology has been reported to have a positive influence on teachers' pedagogy and teaching practices, some researchers also pointed out technology should not be taken as the agent of change (Fisher, 2006). Evidence showed teachers with high technology proficiency might not be able to integrate technology in a pedagogically-sound way and remain at low levels of integration aligned with their traditional teacher-centered teaching approaches (Ertmer & Ottenbreit-Leftwich, 2010; Kirkup & Kirkwood, 2005 Pierson, 2001). It has to be the teacher who acts as the agent of change.

Summary

Literature showed a correlation between TPACK, pedagogy, and technology integration levels. On the one hand, teachers' beliefs and knowledge influence the perceived value of using technology for teaching and further influence their intention for adoption or rejection of technology (Ajjan & Hartshorne, 2008; Hora & Holden, 2013; McKissic, 2012; Mumtaz, 2000). When environmental readiness is equal, teachers' beliefs and knowledge are key factors that influence their pedagogy, i.e. whether and how they use technology in teaching (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Kim et al., 2013; Mumtaz, 2000). On the other hand, technology integration might trigger faculty's reflection on the ways in which they teach, serve as a catalyst for the shift or expansion of teachers' existing beliefs and knowledge, and further influence their pedagogy and teaching practices. Exploration of the dynamic relationship among teachers' knowledge, pedagogy, and technology integration would help understand the phenomenon and provide information for faculty developers and senior administrators on how to help faculty improve their teaching expertise with technology.

Technology Integration Model

The SAMR model was chosen as the framework for this study to evaluate faculty iPad integration levels because of its emphasis on pedagogy during the process of technology integration.

An Introduction to the Model

Developed by Dr. Ruben Puentedura (2006), the SAMR model is a framework that aims to help educators plan and evaluate their technology infusion practices during teaching for transforming learning experiences that result in higher levels of achievement for students. The acronym SAMR stands for substitution, augmentation, modification, and redefinition (see Figure 2).

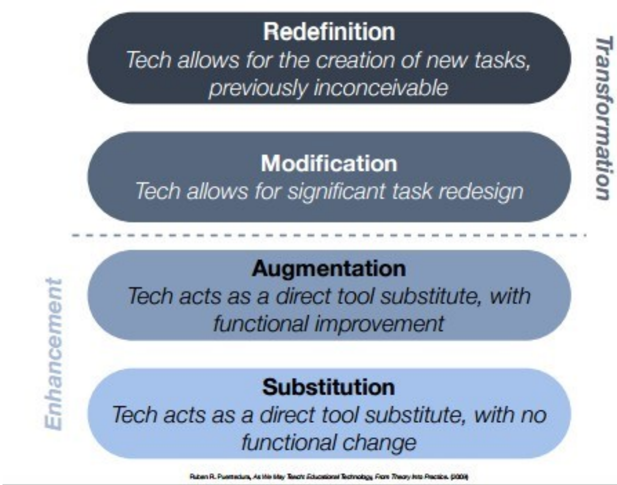

Figure 2. SAMR model (image reproduced by permission of the publisher, © 2006 by Dr. Ruben Puentedura).

In this model, technology integration is classified into two categories and four levels. The four levels in the model are presented by the creator as a form of a ladder that indicates the levels of student learning outcomes and engagement by doing the learning tasks. In this model, technology is not the key element that defines the levels of integration. Instead, it is how a teacher uses technology that defines the levels. It should be noticed that not all learning tasks supported by technology have to or be able to reach the redefinition level. Usually the higher levels of integration are built upon the lower levels of integration. Teachers often integrate technology at different levels to realize different levels of learning objectives (Puentedura, 2006). For example, to enhance students' understanding of a novel, a teacher might ask students to use iPads to read the novel and pick a character they are interested in (a substitution of printed books with no functional improvement). The teacher would then ask students who are interested in the same character to create a concept map with an iPad app that allows collaborative editing in a group to demonstrate their understanding of a character (an augmentation of paper-pencil concept map with functional improvement). After that, students would then be asked to create a group Wiki page to comment on the character they chose with their concept map and then select other multimedia materials to support their argument. They would share their Wiki page with their peers for comments and critique. This is a modification of the original individual essay writing activity into collaborative writing. Through critique, comments, and revisions, students are also exposed to social writing. At the end of the unit, the teacher would ask students to create a comic strip to illustrate their ideas of different endings of the novel and share it on their Wiki page for anybody interested in providing comments and critique. Reaching a global audience advances technology integration into a redefinition level before deemed inconceivable. However, although there are no "bad" levels in the model (Puentedura, 2012), higher levels (modification and redefinition) were reported to be more effective in enhancing students' engagement than lower levels (Bloemsma, 2013).

Research with the Model

Ever since it was developed by Puentedura (2006), the SAMR model has been used as a theoretical framework to guide and evaluate teaching practices with technology, mostly in K-12 education. Research utilizing the SAMR model was very limited but current studies showed the potential of this model in evaluating technology integration levels with the emphasis on pedagogical consideration. For example, Jude et al. (2014) adopted the SAMR model to evaluate the pedagogical adoption of technology at Makerere University, Uganda. Lindsay (2015) used the SAMR model as a framework to evaluate m-learning pedagogical approaches among New Zealand K-12 educators and found the predominant pedagogical approaches using mobile technology were substitution and augmentation. Aiyegbayo (2015) conducted a mixed-method study to investigate why faculty did or did not use the iPad for teaching. The SAMR model was used in this study to identify iPad integration levels of 11 faculty using iPads as an instructional tool. The results showed the majority of iPad usage was at the augmentation level. No usage at the modification and redefinition levels was found. Cavanaugh et al. (2013) used the SAMR model to detect changes in iPad integration levels among faculty who had participated in two professional development programs on iPad integration in six months. They found a significant difference in SAMR levels with a shift to higher levels of integration after six months of iPad implementation. Bloemsma (2013) investigated how iPad activities influenced high school students' engagement in classrooms in a case study. The author categorized iPad learning activities by using the

SAMR model and further identified the relationship between levels of iPad integration and student engagement. He found students reported being more engaged in activities that were at the redefinition and modification levels. The SAMR model was also used to guide the design of training for teachers who participated in a 1:1 iPad deployment project (Chou, Block, & Jesness, 2012).

In spite of its popularity, the SAMR model has been also questioned by some researchers and scholars due to the lack of published research evidence to support its validity (Green, 2014; Linderoth, 2013). The lack of published work that thoroughly explains the theoretical basis and its applications also becomes one of the reasons why people understand and use the model in an inconsistent way. Some researchers appear to consider “tech” in the model as digital technology in contrast to non-digital tools. Thus, their categorization of the integration levels is based on how digital technology is used to achieve the same learning objectives more efficiently or more effectively compared to traditional practices using non-digital tools (e.g. Aiyegbayo, 2015; Cavanaugh et al., 2013; Jude et al., 2014). Some other researchers appeared to believe “tech” included digital and non-digital technology (e.g., Lindsay, 2015). Naturally, an augmentation for a non-digital tool might be a substitution for a digital tool. Classification of the integration levels turns into how a particular emerging tool is used to modify or transform an old learning process in terms of efficiency and effectiveness compared to those supported by old tools, either digital or non-digital.

Another reason why people classify the same learning activity into different levels might be because of the vagueness of the criteria for evaluation. In several presentations, Puentedura (2010, 2012) stated the difference between the lower and higher levels lay on whether the technology allowed the redesign of an old learning activity to promote deeper learning. Based on the example he gave during these presentations, he appeared to believe the redesign involved a shift from teacher-centered instructional methods to student-centered instructional methods and changes in student learning processes. No evidence was found in which Puentedura clearly specified distinct criteria for what elements should be taken into consideration while using this model in evaluating technology integration practices, which partially caused some inconsistent use and even misunderstanding across research and practices.

Modification of the Model

The SAMR model was chosen as the framework to evaluate iPad integration levels in this study because the model encourages pedagogical consideration while using digital technology to enhance high levels of student achievement. To avoid misunderstanding and make the level classification more explicit and consistent during the evaluation process, the researcher provides criteria used to determine iPad integration levels in this study (see Table 2).

Table 2

SAMR Model Levels and Categories

		Category			
		Efficiency ①	Instructional methods②	Student learning process ③	Inconceivable-ness④
Levels	Substitution	N	TC	IL	C
	Augmentation	Y	TC	IL	C
	Modification	Y	SC	SL	C
	Redefinition	Y	SC	SL	IN

Note. ① N = "no change"; Y = "change" ② TC = "Teacher-centered"; SC = "Student-centered" ③IL = "Individual Learning"; SL = "Social Learning" ④ C = "Conceivableness"; IN = "Inconceivableness"

Efficiency means the use of digital technology improves efficiency of learning with functional improvements compared to non-digital tools used for the same learning process.

Instructional methods refer to teacher-centered or student-centered instructional methods. The teacher-centered approach emphasizes knowledge transmission. Teachers' main roles are to organize and present instructional materials for students to receive and a student's role is to receive knowledge. Teachers who prefer teacher-centered instruction usually rely heavily on lectures, demonstrations, and direct instruction as main teaching methods. Student-centered approaches emphasize learning as students construct meaning based on their current knowledge of the content and through participation in carefully chosen tasks provided by the teacher. The responsibility is given to students as they are empowered by the teacher while at the same time guided by the teacher's expertise. Some student-centered instructional methods include but not limited to collaborative and project-based learning.

Student learning process refers to how students conduct their learning, whether they work individually or cooperatively, why they strictly follow the teacher's instruction, or are given opportunities to personalize their learning activities and process.

Inconceivableness means the technology allows a learning process that ranges from impossible to possible and the new task has the potential to improve student learning.

Table 2 showed the four categories about teaching and learning change at different SAMR levels. At the substitution level, technology is merely used as a substitution for the old non-digital tool. Technology is used to support teacher-centered teaching and a student's individual learning; the use of technology does not improve the efficiency of the teaching or learning process. At the augmentation level, technology is still used to support teacher-centered teaching and a student's individual learning process. However, the use of technology significantly increases the efficiency of the teaching or learning process. At the modification level, technology integration supports student-centered teaching methods and a student's cooperative learning process. The teaching or learning process is conceivable by using traditional non-digital tools for the first three levels of the SAMR model. Finally, at the redefinition level, technology is used to support student-centered teaching methods and a student's cooperative learning process. The teaching or learning process is inconceivable by using traditional non-digital tools.

Mobile Learning in Higher Education

What is Mobile Learning?

Although interest in mobile learning has grown exponentially in the past decade, the definition of mobile learning is still not clear (Laouris & Eteokleous, 2005; Traxler, 2007). Deep debates have been ongoing among scholars as to which attributes should be included in the definition of mobile learning (Crompton, 2013). As Traxler (2007) observed, scholars have defined and conceptualized mobile learning mainly from three perspectives:

a) in terms of devices and technology: e.g. "any educational provision where the sole or dominant technologies are handheld or palmtop devices" (Traxler, 2005, p. 262);
b) in terms of the mobility of learners: e.g., "Any sort of learning that happens when the learner is not at the fixed, predetermined location, or learning that happens when the learner takes advantage of learning opportunities offered by mobile technologies (O'Malley et al., 2003, p. 6);
c) in terms of the learners' experience of learning with mobile devices: e.g., "as a process of coming to know, by which learners in cooperation with their peers and teachers, construct transiently stable interpretations of their world" (Sharples, Taylor, & Vavoula, 2007, p. 225).

No matter how mobile learning is defined, one thing is clear--mobile devices play an important role in the realization of mobile learning in and out of the classroom. This study borrowed Traxler's (2011) newest and simplest definition: "mobile learning is learning with mobile devices" (p. 4) as the operational definition of mobile learning. Mobile devices include smart-phones, tablets, netbooks, and handheld computers.

Why Mobile Learning?

Learners' characteristics. The EDUCAUSE report (Dahlstrom et al., 2013) revealed the rapid increase of smartphone and tablet ownership among college students with 75% owning smartphones and 31% owning tablets. It was also noted that 58% of students owned three or more internet-capable devices (Dahlstrom et al., 2013). Just like college students in 2010 do not remember a time when the Internet was not around, students in 2030 will not remember a time without mobile devices. For the iGeneration born after the mid-1990s (Rosen et al., 2010), mobile devices are just as natural and common as desktops for most people nowadays.

College students show more interest and expectations in using mobile devices for learning as their interest of and familiarity with them has increased. The second annual report conducted by McGraw-Hill Education in 2014 (Communications Team, 2015) found 81% college students use portable mobile devices to study. Among all mobile devices, tablets have advanced most rapidly. Students perceived tablets will emerge as powerful learning devices because they are small and portable (and thus easy to bring to campus) while the screen size allows one to retrieve and compose information more easily than small mobile devices (Chen & Denoyelles, 2013). Chen and Denoyelles (2013) found tablets were used for academic purpose more often than smartphones although tablet ownership was still lower than that of smartphones--82% of students who owned a tablet used it for academic purposes compared to 58% for smartphones. According to the Pearson Student Mobile Device Survey (2015), college students believe tablets can transform the way they learn in the future (83%), make learning more fun (79%), and help them learn more efficiently (68%). When asked about their future use of mobile devices in class, 40% of students indicated they would like to use mobile technologies more often than they do now (Pearson Student Mobile Device Survey, 2015).

Advantages of mobile learning. Mobile learning has great potential to enhance learning if used properly. Based on a literature review, Melhuish and Falloon (2010) indicated mobile devices could offer distinct affordances for education: portability, affordable and ubiquitous access, situated, "just-in-time" learning opportunities, connection and convergence, and personalized learning. The authors suggested,

> In many ways mobile technologies have the capacity to stimulate a redefinition of what constitutes a learning "space," away from the constraints of fixed place and time, towards a conceptualization based on connecting people with each other and information, through virtual collaborative spaces and communities which are highly fluid, and not bounded by time or location. (Melhuish & Falloon, 2010, p. 3).

Rachel, Cobcroft, Towers, Smith, and Bruns (2006) concluded mobile devices could be used to motivate learners' engagement, promote social constructivist learning through providing student opportunity to learn skills and theories in context, provide new ways for students to collaborate and communicate in and out of classroom, and promote learner-led content building, expansion, and creation because of its flexible, ubiquitous access to information and web-based tools. Traxler (2011) echoed Rachel et al.'s observation and stated mobile learning offers new learning opportunities for learners**:**

> 1. contingent mobile learning and teaching, where learners can react and respond to their environment and their changing;
> 2. situated learning, where learning takes place in surroundings that make learning meaningful;
> 3. authentic learning, where learning tasks are meaningfully related to immediate learning goals;
> 4. context-aware learning, where learning is informed by the history, surroundings and environment of the learner;
> 5. personalized learning, where learning is customized for the interests, preferences and abilities of individual learners or groups of learners. (pp. 6-7)

Mobile devices' potential for education largely depends on the design of learning materials and activities aligned with mobile devices' affordances and mobile learning theories “rather than focusing solely on content, engagement, or ‘edutainment’” (Melhuish & Falloon, 2010, p. 3). Currently, mobile learning in higher education is conducted mostly by students themselves out of class. However, to realize these new learning opportunities, educators’ involvement is necessary and critical.

IPad Integration in Higher Education

The iPad has dominated the tablet market since its release in 2010. As of 2013, iPad still holds 63% of the tablet market for personal use (Smith & Caruso, 2013) and more than 94% for educational use (Cheng, 2013), although a number of new tablets have been released in the past five years. Many universities and colleges started to implement iPad pilots to explore the potential of iPads to support teaching and learning in higher education,

IPad Deployment in Higher Education

Based on the scale of the deployment, iPad deployment could be classified as whole campus initiatives and small-scale pilots. Examples of whole campus deployment might be Seton Hill University, Illinois Institute of Technology, Lynn University, and Abilene Christian University, to name just a few. Seton Hill University started to implement a 1:1 iPad initiative across its campus in the fall of 2010 (Gawelek, Spataro &Komarny, 2011). All full-time students, full-time faculty, student affairs, and academic support service staff were issued iPads. Illinois Institute of Technology started its deployment with all incoming freshmen and their instructors in 2010 (Illinois Institute of Technology, 2011). Abilene Christian University (iPad Study, 2011) has been conducting campus- wide 1:1 deployment of mobile devices since 2008, starting from iPhones and iPod touches and transitioning to iPads in 2010. The university decided to expand its iPad deployment to every department on campus in 2013 because of encouraging results gained from the first two-year pilot studies. Each first-year student is required to purchase an iPad2 or newer device and faculty members across campus are required to focus on infusing the curriculum with iPad-enhanced teaching and learning.

Besides whole campus deployment, some schools in universities became early adopters. Oklahoma State University (2011) started its iPad pilot among faculty and students from five courses in the School of Media and Strategic Communications and the Spears School of Business in the fall of 2010. The University of Minnesota experimented with 1:1 iPad integration among 500 students within College of Education and Human Development (Wagoner, Schwalbe, Hoover, & Ernst, 2012). Some universities combined iPad and BYOD (Bring your own device) programs. For example, instead of issuing iPads for both faculty and students, Houston Community College (2013) decided to provide iPad minis just for their 200 adjunct faculty in the spring of 2013. Students were encouraged to use their own mobile devices to interact with faculty during classes.

Some universities started small-scale iPad pilots within selected courses. At these universities, the coordinators of the iPad implementation were usually the Center of Teaching and Learning or the library. The Center purchased iPads and invited faculty and students to check them out as an instructional or learning tool. Selected faculty and their students were provided iPads to use during a semester. Faculty usually needed to apply for participation in the pilots and were asked to submit a report or conduct a presentation to share their experiences and findings among other faculty or stakeholders at the completion of the project due to the limited number of iPads. Many universities appear to be using this model, i.e., George Fox University, Indiana University, Lafayette College, Oberlin College, Reed College, University of Maryland, University of Notre Dame, Washington College, and Pittsburg State University. Several cases of small-scale iPad pilots were conducted by a few university libraries (Capdarest-Arest, 2013; Hahn & Bussell, 2012; Maloney & Wells, 2012).

Universities and schools stated different purposes for iPad implementation. For Seton Hill University, the purpose of the large scale iPad implementation was

> to create a teaching and learning environment that would go beyond the confines of the traditional classroom in time and space, enable instantaneous access to information and deepen critical and creative thinking through interactive teaching strategies. (Gawelek et al., 2011, p. 29).

The Oklahoma State University pilot aimed to determine the expense impact, how the device was used, viability as an E-Reader, and the overall enhancement to a student's academic experience (Oklahoma State University, 2011). The University of Minnesota stated its purpose was to determine iPad use related to student retention, engagement, and learning outcomes (Wagoner, Hoover, & Ernst, 2011). The main purpose of Houston Community College (2013) was to take attendance and aid lesson planning and digital materials distribution and lectures. The School of Education at George Fox University (Teaching Program, n.d.) selected candidates in the Master of Arts in Teaching program for their iPad pilot study. Their rationale was to prepare future teachers as far ahead of the educational curve as possible and reduce the expense on print textbooks. The Center of Teaching and Learning at Indiana University stated the aim of iPad pilots was to explore best practices in teaching and learning with iPads through faculty learning communities (Rossing et al., 2012). Reed College selected one course to conduct a 1:1 iPad pilot study in the fall of 2010 (Marmarelli & Ringle, 2011). The purpose was to compare iPads with Kindle DX and determine which would be a better e- reader.

A few universities released their reports to summarize the results of iPad initiatives or pilots. These reports identified both positive and negative aspects of iPad integration. For example, Indiana University's report (Morrone et al., 2012) stated both the main benefits and barriers of using iPad in teaching and learning. The main benefits included enhancing student interest and creative exploration, facilitating the creation of innovative and effective learning environments, facilitating visual representations and active learning, providing access to and manipulation of digital content, and delivering practical applications inside and outside the classroom. The barriers included increasing the student learning curve, increasing the burden on instructors, and providing less functionality (but more promise) than laptops (Morrone et al., 2012). Reed College's report (Marmarelli & Ringle, 2011) showed iPads had better features as e-readers than Kindle DX. Oberlin College (Rose, 2011) decided to cancel the project after piloting iPads in five courses for an academic year because the evaluation showed the shared iPad cart model went against the very design of the product as a personal device and severely hindered the actual power of the devices. However, there was tremendous value for what the iPad contributed to the teaching and learning process (Rose, 2011).

The initiatives, pilots, and full implementation discussed above show iPad integration in higher education is still in the exploratory stage. The majority of universities started their projects without setting up clear pedagogical goals or integration plans. A considerable number of pilots used iPads mainly as e-readers and internet surfing devices. Many stated the main purposes were to reduce the cost on print textbooks, copying learning materials, and administration expenses. iPad integration needs to move forward from the exploratory stage to a higher level integration to justify the expense of the devices and release the potential of the device to benefit students and faculty in a more transformative way. A deeper understanding of the relationship among faculty's knowledge, pedagogy, and integration levels after a long-term iPad integration was needed to inform faculty, administrators, and faculty developers how to support and improve iPad integration.

IPad Research in Higher Education

A thorough review of current publications was conducted by the researcher in order to have a more accurate picture of iPad integration for instructional purposes in higher education in the United States. The results echoed Nguyen et al.'s (2014) observation that research about iPad integration in higher education is still fragmented and at an early exploratory stage. Current literature provided valuable information on the iPad integration process and also showed limitations that need to be addressed in the future. To date, literature showed iPads have been mainly used in the following ways: accessing information, collaboration, and content generation.

Accessing information. Murphy (2011) found from 2010 to 2011, iPads were most commonly used as a course material delivery and Internet surfing tool in higher education. The trend has not changed since then (Nguyen et al., 2014). With built-in multimedia functions, a big screen, e-reading apps, and Internet connectivity, iPads enable ubiquitous access to digital course materials and web-based information including but not limited to e-texts, slideshows, videos, podcasts, simulations, quizzes, and other Web-based resources. Storage of all materials for one course and multiple course materials on one single device brings convenience for students who can access them anytime and anywhere (Alyahya & Gall, 2012; Archibald et al., 2014; Compomizzi, 2013; Hahn & Bussell, 2012; Kinash et al., 2011; Lewis, 2013; Mang et al., 2012). The substitution of traditional print textbooks and reading materials with digital resources has reduced students' expenses, saved paper, and helped create a paperless learning environment (Alyahya & Gall, 2012; Geist, 2011; Hesser & Schwartz, 2013). Well-designed reading apps not only allow students to highlight, annotate, and take notes on digital texts but also provide more advanced functions such as key word search or note sharing and exportation (Geist, 2011; Morrone et al., 2012). Interactive multimedia contents embedded in e-texts (e.g., interactive graphics, simulations, animation, video/audios) were perceived to be effective in improving students' understanding and engagement with learning materials (Giunta, 2012; Johnston & Marsh, 2014). Instant access to Web-based information during class time was found to encourage academic engagement (Mang et al., 2012). Students using iPads were observed to be less likely to engage in off-topic activities than laptops (Fisher et al., 2013; Mang et al., 2012).

Collaboration. Instant access to course materials and Internet information through iPads was found not only beneficial for individual learning but also enhanced students' group work (Davies, 2014; Geist, 2011; Mang et al., 2012; Rossing et al., 2012; Wakefield & Smith, 2012). Davies (2014) provided iPads to students within his seminars so they could access assigned reading materials to prepare for group discussion and presentations. The survey results showed students perceived iPads had increased peer interactivity, group cohesion, presentation skills, and learning engagements (Davies, 2014). Rossing et al. (2012) conducted survey research across different disciplines to explore more than 200 students' perceptions of iPad-supported learning activities in classes. They concluded these iPad-supported activities promoted greater interactions between students during in-class activities, expanded group discussions through extensive search and access of information beyond the wall of the classroom, accommodated different learning styles and learning paces, and increased engagement to a degree hard to achieve by the traditional lecture-discussion learning model. Besides students' perceptions, faculty also perceived students' engagement had increased iPad-supported discussion activities than the same activities without using iPads (Morrone et al., 2012). Fisher et al. (2013) found students who used iPads conducted less off-topic activities and spent more time on interacting, sharing information, and showing progress with each other than those who used laptops during group work. The researchers argued the physical features of the device made it much easier to be used to facilitate communication among multiple students who could view, discuss, and interact with each other and with the device simultaneously (Fisher et al., 2013). Instant access of productivity apps, such as emails, text editing tools, and Dropbox, made sharing and collaborative working among students more efficient (Giunta, 2012). Besides the in-class collaboration, iPads have also been considered an essential tool to stay in touch and maintain effective communication with team members and instructors outside of class (Lewis, 2013).

Content generation. The multimedia functions and various apps that run on iPads provide students with an opportunity to capture learning moments and generate content with this one single device anytime and anywhere. Students reported PDF annotation tools, notetaking apps, and camera functions of iPads enabled them to take not only textual notes during lectures but also record observations in the format of graphics, audios, and videos, which could be easily combined into other e-texts for later review (Hesser & Schwartz, 2013; Mang et al., 2012; Sachs & Bull, 2013; Youm et al., 2011).

The audio and video functions of iPads make it convenient for foreign language learners to practice listening and speaking individually and in groups and generate audio and video assignments (Lys, 2013). Students can create multimedia projects on iPads to demonstrate their learning (Davies, 2014; Deaton et al., 2013).

The portability of iPads makes the device easier to be carried for on-site training or situated learning during field trips. An instant-on Internet connection allows students access to information on the go, collaborate with peers and/or instructors in different locations, and create content on the site. For example, iPads have been used by teacher candidates to record video logs, capture student footage for parent night presentations, record guest speaker presentations, archive students acting in performances, and document follow-up communication after professional development sessions during their teaching practicum (Sachs & Bull, 2013). Besides student-generated content, iPads were also seen useful for instructors to generate presentation materials, document live lectures as learning materials for students' later review, create audio and visual feedbacks to students' questions, and grade assignments (Manuguerra & Petocz, 2011; Marmarelli & Ringle, 2011; Shepherd & Reeves, 2011).

Learning outcomes. iPads have been widely reported to increase students' engagement while being used as an instructional tool (Davies, 2014; Deaton et al., 2013; Morrone et al., 2012; Rossing et al., 2012; Sachs & Bull, 2013; Tualla, 2011) but few research studies examined whether the increased engagement level had positive effects on student learning outcomes. Mixed results were reported by those articles that examined learning outcomes. Bush and Cameron (2011) found annotation apps for e-text had no significant effects on student's participation, comprehension, and academic writing performance in three master-level courses at a military college. Sloan (2013) found no difference in course grades between students who were in the iPad e-text book pilot program and those who took the course in the previous semester. Gertner (2011) examined how reading e-text from iPads influenced students' reading comprehension and skill transfer ability. The results showed the scores for reading comprehension were similar between the e-text and print text groups but the transfer scores of the iPad e-text group were significantly higher than those who used traditional print texts. Using an experimental design, Lee and Lim (2012) compared the effects of two different presentation modes on students' learning: the instructor annotating the slides on his iPad while presenting and the instructor going through the animated PowerPoint slides with no annotation. The results revealed the students in the iPad-based annotation group significantly outperformed the students from the animated PowerPoint-based presentation lecture group for conceptual knowledge acquisition but not factual knowledge acquisition.

Faculty's preparedness for iPad integration. Only a few studies were found that investigated faculty's experience using iPads for teaching and learning. For example, Hargis, Cavanaugh, Kamali, and Soto (2014) examined faculty's perceptions of iPad deployment for the first month utilizing the strengths, weaknesses, opportunities, and threats (SWOT) analysis framework after a national iPad deployment at Arabic universities. They found iPad integration encouraged faculty's informal learning as they engaged in their own research on the ways to implement the tool. The faculty participants asserted the importance of professional development, a professional learning network, and time for iPad integration in teaching. Only half of the faculty felt prepared to use iPads in the classroom after professional development workshops; the majority of faculty were found still at low levels of iPad integration.

Cavanaugh et al. (2013) examined abstracts submitted by faculty members who attended two professional development workshops in six months during a national iPad deployment with TPACK framework. These authors found no significant changes in TCK, PK, and TPACK; however, there was a tendency to shift from novice levels to higher levels. For example, there was a notable decrease in the proportion of abstracts focused on apps and an increase of using more web-resources focused on active learning. For TPK, there was a significant shift from entry and adoption to adaption and infusion. The authors argued these results indicated faculty's more sophisticated ways of using iPads in teaching.

Churchill and Wang (2014) conducted a longitudinal study to explore faculty's perceptions of iPad affordances and possible applications in teaching and learning. Each of the nine faculty participants from diverse disciplines was given an iPad for personal use. Four sets of interviews were conducted at three to four month intervals for 18 months. The participants were also interviewed about their beliefs about iPad adoption, initial impressions of iPads and apps downloaded and used, plans for future use, and possible belief changes at the end of the study. The results showed a strong focus on content accessing apps and accessing resources, which indicated the participating teachers placed a priority on using iPads as a tool for access and delivery of information.

Dickel, Khanna, Ishii-Jordan, and Turner (2013) conducted a survey to investigate faculty attitudes toward iPad integration before and after a semester implementation. The survey consisted of attitudinal 5-point Likert scales and some open-ended questions.

Twenty-nine faculty completed a pre-survey and 16 faculty completed the post-survey. Likert scale results did not show much attitude difference between pre- and posttest. Most of the responses remained neutral (neither agreed nor disagreed) and did not appear to change over time. The comparison of pre and post open-ended questions showed faculty had higher expectations for student use of iPads for in-class and out of class learning than actually occurred. Faculty with higher technological competence appeared to integrate iPads more for both personal use and to support student learning activities. Faculty concerns and worries were shifted from iPad integration strategies, technological issues of iPads, and potential distractions of iPads for student learning to unstable campus wireless connection, copyrights for digital materials, and the high price of iPads compared to cheaper Android devices.

Barriers to iPad integration. Current research on iPad integration also exposed some barriers to using iPads as an instructional and learning tool. Environmental readiness was mentioned in several studies, mainly focusing on Wifi connections (Maloney & Wells, 2012; Mang et al., 2012; Tualla, 2011). Some inherent features of iPads were also identified as barriers for learning: hard to compose or edit long texts (Faris & Selber, 2013; Kinash et al., 2011; Rossing et al., 2012; Sloan, 2013), unable to run Flash-based applications (Sloan, 2013), glitches present in some apps (Sloan, 2013; Tualla, 2011), and lack of computing capability for high-end design tasks (Faris & Selber, 2013). Some students and faculty reported iPads could be distractive due to access of social networking sites and the Internet during class time (Archibald et al., 2014; Dickel et al., 2013; Marmarelli & Ringle, 2011; Rossing et al., 2012; Sachs & Bull, 2013, Youm et al., 2011). The novelty of iPads showed some effect in increasing students' emotional engagements but was also found to increase learning curves and frustration due to unfamiliarity with the technology (Faris & Selber, 2013; Rossing et al., 2012; Tualla, 2011). Some faculty and students also considered the iPad's functionality and usefulness did not justify its relatively high cost compared to a simpler e-Reader device and other android tablets (Sloan, 2013).

Theoretical Framework

A theoretical framework is the underlying structure that scaffolds or frames a study (Merriam, 2009). It is usually presented as a system of concepts, assumptions, expectations, beliefs, and theories borrowed from existing theories or proposed by the researcher to facilitate the understanding of the relationship between the variables and/or inform the data analysis and interpretation in a study (Casanave & Li, 2015). Figure 3 provides the theoretical framework utilized by the researcher based on the literature review presented in previous sections of this chapter to guide the research design, data analysis, and interpretation for this study.

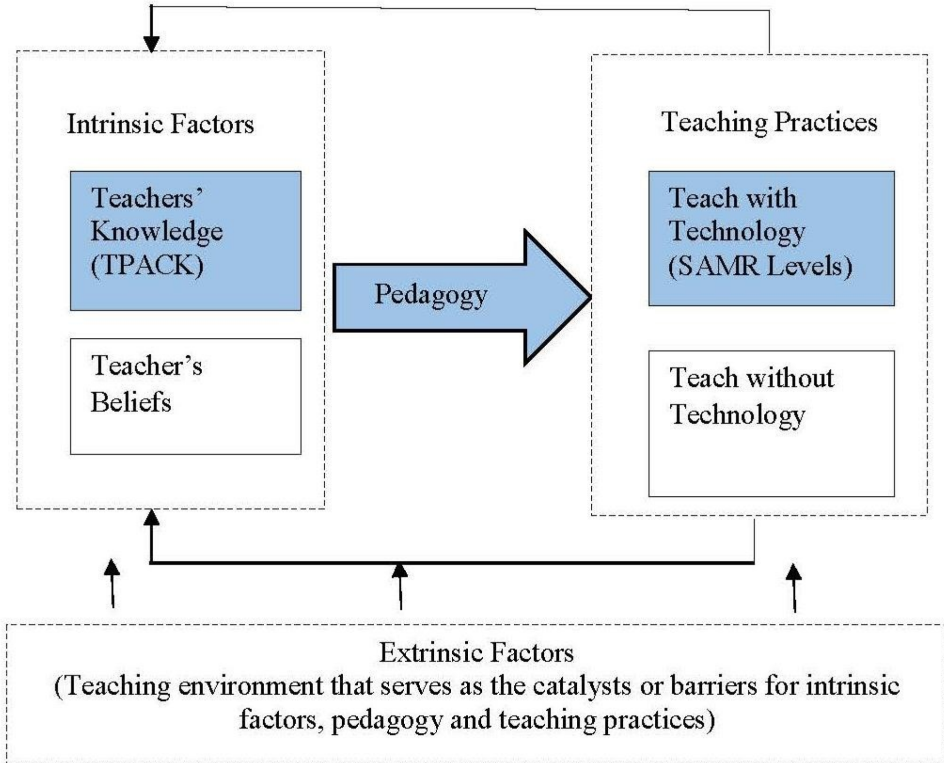

Figure 3. Technology integration theoretical framework.

The framework presents the relationship among the variables in the process of technology integration: extrinsic factors, intrinsic factors, pedagogy, and teaching practices. As the literature indicated, teachers' adoption and integration of technology are influenced by both extrinsic and intrinsic factors. Extrinsic factors refer to contextual environmental factors such as availability of technologies, school's policy and supports, professional development opportunities, etc. Extrinsic factors provide the necessary conditions and context for sustainable technology adoption and integration. Lack of a favorable environment usually hinders the development of intrinsic factors--the actual adoption and integration of technology for teaching and learning.

When enough favorable extrinsic conditions are in place, intrinsic factors play a more critical role in the actual adoption and levels of integration (SAMR levels). As the literature indicated, teachers' knowledge (TPACK) is the basis to support pedagogical integration of technology into teaching practices (Mishra & Koehler, 2006). Teachers gain TPACK through formal education, professional development, self-directed learning, learning by doing, and observing other colleagues' classes. Whether the knowledge learned becomes active elements of a teacher's pedagogy and are actually implemented in his or her teaching practices largely depends on teachers' beliefs (e.g., the conceptualization of teaching and learning, the self-efficacy of the skills in using the knowledge to teach) and the teaching environment (extrinsic factors). Teachers' knowledge, beliefs, and the teaching environment jointly shape a teacher's pedagogy, which are the methods and strategies he or she actually uses and believes are effective in his or her teaching practices in that particular environment. Pedagogy guides the technology integration process and determines the levels of integration. In this framework, pedagogy is a mediator variable that connects the intrinsic factors and teaching practices. On other hand, teaching experience gained from the practices might reinforce or change a teacher's pedagogy through changing his or her knowledge and beliefs.

In this study, the participants were faculty members who had used iPads in their teaching practices for at least two semesters. These continuing practices indicated there were enough extrinsic conditions to support iPad integration and faculty had positive beliefs on iPad integration. The assumption was when the two variables are in place to support iPad integration, iPad integration levels (SARMR levels) are mostly likely to be influenced by faculty's TPACK, which is mediated by their pedagogy. This study focused on exploring the relationship between the independent variable (TPACK) and the dependent variable (SARM levels) with a quantitative research method (survey) and the relationship between the mediator variable (pedagogy) and the dependent variable (SAMR levels) with a qualitative research method. The three elements are highlighted in the framework to show the path of the study.

Summary

Faculty play a critical role in effective technology integration. Without faculty's participation and buy-in, it is impossible for a university to realize its innovation in supporting learning with technology. Both extrinsic and intrinsic factors influence faculty adoption and integration of technology. Literature showed efforts of eliminating extrinsic factors have not significantly increased the adoption of technology in higher education. For those faculty who have already adopted some technology in teaching, the levels of technology integration remain at a low level. Some researchers suggested the intrinsic factors were more crucial in influencing whether and how faculty used technology in their teaching, although the extrinsic factors continuously remained under consideration.

Mobile learning has great potential in enhancing learning in and out of the classroom. Increased ownership of mobile devices among college students, especially tablets in recent years, provides great opportunities for more well-rounded implementation of mobile learning in higher education. Although mobile learning implementation in higher education has increased rapidly in the past decade, literature showed integration levels of mobile learning and mobile devices still remain at a low level even among early adopters who are greatly motivated. To date, few efforts have been devoted to uncover the reasons why mobile device integration is at a low level and how this might be related to faculty's knowledge and pedagogy. Due to the dominant position of iPads among all the other tablets used in higher education, this study focused on iPad integration. The results of this study contributed to the body of current research by deepening our understanding of how iPad integration levels might be influenced by TPACK and pedagogy and the factors that prevent or enhance faculty's pedagogical shift during iPad integration process. This study could inform the decision-making process of administrators and faculty developers when supporting faculty in integrating mobile devices more effectively in their teaching practices.

CHAPTER III

METHODOLOGY

The following research questions were raised in Chapter II.

Q1 How have iPads been used as an instructional tool by faculty in higher education settings in the United States?

Q2 What is the relationship between faculty iPad integration levels as defined by the substitution, augmentation, modification, and redefinition model and their technological, pedagogical, and content knowledge?

Q3 What are the pedagogical differences between faculty members who integrate iPads as an instructional tool?

Q4 Has faculty's pedagogy been shifted because of iPad integration? If there is a shift in pedagogy represented from the research, what are the factors that facilitated the pedagogical shift?

This chapter presents the methodology of the study including an overview of the research epistemology, the research design, participants, data collection and analysis methods, study rigors, and limitations of the study.

Epistemology

Epistemology is "what counts as knowledge and how knowledge claims are justified." (Creswell, 2013, p. 20). The researcher approached this study from a pragmatic perspective. Pragmatism as a paradigm that guides academic research does not see truth in a dualism, i.e., either independent of the mind or within the mind. Instead, pragmatists view knowledge as being both constructed and based on the reality of the world in which people experience and live (Johnson & Onwuegbuzie, 2004). Knowledge, truth, and meaning change over time so what has been obtained in research on a daily base is provisional in nature (Johnson & Onwuegbuzie, 2004). "Truth is what works at the time" (Creswell, 2013, p. 11). Pragmatists are not committed to any single system of philosophy or research method. Instead, they believe individual researchers have the freedom to choose whatever research methods and techniques that meet their needs and purposes to seek the best understanding of their research questions (Creswell, 2013). Pragmatic researchers usually use pluralistic methods (e.g., mixed-methods research) to derive knowledge (Creswell, 2013). Pragmatism provided the philosophical foundation for this study in which the researcher used a mixed-methods research design and collected both quantitative and qualitative data to seek the best understanding of the phenomenon.

Research Design

"In its broadest sense, research is a systematic process by which we know more about something than we did before engaging in the process" (Merriam, 2009, p. 4). The most important decision when planning research is to select the methods and design that will develop the best possible understanding of a problem (Cohen, Manion, & Morrison, 2007). For this study, the researcher sought to understand the current levels of iPad integration in higher education across the United States, an in-depth understanding of how faculty members' TPACK and pedagogy were related to their levels of iPad integration, and how iPad integration experience might have influenced faculty's pedagogy. It was evident a mixed-methods research design combining questionnaires, interviews, and artifact collection was appropriate in meeting the goals and purposes of the study.

Mixed-methods research is "the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study" (Johnson & Onwuegbuzie, 2004, p. 4) for the purpose of gaining a better understanding of the research problem (Creswell, 2014). Greene, Caracelli, and Graham (1989) proposed five general purposes of using mixed-methods research design: triangulation, complementarity, development, initiation, and expansion. Different mixed-methods research design strategies could be employed based on timing, weighting, and mixing of quantitative and qualitative data collection and analysis (Creswell, 2014). In a convergent parallel mixed-methods design, for example, quantitative and qualitative data are collected at the same time, analyzed separately, and compared to see if the findings are consistent (Creswell, 2014). In sequential mixed-methods design, research is conducted in two or more phases. One type of data (qualitative or quantitative) is collected first and used to inform the following phase(s) of the study (Creswell, 2014; Onwuegbuzie & Johnson, 2006).

This study used a sequential mixed-methods design embedded with a convergent parallel mixed-methods design with two phases of data collection. In Phase 1, a convergent mixed-methods research design was used to collect both quantitative and qualitative data using a survey approach to answer the first two research questions that explored current iPad integration levels in higher education in the United States and how they were related to faculty's TPACK. A survey approach is usually used to explore self-reported information on trends, beliefs, attitudes, opinions, characteristics, and behaviors of a population (Ary, Jacobs, Sorensen, & Razavieh, 2010). This approach was a proper fit for the first phase of this study and enabled the researcher to collect iPad integration behavior and an assessment of TPACK from a larger number of faculty members across the country. The convergent mixed-methods design enabled the researcher to triangulate quantitative and qualitative data to more accurately identify faculties' iPad integration levels.

In Phase 2, a basic qualitative research approach was used to answer research questions 3 and 4 that explored pedagogical differences between faculty at different iPad integration levels and how iPad integration experience influenced their pedagogy. To answer the third research question, the researcher explored pedagogical differences between faculties from four levels of iPad integration. To answer the fourth research question, the researcher obtained first-person accounts of how faculty members perceived the influence of iPad integration experience on their pedagogy. A basic qualitative research method was considered to be an appropriate method to investigate and answer these two research questions.

Combining the two phases provided the sequential mixed-methods design for the whole study wherein the results from one approach were used to develop or inform the other approach (Greene et al., 1989). The first phase (the survey) was used for purposeful selection of typical participants for the second phase. The second phase was used to deepen the understanding of the relationship between pedagogy and the SAMR levels for the purpose of expansion wherein the depth or range of the inquiry was expanded by using different research methods for different components of the study (Greene et al., 1989).

Target Population

The purpose of this study was to investigate current iPad integration levels in higher education in the United States, the relationship between faculty's TPACK and their iPad integration levels, pedagogical differences between faculty using iPads at different levels, and the extent to which using iPads in teaching changed faculty's pedagogy. To better answer the research questions, the researcher needed participants who had integrated iPads in their classrooms for a sufficiently long time so they had relatively stabilized their knowledge, pedagogy, and methods of iPad integration. Therefore, the target population of this study was determined to be faculty members who had integrated iPads in their teaching for at least two semesters in postsecondary classrooms at the time of the study. The following rationales were used in selecting this population:

1. Mobile device integration is a complex process. It takes time to master the knowledge and skills. Faculty members who have integrated iPads in their teaching for a longer period of time would have a more comprehensive perception and thus would have more insight to share.
2. Pedagogical change is a progressive transformation that occurs over time. To be able to detect any possible pedagogical transformation, a sufficient period of time for iPad integration would be needed.
3. Continuous use of the iPad indicates faculty's positive beliefs toward iPad integration and favorable extrinsic factors (e.g., availability of the technology, administrative support, etc.) that support the sustainable use.

This helped minimize the extraneous variables that might influence faculty iPad integration levels.

Sampling Methods

In the first phase of the data collection, the researcher used a convenience sampling method to recruit voluntary participants. Convenience sampling is a non-probability sampling technique by which subjects are selected because of their convenient accessibility or voluntariness (Cohen et al., 2007). Potential survey participants were contacted through email (see Appendix A) obtained from professional listserv, official webpages of the universities that had conducted iPad initiatives, websites of professional organizations, and personal references. Responses were collected with the survey, including 160 valid responses for iPad Usage section, 151 for TPACK section and 147 for the demographic section. In the second phase, a purposeful sampling technique was used to select the interviewees from those who had completed the questionnaire in the first phase of the study and agreed to accept a follow-up interview. Purposeful sampling is often used when the researcher wants to select typical representatives to study in depth (Merriam, 2009). Four participants from each level were randomly selected and contacted. The first two respondents were interviewed. Totally eight participants were interviewed. A detailed description of the participants is included in the participant section in Chapter IV.

Data Collection

Instruments. A questionnaire (see Appendix C) and an interview protocol (see Appendix D) designed by the researcher w0ere used to collect quantitative and qualitative data. The questionnaire consisted of two filter questions and three sections. Filter questions were placed before the three sections and used to select qualified participants. Anyone who had not used the iPad as an instructional tool or had used it less than two semesters was thanked and automatically removed from of the survey. The first section, iPad Usage survey, consisted of 18 Likert scale items and two open-ended questions about iPad integration. The 5-point Likert scale items ranged from *Never* to *Very often*. The open-end questions asked the participants to elaborate other iPad usage not listed in the Likert scale questions and also stated their main purpose of iPad integration in their teaching. Textual responses were used to further clarify the participants' levels of iPad integration and triangulated the responses to the closed-ended questions in the same section. Section 2 of the TPACK survey consisted of 35 Likert scale items with 5- points ranging from *Strongly disagree* to *Strongly agree*. Among the items, 23 items were adapted from three previous TPACK surveys developed by other researchers and 12 items were developed by the researcher. Of the 23 items modified from the previous surveys, 13 items were from *Survey of Preservice Teachers' Knowledge of Teaching and Technology* by Schmidt et al. (2009), four items from *the TPACK Survey* by Sahin (2011), and six items from the *HE-TPACK Survey* by Garrett (2014). Schmidt et al. and Sahin's surveys were originally developed to measure pre-service teachers' TPACK and had established good validity and reliability within each construct. Garrett's *HE-TPACK Survey* was designed to measure higher education faculty TPACK for research purposes and had modest validity and reliability. Modification of these items was basically a rewording of the original statements to make them easier to understand or consistent with the syntactic structure of other statements. Twelve new items were developed by the researcher and some sub-sections were added to better capture the information needed for this study. The last section of the questionnaire consisted of 12 questions to collect participants' demographic information. A consent form was attached before the questionnaire to inform the participants of the purpose, voluntariness and confidentiality of the survey. At the end of the survey, the participants were asked to provide their contact information if they agreed to accept a follow-up interview.

The interview protocol described in App0endix D was used to collect qualitative data for the second phase qualitative study. There were three groups of semi-structured questions. The first group of two questions was warm-up questions to get participants comfortable. The second group consisted of five questions about the participants' pedagogy. The third group of three questions explored participants' perceived influence of iPad integration on their pedagogy and what might have triggered any shift. By the end, there were two closing questions.

Both the questionnaire and the interview protocol were sent to three experts from the Educational Technology field for review. They were also piloted with three instructors from the target population with think-aloud techniques to check usability. Revisions were made after each review or testing process. The pilot data and participants were excluded from this study.

The procedure. There were two phases of data collection (see Appendix B for a visual model). In Phase 1, the questionnaire was administrated to obtain information about iPad integration and TPACK of the participants (see Appendix C). Demographic information was also collected for the purpose of sample description. In Phase 2, semi-structured interviews were conducted with two participants from each level of iPad integration to obtain first-person accounts of their pedagogy and perceptions of how iPad integration changed or did not change their pedagogy. The online video conferencing tool Zoom was used for all interviews. Interviewing is necessary when the phenomenon of a study, such as feelings or how people interpret their experiences, cannot be observed directly (Merriam, 2009). A semi- structured interview method was chosen to obtain specific information needed from the participants with the guidance of some prewritten questions while still allowing emerging themes to occur (Merriam, 2009). All interviews were recorded and transcribed for later analysis. Artifacts regarding the same content teaching before and after iPad integration, such as participants' course syllabi, lesson plans, assignment instruction documents, were also collected for the purpose of detecting evidence of their current pedagogy and perceived pedagogical shift. The artifacts were used to triangulate and supplement the interview results.

Data Analysis

Data analysis is the process of examining data to identify evidence to answer the research questions (Merriam, 2009). Both quantitative data and qualitative data were collected and analyzed in this study (see Appendix C). Numeric data collected through the questionnaire were imported into SPSS and examined before data analysis. Histogram graphs were plotted to check normality of the data. The internal consistency of Section 1 iPad usage and Section 2 TPACK in the questionnaire were calculated to determine the reliability within each construct.

To answer research question 1, the means of the responses for iPad usage were calculated to determine the levels of iPad integration among the sample. The textual responses for the open-ended question were classified and associated with the Likert scale questions for the purpose of supplementing and triangulating the quantitative results. To answer research question 2, the Pearson product-moment correlation coefficient was calculated to detect any possible correlation between iPad integration levels and the participants' TPACK level. Independent *t*-tests were conducted among the participants from different SAMR levels to determine whether and how their TPACK was associated with the levels of iPad integration.

For qualitative data obtained in the second phase, the researcher followed Merriam's (2009) suggestion to process data collection and analysis simultaneously. Each interview recording was transcribed and coded immediately after the interview was concluded. Interview results from different levels of the participants were cross examined to identify similarities and differences in their pedagogy (research question 3), perceived pedagogical shift (research question 4), and factors that might have led to the shift (research question 4). The artifacts were analyzed and used to triangulate the information obtained from the interview. An analysis scheme was developed based on the qualitative data to present and discuss the results.

Study Rigor

"All research is concerned with producing valid and reliable knowledge in an ethical manner" (Merriam, 2009, p. 209). The following procedures were followed to establish the validity and reliability for both quantitative and qualitative data collection process, analysis, and report.

Validation of the First Phase
Survey Research

The validity and reliability of an instrument are main threats to survey research (Ary et al., 2010). The validity of an instrument refers the extent to which it measures what it is supposed to measure (Thorndike & Thorndike-Christ, 2009). The reliability of an instrument refers to the stableness of the instrument, i.e., how consistent the questionnaire is in measuring what it is supposed to measure (Thorndike & Thorndike-Christ, 2009). Reliability and validity are key indicators of the quality of an instrument and should be examined before data collection. To validate the questionnaire used in the first phases of this study, content validity and internal consistency (reliability) were checked and reported. Questionnaire items were developed based on a review of current literature or modified from previous surveys that measured the same constructs. Content validity of the questionnaire was established through expert review. Three experts from the educational technology field examined the content of the questionnaire. The questionnaire was also piloted among three instructors from the target population using a think-aloud technique to check its usability. Pilot participants completed the questionnaire independently via an online link and identified any ambiguities, confusion, or inadequacy. Pilot samples were excluded from the current study. Revisions were made after each validation step.

Another threat to the validity of survey research is the truthfulness of responses due to the ability and willingness of the participants. Participants were informed of the voluntariness and confidentiality of their participation to increase the truthfulness of the responses. Likert scale questions in the TPACK section were randomized to minimize participants' social desirability bias. After data collection, Likert scale responses in the iPad Usage section were triangulated with the open-ended questions to check the validity of the data.

Response rate was also another factor that might influence the validity of the survey results. Multiple resources--university listservs, professional organization's listservs, and personal emails--were used to maximize the coverage of the target population and increased the response rate. Two reminders were sent through emails to remind participants of completing the survey after the initial contact.

Trustworthiness of the Second Phase Qualitative Study

Merriam (2009) suggested four categories to evaluate the trustworthiness of qualitative research: credibility, dependability, transferability, and ethnical consideration. These were used to examine and establish the trustworthiness of the second phase of this research project.

Credibility, also called internal validity, refers to how closely research findings match reality (Merriam, 2009). To ensure internal validity, the researcher established the reliability and validity of the instrument--the interview protocol used to collect data. The interview protocol was sent to three content experts to check content validity. The protocol was then pilot tested with three faculty members from the target population using a think-aloud strategy. The purpose of the pilot study was to make sure the participants not only understood the questions but understood them in the same way. The results of the pilot study were used to revise the protocol but excluded from the current study. After data collection, the researcher triangulated data obtained from the interviews and artifacts. Comparing and cross-checking data collected through different methods helped determine the validity of the raw data collected (Creswell, 2013; Merriam, 2009).

Dependability of a qualitative research study refers to "whether the results are consistent with the data collected" (Merriam, 2009, p. 221). Field notes were taken during interviews to record the researcher's reactions, impressions, and observations of the interviewees. Reflexivity was used in the form of research journals in which the researcher critically reflected her assumptions, bias, and disposition regarding the research. An audit trail that included the detailed records of how data were collected and how the results were coded and categorized was also developed to help the researcher reflect on the research process and examine possible bias. Raw data, the analysis scheme, and the final manuscript were sent to an expert in the educational technology field for peer review to evaluate whether the findings and analyses were plausible based on the data.

Transferability is a type of external validity that refers to what extent the findings of a study can be applied to other situations (Merriam, 2009). The special nature of qualitative research is not seeking generalizability since reality is interpreted and there is no single reality for the same event or phenomenon (Merriam, 2009). Instead, it leaves the reader to decide whether the findings can apply to his/her particular situation. To enhance the transferability of the qualitative study, the researcher used a thick description strategy while writing the manuscript. Thick description is defined as "a highly descriptive, detailed presentation of the setting and in particular, the findings of a study" (Merriam, 2009, p. 227). A detailed description of the characteristics of the participants, their teaching experiences, iPad integration experience, and their pedagogy were provided to the readers for a thorough assessment of the possibility in using the results of this study in their situation.

"To a large extent, the validity and reliability of a study depend on the ethnics of the investigator" (Merriam, 2009, p. 228). For this qualitative research, the researcher as the primary instrument of data collection and analysis followed strict ethical principles of research. The research was approved by the University of Northern Colorado's

Institutional Review Board (IRB; see Appendix E) and consent forms (see Appendix F) from the participants were collected. All digital data were stored in a password-protected folder in the researcher's personal computer and paper data in a locked cabinet in her home office. The researcher used reflection journals and an audit trail to keep track of her research process and tried her best to make sure her own personal biases and opinions did not get in the way of the research. The researcher reported the results as honestly as possible.

Legitimation of the Mixed-Methods Approach

Quantitative research seeks validity and generalization. Qualitative research seeks trustworthiness and authenticity. When combined, mixed-methods research usually gains "complementary strengths" from multiple research methods and helps to minimize their individual weaknesses (Creswell, 2013). To solve the difference in terminology, Onwuegbuzie and Johnson (2006) suggested using "legitimation" to refer to the validity or trustworthiness of mixed-methods research. They defined "legitimation" as "obtaining findings and/or making inferences that are credible, dependable, transferable, and/or confirmable" (Onwuegbuzie & Johnson, 2006, p. 52).

The legitimation of this mixed-methods research was fulfilled through weakness minimization and multiple validities suggested by Onwuegbuzie and Johnson (2006). Weakness minimization means to compensate for the weaknesses in one approach with the strengths of another approach (Onwuegbuzie & Johnson, 2006). The results of the Likert scale questions in the iPad Usage section were compensated and triangulated with the results from the open-ended questions. Multiple validities mean to address the legitimation of the mixed-methods research through the validation of its quantitative and qualitative components respectively and collectively (Onwuegbuzie & Johnson, 2006). The validation of the quantitative and qualitative components of this study was addressed respectively based on the nature of the research methods. The sequential design of the study allowed the first phase to provide inference for the second phase and the second phase expanded upon the first phase.

Research Permission and Ethical Considerations

Permission to conduct this research was approved by the IRB of the University of Northern Colorado (see Appendix E). Consent forms were provided for all participants in which the research purpose, procedures, and their right as a participant were addressed (see Appendix F). Participation in the study was voluntary. Participants remained anonymous during the survey phase. Personally identifiable information was collected from those participants who agreed to accept the follow-up interview. Confidentiality was addressed by storing all the digital data collected in a password- protected folder on the researcher's personal computer and paper data in a locked cabinet at the researcher's home. Only the researcher had access to the data. Pseudonyms were used for interviewed participants when the results were reported.

Limitations

Three main limitations were identified in this study:

1. Convenience sampling might have hindered the generalization of the study results. Because the participants were selected based on their voluntariness, the variation of the sample might not have reflected the real characteristics of the target population (Ary et al., 2010).

2. Most of the qualitative and quantitative data were collected through self-reporting techniques. This form of data could lead to response errors due to the ability and/or willingness of the participants to provide truthful responses (Ary et al., 2010). The concurrent mixed-methods design in the first phase and the inclusion of artifact analysis in the second phase provided secondary sources of data to triangulate and strengthen findings from these limited methods.
3. The study focused on examining details of selected participants within the target population. This qualitative study approach was appropriate and valuable in obtaining in-depth understanding and perspectives of the phenomenon but was also subjected to the influence of the researcher's personal bias and the representativeness of the cases (Merriam, 2009).

The intent of the qualitative study was to provide rich description of the participants' pedagogy and its influence on iPad integration. The results should not be taken as representative of all members of the target population.

Summary

This study employed a sequential mixed-methods research design with two phases of data collection and analysis to explore the relationship among faculty iPad integration levels, TPACK, and pedagogy. The participants were faculty members who had used the iPad as an instructional tool for at least two semesters. A convenience sampling technique was used to select participants for Phase 1 and a purposeful sampling technique was used to select participants for Phase 2. Both quantitative and qualitative data were collected and analyzed to identify the levels of iPad integration (research question 1), the relationship between the integration levels and TPACK (research question 2), and the difference between faculty members from different iPad integration levels in terms of their pedagogy (research question 3). The influence of iPad integration on faculty's teaching practices and pedagogy were also explored by using semi-structured interviews (research question 4). Efforts were made to establish validity and/or trustworthiness for each phase of the study. The data were triangulated, developed, and expanded in different parts of the study, which assisted in establishing the legitimation of the whole mixed-methods study. Weight was given equally to both quantitative and qualitative data collection as they were used to provide inference for each other and also different components of the study.

CHAPTER IV

RESULTS

The purpose of this study was to identify how iPads were used in higher education sectors in the United States and the relationship among faculty's knowledge, pedagogy, and iPad integration levels as defined by the SAMR model. Using a mixed-method research design, the researcher administrated a survey and conducted follow-up interviews with faculty who had been using iPads as an instructional tool for at least two semesters by the time of the study. This chapter presents the findings in the order of the research phases and the research questions in each phase.

Phase 1: The Survey Research

To answer the first and second research questions, a questionnaire was administrated. Both qualitative and quantitative data were collected with 18 Likert scale questions and two open-ended questions regarding iPad usage. Quantitative data were collected with 35 Likert scale questions for TPACK. This section presents the results obtained using the questionnaire.

The Participants

The sampling pool. The target population of the study was higher education faculty who had integrated iPads in their teaching for at least two semesters in the United States. After an extensive search in Google, six Apple distinguished schools, three Apple distinguished programs, eight iPad initiatives, and 87 authors of conference proceedings or journal articles that studied iPad integration in higher education in the United States were identified. An international educational communication and technology association was also contacted and agreed to send an invitation letter with a survey link to its membership. Potential survey participants were contacted through emails (see Appendix A). Participants were also asked to forward the survey links to their friends and colleagues who were qualified for the study. Table 3 summarizes the number and nature of the institutions contacted for recruiting participants.

Six Apple distinguished schools recognized by the Apple Company (Apple) for their one-on-one iPad implementation in their entire institutions were selected. Of the six institutions, two were community colleges and four were bachelor/master universities; 986 faculty members from the six institutions were contacted through emails. The three Apple Distinguished Programs were recognized by Apple for their one-on-one iPad implementation within their academic programs. One program was from a community college and the other two programs were from two large public doctoral universities; 253 faculty from the three programs were contacted. Eight iPad initiatives were identified through information presented on their school websites: one public bachelor/master university, three private bachelor/master universities, two doctoral teaching-intensive public universities and two doctoral research-intensive public universities; 929 faculty from these iPad initiative programs were contacted. Eighty-seven authors of journal articles and proceeding papers that studied iPad integration were identified through literature review and contacted through emails. In total, 2,255 faculty were contacted directly through email addresses. The invitation letter with the survey link was also sent to all members of an international educational technology association through its membership listserv. The number of the members for the professional association was unknown and the number of the members who had used iPads as an instructional tool was also unknown. According to the participation messages received through the association's website, 43 members agreed to participate. The initial invitation and two reminders were sent to the potential participants described above. This phase of data collection lasted for a month.

Table 3

The Sampling Pool

Category	Apple Distinguished Schools	Apple Distinguished Programs	iPad Initiatives	Authors of Journal Articles	Professional association
N	6	3	8	87	1
Category of the Institution	2 community colleges 4 bachelor/ master universities	1 community college 2 large doctoral public universities	1 bachelor/master universities 3 bachelor/master universities 2 doctoral teaching-intensive public universities 2 doctoral research intensive public universities.	N/A	1 international education technology study association
Number of faculty contacted	986	253	929	87	Unknown (43 agreed to participate)
Number of faculty using iPads as an instructional tool for at least two years	Unknown	Unknown	Unknown	Unknown	Unknown

The response rate. Since the number of the qualified participants and the number of the qualified participants who had been contacted were both unknown, it was impossible to calculate the response rate for the survey. In total, 275 faculty agreed to participate and started the survey. Among the 275 participants, 109 participants were automatically opted out of the survey because they had not used iPads as an instructional tool, had used them for less than two semesters, or both. The remaining 166 participants completed the iPad Usage Likert scales; 130 participants responded to iPad Usage open-ended question 1 and 145 participants responded to the second open-ended question; 157 participants completed both the iPad Usage Likert scale and TPACK Likert scale section; and 147 participants completed the iPad Usage Likert scale, TPACK Likert scale, and the demographics section. Six responses were excluded from the 166 responses because their responses to the open-ended questions indicated they had not used iPads in higher education or did not use it as an instructional tool. Nine responses to the first open-ended question and 10 responses to the second open-ended question were excluded because the questions were not answered.

As a result, 160 responses were kept and used to identify participants' iPad integration levels (SAMR levels); 151 responses were kept and used to identify the relationship between the iPad integration level and TPACK; 147 responses were kept and used to present the demographic characteristics of the sample for this study; and 121 responses were kept for the first open-ended question and 135 responses were kept for the second open-ended question. Table 4 presents the numbers of recorded responses and valid responses.

Table 4

Participation Summary

Survey Section	Responses (*n*)	Valid Response (*n*)
Participants who started the survey	275	
Participants excluded by the filtering questions	109	
Section 1 iPad Usage Survey		
Part 1 Likert Scale	166	160
Part 2 Open-ended Questions		
Open-ended Question 1	130	121
Open-ended Question 2	145	135
Section 2 TPACK Survey	157	151
Section 3 Demographic information	147	147

Age and gender. As presented in Table 5, the majority of the participants were between 30 and 60 years old (80.27%) and 67.35% were female.

Table 5

Age and Gender of Participants

Variable	*n*	Percentage
Age (N = 147)		
Below 30	3	2.04
30-40	39	26.53
41-50	39	26.53
51-60	40	27.21
Above 60	26	17.69
Gender (N = 147)		
Male	48	32.65
Female	99	67.35

Note. Percentage may not equal 100% due to rounding.

Education levels and employment status. As presented in Table 6, more than 70% of the participants had a doctoral degree (70.75%), about 21% had a master's degree, and only about 7% participants had a bachelor's or lower degree. Approximately 89.28% of participants reported to be employed as full-time faculty in higher education. The remaining 10.88% reported themselves to be adjunct professors or administrators who also taught (e.g., dean, program coordinator).

Table 6

Education Levels and Employment Status of Participants

Variable	*n*	Percentage
Education level (*N* = 147)		
Doctorate	104	70.75
Master	32	21.77
Bachelor	5	3.40
Other	6	4.08
Employment Status (*N* = 147)		
Instructor	23	15.65
Assistant professor	30	20.41
Associate professor	54	36.73
Professor	24	16.33
Other	16	10.88

Note. Percentage may not equal 100% due to rounding.

Teaching experience. As presented in Table 7, the majority of participants were experienced teachers who had more than 10 years teaching experience (62.29%). About 30% of participants had 6-10 years teaching experience. Only 8.2% of the participants were relatively novice teachers who had taught five years or less.

Table 7

Teaching Experience of Participants

Variable	*n*	Percentage
0-5 years	10	8.20
6-10 years	36	29.51
11-15 years	24	19.67
16-20 years	18	14.75
Above 20 years	34	27.87
Total	122	

Note. Percentage may not equal 100% due to rounding.

Type of institution. As presented in Table 8, 60.54% of the participants worked at four-year bachelor/master institutions and 27.21% came from doctoral universities. Only 8.84% of the participants were from two-year community colleges.

Table 8

Institutions of Participants

Variable	*n*	Percentage
Two-year community college	13	8.84
Four-year bachelor/master institution	89	60.54
Doctoral research-intensive university	25	17.01
Doctoral teaching-intensive university	15	10.20
Other	5	3.40
Total	47	

Note. Percentage may not equal 100% due to rounding.

Disciplines. The participants were from a variety of disciplines. The top four largest content areas were Education and Behavioral Science (24.49%), Science (19.05%), Medical &Health Care (13.61%), and Social Science (12.93%) as presented in Table 9.

Table 9

Disciplines of Participants

Variable	*n*	Percentage
Science	28	19.05
Social science	19	12.93
Humanities	13	8.84
Education and Behavioral Science	39	24.49
Business	8	5.44
Medical & Health Care	20	13.61
Engineering	2	1.36
Performing and Visual Arts	10	6.80
Computer Science	3	2.04
Other	5	3.40
Total	147	

Note. Percentage may not equal 100% due to rounding.

IPad integration model. As presented in Table 10, the majority of participants (76.87%) taught 1:1 tablet classes in which students either used the tablet issued by their school or purchased the iPad as required by the school; 10.88% used the tablet carts model. Only 6.12% of participants taught in a “Bring Your Own Devices (BYOD)” environment in which students brought their personal mobile devices to class for academic use. Only three participants used the iPad as their teaching tool and their students did not have access to the iPad or were not required to use it.

Table 10

Model of iPad Integration

Variable	*n*	Percentage
1:1 Tablet	113	76.87
Tablet Carts	16	10.88
BYOD	9	6.12
Mixed (iPad cart +BYOD)	6	4.08
Other (Instructor access only)	3	2.04
Total	147	

Note. Percentage may not equal 100% due to rounding.

Frequency of iPad usage. Table 11 summarizes the frequency of iPad usage for this sample. The majority of participants (84.35%) taught with iPads weekly, 15.60% used iPads occasionally, and 35.37% of participants used iPads every day for teaching.

Table 11

Frequency of iPad Usage

Variable	*n*	Percentage
Daily	52	35.37
2-3 times a week	40	27.21
Once a week	32	21.77
2-3 times in a month	15	10.20
Less than once a month	8	5.44
Total		147

Note. Percentage may not equal 100% due to rounding.

Level of integration. Most of the time, iPads were used at the undergraduate level (86.39%). Some participants also used iPads in master level courses. iPads were used least in doctoral level classes (see Table 12).

Table 12

Academic Levels of iPad Usage

Variable	*n*	Percentage
Undergraduate	127	86.39
Master/graduate certificate	48	32.65
Doctoral level	21	14.29

Note. Percentage may not equal 100% due to repeated counting.

Training and comfortableness. Even though many participants (41.50%) reported that they had not had any formal training before or during teaching with iPads, the majority of participants (78.23%) reported being very comfortable when using iPads for teaching (see Table 13).

Table 13

Training and Comfort Levels of iPad Usage

Variable	*n*	Percentage
Training		
Yes	86	58.50
No	61	41.50
Comfort Level Teaching with iPads		
Very comfortable	115	78.23
Somewhat comfortable	31	21.09
Somewhat uncomfortable	1	0.68

N = 147

The Instruments

Reliability. To check the reliability of the questionnaire, internal consistency coefficient (Crobach's α) was calculated using SPSS for the iPad Usage Likert Scale and TPACK sections. High internal reliabilities were obtained for both scales. A commonly accepted rule of thumb for internal consistency is between 0.7 and 0.8 is acceptable, between 0.8 and 0.9 is good, and being equal or higher than 0.9 is excellent (George & Mallery, 2003). All α values for the sub-dominions of the two Likert scales were higher than 0.7, indicating acceptable to good reliability of the scales across the dominions as presented in Tables 14 and 15.

Table 14

Reliability of iPad Usage Scale

Variable	N	Item *N*	Cronbach α
For teacher use	160	6	.808
For student use	160	12	.867

Table 15

Reliability of the Technological, Pedagogical, and Content Knowledge Scale

Variable	N	Item n	Cronbach α
Technological knowledge	151	5	.866
Pedagogical knowledge	151	5	.838
Content knowledge	151	5	.701
Technological pedagogical knowledge	151	5	.877
Pedagogical content knowledge	151	5	.792
Technological content knowledge	151	5	.890
Technological, pedagogical, and content knowledge	151	5	.850

Validity. Besides the expert review of the instruments, the validity of the questionnaire was also triangulated by the qualitative results. Eight interviewees were identified and classified into different SAMR levels with the iPad Usage survey. The interviews confirmed their integration levels, which indicated the iPad Usage survey was valid in identifying participants' integration levels. The interview and artifact data also demonstrated the difference between the interviewees' TPACK knowledge, which roughly corresponded with self-reported data collected with the TPACK survey and implied the validity of the scale.

IPad Usage and Integration Levels

Q1 How have iPads been used as an instructional tool by faculty in the higher education settings in the United States?

The Likert scale. The participants were asked to report their frequency of iPad usage in different instructional activities for both teacher use and student use using a 5-point Likert scale (*Never* = 1, *Rarely* = 2, *Sometimes* = 3, *Often* = 4, and *Very often* = 5). According to the SAMR model, technology that emphasized only teacher use did not reach modification or redefinition levels because these two higher levels focused on how technology was used by students to enhance their learning under the instructor's guidance. Thus, the teacher use section only consisted of two SAMR levels of usage: substitution and augmentation. In the student use section, the items measured four levels of iPad usage. For each item, if the average mean was higher than 3.00, it indicated moderate to high frequency of using iPads for that category of activity. For all items in each SAMR level, if the average means of the items were higher than 3.00, it indicated the participants were using iPads at that particular level. The means and standard deviations of each item are summarized in Table 16.

Table 16

IPad Usage Descriptive Statistics: Means and Standard Deviations

	iPad Usage Item	*N*	*M*	*SD*
Substitution (teacher use)	S1T1. conduct personal productivity activities (e.g., calendar, Word documents, notes).	160	3.69	1.145
	S1T2. store and read e-text	160	3.71	1.168
	S1T3. collecting student work digitally	160	3.21	1.319
	Average		3.54	
Augmentation (teacher use)	S1T4. grade assignments	160	2.99	1.288
	S1T5. present lectures and/or digital content to students	160	3.61	1.369
	S1T6. share contents between students and teacher (e.g., dropbox, google drive)	160	3.26	1.357
	Average		3.29	
Substitution (student use)	S1S1. take notes	160	3.57	1.142
	S1S2. retrieve assigned learning materials	160	4.08	.955
	S1S3. conduct personal productivity activities (e.g., calendar, Word documents)	160	3.56	1.169
	Average		3.74	
Augmentation (student use)	S1S4. access online information for individual study	160	4.11	.958
	S1S5. share contents among classmates or group members (e.g. dropbox, google drive)	160	3.45	1.159
	S1S6. take quizzes, surveys or tests	160	3.28	1.406
	Average		3.61	
Modification (student use)	S1S7. create multimedia content to demonstrate learning	160	3.28	1.240
	S1S8. interact in small group activities	160	3.17	1.235
	S1S9. conduct peer review and evaluation	160	2.47	1.228
	Average		2.97	
Redefinition (student use)	S1S10. engage with a learning environment outside the classroom through digital apps (e.g., field trip)	160	2.58	1.412
	S1S11. communicate with discipline experts around the world	160	1.76	.970
	S1S12. interact with a global audience	160	1.82	1.126
	Average		2.05	

Table 16 shows for teacher use, iPads were used mostly as an e-reader to store and read e-text (*M*=3.71) at the substitution level and as a presentation tool at the augmentation level (*M* =3.61). For student use, iPads were used most often to retrieve assigned learning materials (*M* =4.08) at the substitution level and access online information for individual study at the augmentation level (*M* =4.11). iPads were sometimes used by students at the modification level (*M* =3.28) to create multimedia content. None of the means at the redefinition level were higher than 3.00, indicating the participants rarely used iPads to support their students' learning at this level. The average mean for each SAMR level showed iPads were used more often at the substitution and augmentation levels (average $M > 3.00$) than modification and redefinition levels (average $M < 3.00$).

The participants were grouped into the 1:1 implementation group and non 1:1 implementation environment based on the models they used during iPad integration to detect whether student access to the iPad influenced the instructors' integration level. The 1:1 implementation group included only the participants whose students had unlimited accesses to the iPad in and out of classroom on 1:1 ratio. The non 1:1 implementation environment included participants who used iPad carts, BYOD, mixed, and other models in which students had limited access, not all students had access, or students had no access at all. Table 17 presents the descriptive statistics of the results that show the means of the 1:1 implementation group were higher than those of the non 1:1 implementation group at four SAMR levels, indicating higher frequency of iPad usage for the 1:1 implementation group at all levels.

Table 17

Implementation Models Versus iPad Integration Levels: Descriptive Statistics

	Group	*n*	*M*	*SD*	Std. Error Mean
MEAN_SUB	1:1 Implementation	113	3.76	.786	.074
	Non 1:1 Implementation	33	3.28	.861	.150
MEAN_AUG	1:1 Implementation	113	3.58	.832	.078
	Non 1:1 Implementation	33	3.09	.910	.158
MEAN_MOD	1:1 Implementation	113	3.05	.980	.092
	Non 1:1 Implementation	3	2.81	1.077	.188
MEAN_RED	1:1 Implementation	113	2.14	1.029	.097
	Non 1:1 Implementation	33	1.79	.758	.132

Independent *t*-tests were conducted to detect whether there was a statistically significant difference for frequency of iPad usage between the 1:1 implementation group and non 1:1 implementation group at each SAMR level. The normality of the data was checked with kurtosis and skewness values. According to Bulmer (1979), if the skewness is between -.5 and .5, the data distribution is approximately symmetric. The rule of thumb for a kurtosis value is +/-1 is considered very good for most psychometric uses but +/-2 is also usually acceptable. The data for each independent *t*-test at each SAMR level showed no violation of normality and equal variance, which was confirmed by kurtosis and skewness values across the four SAMR levels (between +/-0.5 for skewness and between +/-1 for Kurtosis) and all Levene's test values ($p > 0.05$). Table 18 presents the results showing a significant difference between the two groups at the enhancement levels but not at the transformation levels. Both groups showed a lack of iPad integration at the transformation levels.

Table 18

Implementation Models Versus iPad Integration Levels: Independent t-Test

Levene's Test for Equality of Variances (assumed)			*t*-test for Equality of Means				
	F	Sig.	*t*	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
SUB	.807	.371	3.05	144	.03**	0.485	.171
AUG	.0482	.489	2.93	144	.004**	0.492	.160
MOD	.034	.853	1.16	144	.25	0.229	-.163
RED	3.852	.052	1.82	144	.071	0.351	-.031

Note: **=significant at .001, two-tail level. SUB = Substitution, AUG = Augmentation, MOD = Modification, RED = Redefinition

A chi-square test of independence was also performed to examine the association between iPad integration levels and training. There was no significant association between participants who received training or those with no training for iPad integration in terms of their iPad integration levels, $\chi2$ (3, 143) = 1.641, $p = .650$.

Open-Ended question 1. The first open-ended question asked participants to describe other ways iPads had been used in their teaching for instructional purposes. The question was used to collect the information about iPad usage that was not included in the Likert scale questions. The results were used to supplement and triangulate the Likert scale questions. In total, 130 participants responded to the question. Nine responses were irrelevant to the question and excluded from the data analysis and 121 responses were coded and associated with the Likert scale questions so the results from the two data resources could be compared and contrasted. Table 19 presents the codes for these responses and their frequency, percentage, SAMR level, and associations with the close-ended questions. New usages that were not included in the Likert scale questions are highlighted.

The results showed 78.9% of the responses described the usages already included in the close-ended questions. Ten participants mentioned using iPads to model K- 12 usage, which could not be classified and associated with Likert scale questions due to its vagueness. All the other usages that were not included in the Likert scale questions were at a very low frequency but provided some other ways in which iPads could be used to support student learning.

Table 19

Frequency of iPad Usage from Open-Ended Question 1

SAMR Level	Text Response	Corresponding Likert Scale Question		*n*	%
Substitution	Access course materials	S1S2		13	10.00
	Personal productivity	S1S3		6	4.62
			Total	19	14.62
Augmentation	In-class quizzes/polls	S1S6		20	15.38
	Presentation--Teacher	S1S5		15	11.54
	Access online information	S1S4		12	9.23
	Synchronous communication			10	7.69
	e-Portfolio			5	3.85
			Total	62	47.69
Modification	Create multimedia content	S1S7		29	33.84
Redefinition	Mobile app creation			2	1.67
	Field trip	S1S10		2	1.67
			Total	4	3.34
None	No other usages			17	13.08
Unable to classify	Modeling iPad integration for K- 12 learning environment			10	7.69
Unable to classify	The responses are irrelevant to the question			9	6.92

Note. The accumulative number is more than the number of responses due to the repeated counts of some responses for different codes.
N = 135

The results of the open-ended question 1 supplemented and triangulated the Likert scale questions. Responses to the question provided more evidence that iPads were used more frequently at the enhancement levels (mostly at the augmentation level for this set of data), moderately used at the modification level to create multimedia content, and seldom used at the redefinition level. Since these responses were about additional usage, the results should not be used solely to describe the trend of iPad usage.

Open-Ended question 2. In total, 145 participants responded to the second open-ended question about the purposes of iPad integration. Ten responses were excluded from the data analysis due to its irrelevancy to the question and 135 responses were analyzed using an open coding technique (Creswell, 2013) to identify information and phrases or key words related to the purposes of iPad integration from each response. After close scrutiny of the codes obtained from the open coding process across all responses, the researcher grouped similar codes into themes (i.e., more general purpose). Table 20 presents the codes assigned to individual responses, the frequency each code was used, the themes each code fell into, and the percentage in which each theme occurred compared to total responses (N = 135). Within each theme, the codes are listed in descending order of frequency.

Table 20

IPad Integration Purposes

Themes	Codes		*n*	%
Deliver content	Easy access to digital learning materials and resources		33	
	Presentation		14	
	Simulation/visualization		2	
		Total	49	36.30
Facilitate learning process	Engagement		12	
	Active learning		6	
	Interaction		5	
	Mobile learning opportunities		5	
	Collaborative learning		4	
	Cater to new generation's learning styles		3	
	Provide equal learning opportunities		2	
	Flipped classroom		1	
		Total	38	28.15
Career preparation	Model K-12 usage		17	
	Digital literacy		8	
		Total	25	18.52
Assessment	Multimedia production		10	
	Formative assessment		6	
		Total	16	11.85
Reduce cost	Cut paper use		6	
	Reduce textbook costs		1	
	Attract student enrollment: 1		1	
		Total	8	5.93
Personal productivity	Take notes/calculator, etc.		8	5.93

Note. The accumulative number is more than the number of responses due to the repeated counts of some responses for different codes.
N = 135

Deliver content. The most frequently-mentioned purpose of using iPads was to deliver content (36.30%) through online platforms, teacher presentation, and simulation/visualization tools. Some examples of the comments are presented as follows:

> Electronic textbooks, materials and learning management system (#13).
>
> Easy of delivering lectures, class contents and further resources for students (# 95).
>
> To extend the reach of the students to information beyond the brick and mortar of the classroom (#68).
>
> The iPad frees me from the front of the classroom, allowing me to interact with my students (#81).
>
> To simulate phenomenon that we cannot directly observe in a classroom (#119).
>
> Used the iPad as a computational device and visualization tool (spreadsheets, graphing calculator, etc.) that would allow students to explore content individually as well as collaborate on the same device (#145).

Facilitate learning process. Responses from 28.15% of the participants indicated their purpose of using iPads was to facilitate the student learning process. They used the iPad to increase engagement, promote active learning, enhance interactions, support collaborative learning, cater to 21st century learning styles, provide mobile learning opportunities, etc. Some examples of the comments are presented as follows:

> The main purpose of integrating iPad into teaching is to leverage the capabilities of the device to foster more engagement and interactivity in/out of the classroom (#40).
>
> The main purposes of iPad integration are to make available teaching tools that go beyond the passive lecture (#23).
>
> Millennial students, in particular, are consumer-oriented individuals that have grown up utilizing digital technology. Integrating the iPad into my learning environment has allowed me to provide more individualized instruction, increase student engagement and meet the needs of this new generation of learners (#84).
>
> The iPad has completely changed how we teach. We have been able to connect with the Next generation and tie it to tech ed in a way no other institution has (#102).
>
> Using iPads allows the redesign of the learning process so that we move outside the classroom and dorm room to allow learning moments anywhere (#53).

Career preparation. Responses from 18.52% of the participants indicated their main purpose for using iPads was to model its use in real workplaces and prepare students for future careers. Some examples of the comments are presented as follows.

> The goal is to have pre-service teachers prepared for the educational technology that they may find in their student teaching placements or future classrooms. We closely look at apps specific to their teaching content. Students describe an application, its implications in the learning context and reflect on how it may be used by teachers, students, etc. (#52).

> Journalism students require a high level of comfort with a broad range of digital technologies and using the iPad as part of the class provides fluency with a variety of tools (#7).

> We used the iPad to ground the student into using mobile devices for academic and personal productivity through personal adoption we see a greater transition to use of mobile devices in the work environment and the student understands through personal use how to apply to the health care setting (#126).

Other purposes. iPads were also used for conducting assessments, cutting costs, and increasing personal productivity. Responses from 11.85% of the responses included assessment as one of the purposes of iPad integration. iPads were used for in-class quizzes to check student understanding and provide more interaction between the instructor and students. Only about 6% of the participants used iPads for personal productivity. A participant observed, "Also, students like the light-weight iPad for taking notes often including a lightweight keyboard" (#23).

Responses to the second open-ended question showed the iPad was integrated for different purposes and in different ways by different users. The majority of participants talked about the purposes of iPad integration from technical perspectives and emphasized the iPad's affordances, e.g., access to online resources and multimedia production. Some participants talked about the purposes of integration beyond its technical affordance and emphasized its pedagogical value, e.g., how iPads could be used to engage and promote more active learning opportunities for their students.

Summary. The results obtained from the iPad Usage survey showed iPads were used for a variety of instructional activities and for different purposes by participants of this sample. iPads were primarily used as a content consumption tool such as accessing learning materials and searching information online. The multimedia functions of iPads were also moderately used to create multimedia content such as documenting learning process and creating presentations. Both quantitative and qualitative data showed iPads were used more often at the enhancement levels (substitution and augmentation) than at the transformation levels (modification and redefinition). Unlimited access to the device appeared to promote the enhancement levels of the integration but not the transformation levels. Integration levels were found not significantly different between the faculty who received trainings and those who did not receive any trainings for iPad integration.

iPad Integration Levels and Technological, Pedagogical, and Content Knowledge

Q2. What is the relationship between faculty iPad integration levels as defined by SAMR model and their TPACK knowledge?

Groups. Using mean values as indicators of SAMR levels, the participants were divided into mutually exclusive groups based on their responses to the iPad Usage Likert scale questions (See Table 16). Participants who had an average mean value higher than 3.00 for the three redefinition items (S1S10 to S1S12) were assigned to the R group. Participants who had an average mean value higher than 3.00 for the three modification items (S1S7 to S1S9) but lower than 3.00 for the redefinition items were assigned to the M group. Participants who had an average mean value higher than 3.00 for the six augmentation items (S1S4 to S1S6 and S1ST4 to S1ST6) but lower than 3.00 for both M and R items were assigned to the A group. The remaining participants were assigned to the S group. After the participants were assigned to four groups using four SAMR levels, they were grouped into two bigger groups: enhancement (S+A group) and transformation (M+R group). Table 21 summarizes the frequencies, percentage, and cumulative percentage for each level.

Table 21

Integration Group Frequency and Percentage

Group	SAMR Level	*n*	Percentage	Cumulative Percentage
Enhancement (E)	S	41	25.6	25.6
(*N* = 81)	A	40	25.0	50.6
Transformation (T)	M	56	35.0	85.6
(*N* = 79)	R	23	14.4	100.0
	Total	160	100.0	

Note. S = Substitution, A = Augmentation, R = Redefinition, M = Modification

The results showed 14.4% of participants used iPads up to the redefinition level; 35% used iPads up to the modification level; 25% used iPads up to the augmentation level; and 25.6% used iPads only at the substitution level. About 50.6% of the participants used iPads mainly at the enhancement level (S or A) and 49.4% of the participants sometimes used iPads up to the transformation level (M or R).

Technological, pedagogical, and content knowledge survey. The TPACK survey was administrated to this sample to collect self-reported data of the teacher's knowledge. The survey consisted of 35 Likert scale questions with five items for each TPACK construct and a 5-point scale ranging from *Strongly disagree* to *Strongly agree*.

The order of the items was randomized to obtain more trustworthy responses. Table 22 summarizes the means and standard deviations of the 151 valid responses. The means for seven TPACK constructs were all higher than 4.00, indicating the participants in this sample perceived their TPACK knowledge at a high level.

Table 22

Means and Standard Deviations of Technological, Pedagogical, and Content Knowledge Constructs

Variable	*N*	*M*	*SD*
Technological knowledge	151	4.16	.641
Pedagogical knowledge	151	4.41	.483
Content knowledge	151	4.50	.398
Technological pedagogical knowledge	151	4.29	.531
Pedagogical content knowledge	151	4.46	.429
Technological content knowledge	151	4.15	.610
Technological, pedagogical, and content knowledge	151	4.31	.547

IPad integration levels versus technological pedagogical and content knowledge. To detect the difference in TPACK between the participants using iPads at different SAMR levels, the means of the seven TPACK constructs were computed for both the enhancement and transformation groups. The results showed the transformation group had a slightly higher mean value across all TPACK constructs than the enhancement group, indicating the participants who used iPads at the transformation levels perceived their TPACK higher than those at the enhancement levels (see Table 23).

For the enhancement group, the participants perceived their CK was the highest and TCK the lowest among all seven constructs. For the transformation group, the participants also perceived their CK was the highest but they also perceived their PK and PCK were almost as identically high as their CK. They perceived TK the lowest among the seven constructs. It should be noted that on average the participants from this sample tended to perceive their TPACK at a high level (average $M > 4.00$).

Table 23

Descriptive Statistics for Enhancement and Transformation Group

Construct Mean	Group	*M*	*SD*	*n*
MEAN_TK	Transformation	4.24	.599	76
	Enhancement	4.09	.676	75
MEAN_PK	Transformation	4.56	.453	76
	Enhancement	4.26	.470	75
MEAN_CK	Transformation	4.57	.401	76
	Enhancement	4.43	.383	75
MEAN_TPK	Transformation	4.44	.499	76
	Enhancement	4.13	.521	75
MEAN_PCK	Transformation	4.55	.436	76
	Enhancement	4.37	.404	75
MEAN_TCK	Transformation	4.32	.601	76
	Enhancement	3.98	.575	75
MEAN_TPACK	Transformation	4.47	.489	76
	Enhancement	4.16	.558	75

N = 151. TK = Technological Knowledge, PK = Pedagogical Knowledge, CK = Content Knowledge, TPK = Technological Pedagogical Knowledge, PCK = Pedagogical Content Knowledge, TCK = Technological Content knowledge, TPACK = Technological, Pedagogical, and Content Knowledge

The individual scores for TPACK survey were summed and used as an indicator of TPACK levels of individual participants. The data was checked with histograms, kurtosis, and skewedness to determine the normality of the data for each group. The histograms showed the enhancement group (SA) data were normally distributed (see Figure 4) and the transformation group (MR) data were slightly and negatively skewed (see Figure 5).

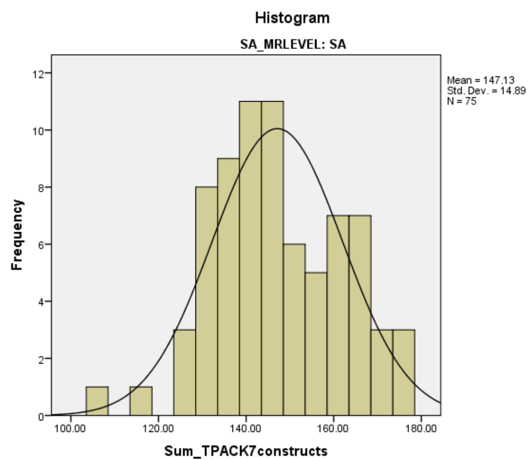

Figure 4. Histogram of technological, pedagogical, and content knowledge total scores for the enhancement group.

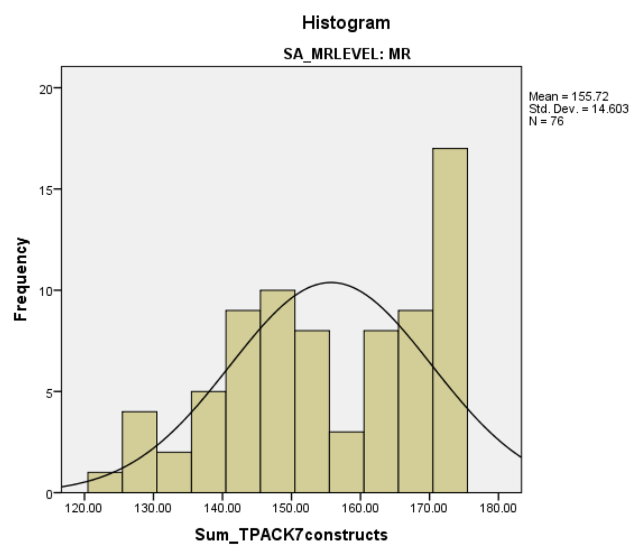

Figure 5. Histogram of technological, pedagogical, and content knowledge total scores for the transformation group.

According to Bulmer (1979), if the skewness is between -.5 and .5, the data distribution is approximately symmetric. The rule of thumb for a kurtosis value is +/-1 is considered very good for most psychometric uses but +/-2 is also usually acceptable. The data of the enhancement group were normally distributed with skewness = -.002, *SE* =.277, and kurtosis =-.410, and *SE*=.548; the normality of the transformation group data was acceptable with skewness = -.299, *SE*=.276, and kurtosis = -.939, *SE*=.545. Levene's test for equality of variances indicated the two groups of data had no significant difference in terms of their variances (F=0.187, p = 0.666). An independent sample t-test was conducted and the results showed a statistically significant difference between the TPACK levels of the two groups. The participants in the transformation group (M = 121, SD = 14.2) perceived their TPACK levels were higher than those who were using iPads at the enhancement level (M = 117, SD = 10.3), $t(149)$ = -3.614, p = .000.

IPad integration levels versus the sub-constructs of technological, pedagogical, and content knowledge. An independent sample t-test was conducted for each TPACK construct to detect the difference between the enhancement and transformation groups. The data showed no violation of normality and equal variance, confirming the kurtosis and skewness values across the seven constructs (between +/-1 for skewness and between +/-2 for kurtosis) and Levene's test values (p > 0.05). As presented in Table 24, the results show statistically significant differences among the means for six constructs between the two groups. Compared to the enhancement group, the transformation group had higher PK, TCK, TPK, and TPACK means at the significant level of .01, two-tail, and higher CK and PCK at the significant level of .05, two-tail. There was no statistically significant difference for TK between the two groups.

Table 24

Independent t-Test Results Between the Enhancement and Transformation Group

Levene's Test for Equality of Variances (assumed)			*t*-test for Equality of Means				
	F	Sig.	*t*	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Sum_TK	2.014	.158	-1.51	149	.133	-.784	.519
Sum_PK	.019	.889	-3.91	149	.000**	-1.470	.376
Sum_CK	.465	.496	-2.09	149	.038*	-.669	.320
Sum_TCK	1.391	.240	-3.52	149	.001**	-1.685	.479
Sum_TPK	.634	.427	-3.65	149	.000**	-1.518	.415
Sum_PCK	.600	.440	-2.58	149	.011*	-.884	.342
Sum_TPACK	.007	.935	-3.71	149	.000**	-1.583	.427

Note: *=significant at .05, two-tail level; **=significant at .001, two-tail level.
TK = Technological Knowledge, PK = Pedagogical Knowledge, CK = Content Knowledge, TPK = Technological Pedagogical Knowledge, PCK = Pedagogical Content Knowledge, TCK = Technological Content knowledge, TPACK = Technological, Pedagogical, and Content Knowledge

Correlation between the integration levels and technological, pedagogical and content knowledge. Each participant's iPad Usage Likert scale score was summed and used to represent the levels of the individual's SAMR level. Each participant's TPACK Likert scale score was also summed and used to represent the levels of the individual's TPACK. A Pearson product-moment correlation test was run113 in SPSS to determine the relationship between SAMR and TPACK scores at the significance level of .05, two-tailed. The data showed no violation of linearity and normality as confirmed with the scatter plot (see Figure 6). No significant outliers were identified and removed.

The results showed a weak positive correlation between SAMR and TPACK scores at the significance level of .01, two-tailed, $r(149) = .336$, $p = .000$.

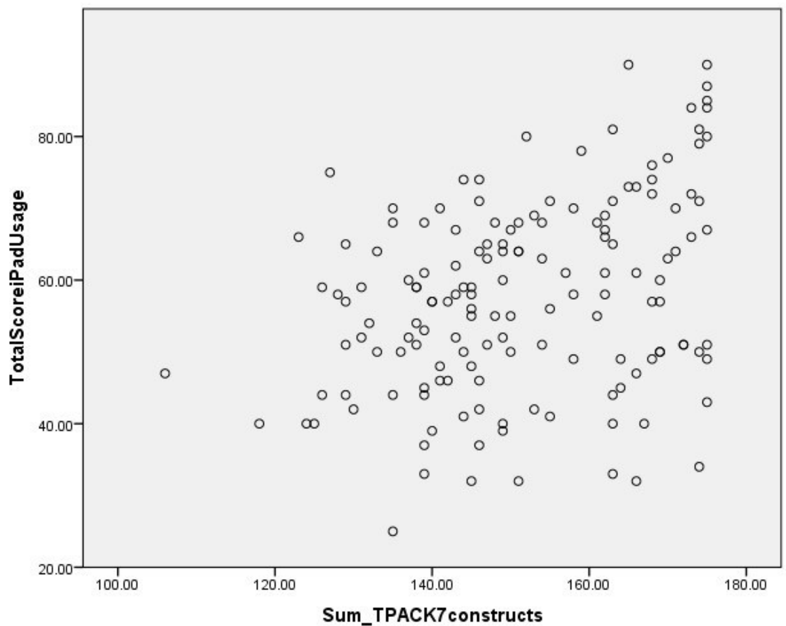

Figure 6. Scatter plot for iPad usage total scores and technological, pedagogical, and content knowledge total scores

Summary. The participants were grouped into the enhancement and transformation groups based on the mean values of their responses to the Likert scale questions at each SAMR level. A Pearson product-moment test was conducted and 114 indicated a weak positive correlation between participants' SAMR and TPACK levels. Independent *t*-tests were conducted between the enhancement and transformation groups. The results indicated the participants who used iPads at the transformation level perceived their total TPACK knowledge statistically significantly higher than those at the enhancement level. The transformation group perceived their PK, CK, TPK, PCK, TCK, and TPACK knowledge significantly greater than those of the enhancement group. No statistically significant difference was found for TK between the two groups.

Phase 2: The Qualitative Study

In this phase, eight participants who took the survey in the first phase were interviewed--two each from each SAMR level. Artifacts such as syllabi before and after iPad integration, assignment descriptions, and iPad integration reports were also collected from some of the participants to triangulate the interview results and provide additional evidence. Quantitative data collected with the questionnaire in the first phase of the study were also used to make sense of the participants' pedagogy. This section presents the results including a description of the participants, data analysis scheme, results of pedagogical difference (Q3), and the results of the pedagogical shift (Q4).

The Participants

In total, 87 participants provided email addresses for the follow-up interview. Four participants from each SAMR level were randomly selected from these participants and contacted. The first two responders from each level were interviewed. This section briefly describes the demographic information of the eight participants.

Substitution level. Dr. L was classified as using iPads at the substitution level and her interview confirmed her classification. Dr. L is an associate professor in special education at a large university on the west coast of the United States. She has been teaching at the higher education level for 36 years. She also has 14 years of teaching experience as a K-12 school teacher. She chose the teaching profession because of the inspiration she got from a book about children with disabilities when she was in middle school. She decided she wanted to teach kids with disabilities and became a school teacher and a professor later after she obtained all her degrees and credentials. On average, Dr. L uses iPads for teaching once a week at both undergraduate and graduate levels in a 1:1 iPad implementation environment. She expressed she was very comfortable in using iPads for teaching. Dr. D was classified as using iPads at the substitution level and her interview confirmed her classification. Dr. D is a psychology instructor at an east coast private college. She started to teach at higher education levels five years ago after a decade pause from her career as a children development educator. She chose to be a teacher because of her personal interest in teaching and learning theories. Dr. D uses iPads for teaching two to three times each week at both undergraduate and graduate levels in a 1:1 iPad implementation environment. She expressed she was somewhat comfortable in using iPads for teaching.

Augmentation level. Dr. G was classified as using iPads at the augmentation level and her interview confirmed her classification. Dr. G has been teaching for 20 years in higher education, starting as a lab assistant. For the last nine years, she was a tenure track assistant professor in a chemistry department at a west coast university. She chose education as her profession because of its meaningful value to society and the opportunity to make a personal impact on her students. Dr. G uses iPads for teaching two to three times each week at the undergraduate level in a 1:1 iPad implementation environment. She expressed she was very comfortable in using iPads for teaching. Dr. W was identified as using iPads at the augmentation level and her interview confirmed her classification. Dr. W is a business instructor in a small private college in the Midwest region of the United States. She has been teaching at the higher education level for six years--four years as a graduate assistant and two years as a full-time instructor. Before teaching, she worked in the corporate world for 25 years. She decided to go back to school to get her doctoral degree so she could share her personal experience gained from the workforce with college students in hopes of better preparing them for a future career. Dr. W uses iPads for teaching two to three times each week at both undergraduate and graduate levels in a 1:1 iPad implementation environment. She expressed she was very comfortable in using iPads for teaching.

Modification level. Ms. V was classified as using iPads at the modification level and her interview confirmed her classification. Ms. V is an adjunct instructor in public health and has been teaching for nine years at a university on the west coast of the United States. She has also been teaching at a local community college for four years. Before teaching, she worked as a community health educator for a non-profit organization for many years. She chose to teach full time because she found she enjoyed teaching and actually had a talent for it. Ms. V uses iPads for teaching every day at the undergraduate level in a 1:1 iPad implementation environment. She expressed she was very comfortable in using iPads for teaching. Mr. B was classified as using iPads at the modification level and his interview confirmed his classification. Mr. B is a visual communication professor in a journalism department. He has been teaching for 12 years at a university on the west coast of the United States. He also has eight years of elementary school teaching experience. Before teaching, he worked for nonprofit organizations as a photographer and documentarist for many years. He stated he chose education as his profession due to his interest in working with kids, his involvement in education projects during his career in Africa, and his graduate studies. He teaches with an iPad once a week on average at the undergraduate level in a 1:1 iPad implementation environment and feels very comfortable in using it for teaching.

Redefinition level. Dr. M was classified as using iPads at the redefinition level and her interview confirmed her classification. Dr. M is a foreign language professor who has been teaching at the university level for 26 years. She is an associate professor at a medium-size public university on the west coast of the United States. She trained and worked as a translator in Europe and on the east coast of the United States for some years before she started her teaching career. She discovered her interest in teaching after she started to teach college level foreign language classes at the university where she studied for her Ph.D. After she graduated with her doctoral degree, she changed her original plan to be a writer and became a professor instead. She described herself as a natural teacher. Dr. M teaches with iPads two to three times each week at the undergraduate level in a 1:1 iPad implementation environment. She expressed she was very comfortable in using iPads for teaching. Ms. K was classified as using iPads at the redefinition level and the interview confirmed her classification. Ms. K is an instructor in communication at a large research university in the Midwest. She used to be a journalist and editor. She taught as an adjunct instructor from 2004 until she was hired as a full-time instructor in 2011. She chose education as her profession because she enjoyed teaching and wanted to help people become better magazine writers. Ms. K teaches with iPads every day at the undergraduate level in a 1:1 iPad implementation environment. She expressed she was very comfortable in using iPads when teaching.

Data Type

Table 25 presents both qualitative and quantitative data collected from these eight interviewees.

Table 25

A Summary of Qualitative and Quantitative Data

Participants	Qualitative Data	Quantitative Data
Dr. L	Interview transcript	iPad usage survey, TPACK survey
Dr. D	Interview transcript, a syllabus after iPad integration	iPad usage survey, TPACK survey
Dr. G	Interview transcript	iPad usage survey, TPACK survey
Dr. W	Interview transcript, syllabi for the same course before and after iPad integration	iPad usage survey, TPACK survey
Ms. V	Interview transcript	iPad usage survey, TPACK survey
Mr. B	Interview transcript, syllabi for the same course before and after iPad integration, iPad integration reports	iPad usage survey, TPACK survey
Dr. M	Interview transcript, iPad integration reports, student reflection papers	iPad usage survey, TPACK survey
Ms. K	Interview transcript	iPad usage survey, TPACK survey

Quantitative data. Average means of the interviewees for their iPad usage survey and TPACK survey were summarized and are presented in Table 26. The SAMR level identified by the survey research from the first phase of the study was confirmed by interview data. The mean values of the enhancement and transformation groups showed a bigger difference among their TPK, TCK, and TPACK than other constructs. Quantitative data were used to supplement and make sense of the interview results.

Table 26

The Survey Responses of the Interviewees

	SAMR Levels				TPACK Knowledge							Survey identifie d level	Interview identified level
	S	A	M	R	TK	PK	CK	TPK	PCK	TCK	TPACK		
Dr. L	2.83	2.67	2.00	1.00	4.00	4.80	4.80	4.00	5.00	4.00	4.00	S	S
Dr. D	3.50	2.50	1.67	1.00	2.80	5.00	3.80	3.40	4.20	4.00	3.80	S	S
Dr. G	3.50	3.83	2.33	1.67	4.20	4.60	4.80	4.40	4.20	4.20	4.60	A	A
Dr. W	3.83	3.17	1.67	1.00	5.00	4.00	4.60	4.40	4.20	3.80	4.00	A	A
AVE	**3.42**	**3.04**	**1.92**	**1.17**	**4.00**	**4.60**	**4.50**	**4.05**	**4.40**	**4.00**	**4.10**		
Ms. V	4.33	4.50	3.67	1.67	4.40	4.40	4.40	4.20	4.60	4.40	4.20	M	M
Mr. B	4.00	3.83	3.67	2.67	4.20	4.60	4.40	4.80	4.80	4.80	4.80	M	M
Dr. M	4.00	3.83	3.67	3.67	4.40	4.60	4.40	5.00	4.60	4.60	4.80	R	R
Ms. K	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	R	R
AVE	**4.33**	**4.29**	**4.00**	**3.26**	**4.5**	**4.65**	**4.55**	**4.75**	**4.75**	**4.70**	**4.70**		

Note. AVE = Mean average of the group

Qualitative data. Every participant was interviewed and artifacts were collected from some of the participants. Qualitative data were the main resources used to answer research questions 3 and 4.

Pedagogical Differences

Q3. What are the pedagogical differences between faculty members at different levels of iPad integration?

To detect differences between faculty members across different SAMR levels, the participants were asked to describe their teaching and learning philosophy, the responsibility of the teacher and students in the learning process, strategies they used to teach, and how they evaluated students' learning outcomes. The answers were coded and cross-examined to identify similarities and differences. An analysis scheme was developed based on the collected data. The format of the analysis scheme was adapted from one created by Kember and Kwan (2000). Similar to Kember and Kwan's study, two broad pedagogical preferences were identified: content-centered and learning centered. Content-centered pedagogy focuses on how to help students master the materials and content to be taught. Learning-centered pedagogy focuses on how to help students construct their own knowledge and perspectives toward the discipline. These two categories of pedagogical strategy should be considered as continua instead of discrete categories. Associated dimensions for each pedagogical preference are presented in Figure 7.

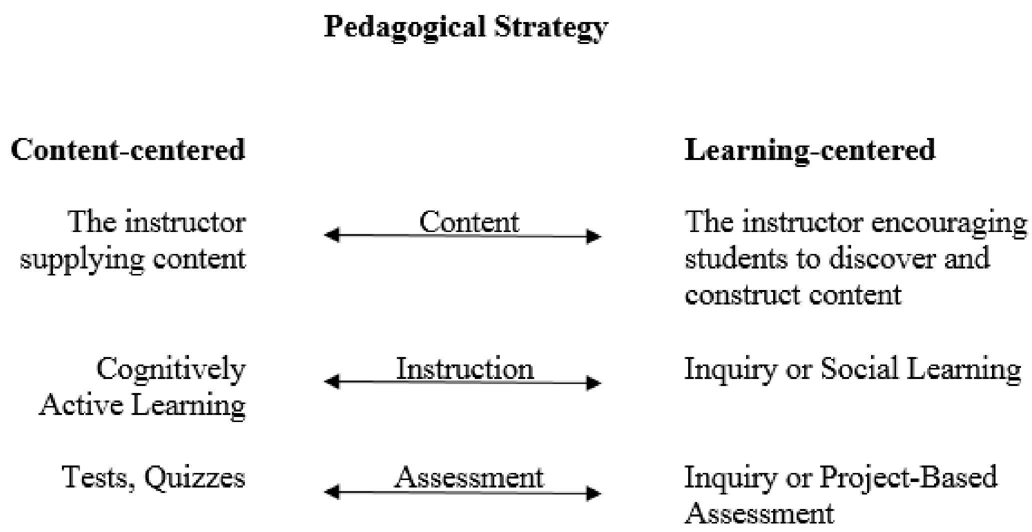

Figure 7. Pedagogical Strategy Scheme

Content. Instructors at the content-centered pole usually determined what was important and made efforts to provide content such as PowerPoint slides, handouts, examples, articles, audio/video materials, and websites. Instructors at the learning-centered pole also provided some content. However, they tended to use the provided content as a starting point. Students were encouraged to build from there and discover more individually or collaboratively to construct their own knowledge base and perspectives about the discipline.

> I choose my textbook very carefully and realize that there are some students who are really struggling for a particular test. Then I will get other means to get the same information across...And now it is so easy on the internet to find pretty decent resources. So I try to line up the readings, try to get them back to the original readings, I also tried to get them resources so that they can go back, like, understand on their own. (Dr. D)

> Everything (in the textbook) is black and white. And it is really sad when you think of the beauty of anything French, you know, from museums, paintings, monuments, streets, everything, you have to see them in color. So I have my students to do research, find illustrations, find video clips, find movies, about what we learned, and put them into some kind of personal folder that would be very personalized ideas of what French culture is. (Dr. M)

Instruction. Instructors at the content-centered pole usually employed more direct instruction and cognitively active learning activities during class time to help students process, synthesize, and/or apply the content provided. Emphasis was on acquisition of the provided content. Instructors at the learning-centered pole were inclined to employ more inquiry or social learning activities, encouraging students to develop knowledge and skills through the interaction with the learning context, with the instructor, and with their peers. Students were also encouraged to develop their own interpretations and perspectives about the discipline. The emphasis was to allow students to personalize their own learning experiences.

> What it typically looks like is that I will give them background, some readings, or watch a movie. And then in the classroom I might supplement that with a three minute YouTube so that we're all on the same page. And then I'll try to have it be either break down in small groups or very much something that everybody has to be an active participant. Nobody is sitting in the back row and play Candy Crush. (Dr. D)

> Usually, if it's a 50 or 75-minute period of class, kind of review what we've learned before, and or presenting a new question where I kind of almost test their prior knowledge, to know what they know from their own background, from their own major. And from there, I kind of tailor based on what their responses are. We go forward with the material for that day. I may present for a little bit or they have some sort of reading, and then I will often have a bigger question for the day that they will work through little by little. I don't just present the answers. (Dr. G)

> I teach magazine writing. I give them the foundation knowledge of, kind of how they are structured. Then they broke up into, depending on the class size, two or three groups. And then they are working on developing a concept for a magazine. From that concept, they develop story ideas. And we work through their story ideas, analyze how these ideas might fit in the magazine, whether they are realistic to do, sources, how you get sources, how you interview sources. Then they take those ideas and they actually execute them. I will bring in, based on the theme of their magazine, like last year we have "Millenniums" as one of our themes. So I brought in sources that are related to one of their topics they wanted to write on. Have them interview that person in front of us. Have not only the students but the person they interview to evaluate for them how the interview went. From there they developed stories. We ended up, at the end of that class,

> created a magazine that got published in iTunes U store. So we have a magazine now, called Millennium. (Ms. K)

> I try to introduce topics maybe with a brief lecture and maybe some visual examples. And then I often times give my students a chance to break up into groups. Maybe they work on a social media like a Tumblr blog or a Pinterest account where they create presentations. They do their own research. I'll give them to certain issues to investigate. And they will investigate them in a group online or wherever. And they will put together a presentation...That is more important. Instead of just having somebody standing there, just lecturing. (Mr. B)

Assessment. Instructors at the content-centered pole frequently used traditional tests, quizzes, and exams to check student understanding. They sometimes used problem-based assessments to test student mastery of certain knowledge or skills. Emphasis was on the acquisition of knowledge (Perrenet, Bouhuijs, & Smits, 2000) and usually took place in classroom settings. Instructors at the learning-centered pole also used traditional tests, quizzes, and exams but these assessments did not dominate evaluation methods. Learning-centered instructors were inclined to employ more project-based assessments in which students were provided opportunities to actively design and execute projects set in real-life situations and closer to professional reality (Perrenet et al., 2000). Emphasis was on the comprehensive application of knowledge and skills in authentic contexts.

> I like to have them practicing. A lot of what I teach is quantitative. So it is quantitative management. So it is a lot of numbers. So I like to have them working along with problem sets that type of things in the classroom. (Dr. W)

> So when it's a large class, certainly multiple choice test and short answer test is a way to get at it. But I try to mix it up so that it is not all...because a lot of students have test anxiety. I do not think they bring their best. So try to have it be a lot of different ways that they could show me they've mastered something, whether that is through a writing sample, through discussion or through some...I do some quick online quizzes and some more major tests. (Dr. D)

> So… assignments definitely. Exams. Class participations, group work, like I said, quizzes, exit tickets to check in with them in terms of their understanding of the of the contents. We have brief writing assignments that are like typical homework assignments but they consist of various different... it could be like a

> writing practice perhaps, but it could also be taking their iPad out in their community and documenting certain things and then writing about it for example. So I have a variety of ways to evaluate their learning. (Ms. V)
>
> I do not do any exams. So a quiz standpoint, the only thing we do is APA style. They would do it on the iPad. They do all the multimedia content, writing content, everything. Like I said, it is like a real world preparatory. So it's all writing. (Ms. K)
>
> For this particular class, the class that I teach with iPads, there are many assessment tools. So obviously they are going to publish types of essays, or reports, so this will be one way. We will do oral presentations. The oral presentation will be assessed on, you know, the preparation for the type of research they have to do a bibliography. They have to do, um, to find illustrations. They also have to speak clearly and address the public, also public speaking types of assessment. So it is a variety of aspects in their presentations. In the interviews that they do, that something else I will talk about later, they have to find a francophone person, a French speaking person on the campus or among their acquaintances. And so they have to submit the questions first. And the questions have to reflect curiosity about the culture. And I encourage them to test what they learn from the book. In the textbooks it will say, you know, (French), the type of funeral. I think it's fun for them to ask a person who's been French educational system to see if they really think the same thing, you know, you can test whatever they were told in the book. But also the interesting questions about the culture, personal questions that they are curious about, that are pertinence to French culture. Anyway, so contents. And when they... I have exams obviously. (Dr. M)

Based on an analysis of the interview transcripts and artifacts, participants were classified into three pedagogical strategy groups (see Figure 8): blended, content-centered, and learning-centered. The blended group is a transitional stage between content-centered and the learning centered. Instructors classified into this group shared a lot of similarities with the content-centered group but also used some learning-centered instruction or assessment strategies. The classification indicated an association between the levels of iPad integration and the instructors' pedagogical inclinations. Instructors who used iPads at the enhancement levels tended to cluster more toward the content-centered end of the continuum while instructors who used the iPad at the transformation levels clustered more toward the learning-centered end of the continuum. However, it also appeared pedagogical inclination did not determine the integration levels. Instructors with similar pedagogical inclinations might use the iPad at different levels as those in the blended group. The results indicated higher levels of iPad integration required more learning-centered pedagogy but having a learning-centered pedagogy did not guarantee higher levels of iPad integration.

SAMR Levels

R			Ms. K Dr. M
M		Ms. V Mr. B	
A	Dr. G	Dr. W	
S	Dr. D	Dr. L	
	Content-centered	**Blended**	**Learning-centered**

Pedagogy

Figure 8. Pedagogy versus integration levels.

Pedagogical Shift

Q4 Has faculty's pedagogy shifted because of iPad integration?
If there was a shift in pedagogy represented from the research, what factors facilitated the pedagogical shift?

To explore the impact of iPad integration on the participants, they were asked questions about their experience using technology for teaching before iPad integration, how they have used iPads in their teaching, whether they thought iPad integration had influenced the way in which they taught, and provided some examples of the difference if they believed they did change the way they taught due to using iPads. The participants were also asked what factors they thought had promoted or hindered their iPad integration. Table 27 summarizes the pedagogical shift or no-shift at each SAMR level. This section presents the results of the two groups (no shift group and shift group) as well as the factors that might have influenced the pedagogical shift.

Table 27

Pedagogical Shift at Each Integration Level

SAMR Level	No Shift	Shift
R	Dr. M	Ms. K
M	Mr. B	Ms. V
A	Dr. W	Dr. G
S	Dr. L	Dr. D

No shift. Four of eight participants determined there was no fundamental shift in their pedagogy. Three of four participants (Dr. L, Dr. W, and Mr. B) said they did not think iPad integration had changed their pedagogy. An examination of the interview responses and artifacts confirmed their perceptions. These participants had their teaching routines and were happy with existing pedagogical strategies. Adoption of the iPads fit their current pedagogy and helped improve the efficiency or effectiveness of what they had already been doing. Learning activities might have been adjusted because of using the new tool but the nature of instruction and assessments was not changed. The following are personal accounts from their interviews:

> For me, it was not, it was just learning, taking a lot of things I've already done and just applying them using some of the new programs or apps. (Dr. L)

> No, I don't think I teach differently. I think what's different is the students interact. They all have an iPad so they are following along with the presentations. They see it up on the board, or you know, being projected. They also see it on their iPad I think it just change the way that the students interact, more than it changes the way that I teach. (Dr. W)

> I do not think it changes my teaching, post-iPad, things like that. I think I'm still pretty much the same. (Mr. B)

One participant (Dr. M) believed that iPad integration changed her ways of teaching. An examination of her interview and artifacts indicated her pedagogy had not changed. What had changed was the implementation of the same activities due to the availability of the iPad. For example, Dr. M described how the same learning activity was implemented before and after iPad integration.

> One activity I use in this class is to have students interview francophone speakers. This used to be reported on paper with a brief discussion of the difference in interviewees' answers in class. With the iPads, students film the interview and edit the video clips with iMovie. And we watch the videos in class. Students can hear the different accents and see the different faces of "Francophonie." We also discuss responses after watching the videos. I asked the students to adapt their

> questions to the interviewees, and also to "test" what they read in their textbook about the French.

Dr. M provided this example as evidence she had changed her way of teaching. She also provided examples of how iPads had influenced students' ways of making flash cards or documenting their field trips. However, to the researcher, what had changed here was not her fundamental pedagogy but the implementation of the same learning activities.

It is worthy of note that although these participants did not change their pedagogy after iPad integration, they did adjust the ways in which they implemented similar learning activities. Usually, use of the iPad improved the efficiency and/or effectiveness of old learning activities to some extent. For example, before using the iPad, Dr. W had a simulation activity in which students worked on a long simulation out of class in group and presented the results in class. After using iPads, students worked on multiple short simulations in class with Dr. W as the guide. Before using the iPad, Mr. B used to ask his students to create visual presentations at home and present them during class time using the projector in front of the classroom. After using the iPad, he started to organize students in creating visual presentations on social media in class with him walking around and helping. Instead of merely reporting back the interview answers orally, now Dr. M asks students to document the process and share with the class so all the students can watch and hear different accents and discuss the answers together. Dr. L replaced paper charts with a digital spreadsheet that could be projected on the big screen and seen by all the students.

Shift. Four participants that were determined to have a pedagogical shift after iPad integration although it was not necessary what they thought of by themselves. Three participants believed iPad integration had changed their ways of teaching. Dr. G stated her pedagogy had changed in recent years toward more learning-centered. She used to focus on lecturing and had almost no interactions with students. In recent years, she started to pay more attention to student learning. She stated her reasons for integrating iPads into teaching was to "put the control in students' hands," indicating it was the change in her pedagogy that made her realize the value of the tool and decided to adopt it. After she used the iPad, she started to create more opportunities for her students to interact with her, to engage with the learning content, and to practice the knowledge. For example, she started to integrate in-class quizzes or Socratic questions to engage students during her lecture and adjusted her lectures based on the results. She integrated 3-D models into teaching and allowed her students to manipulate and do simulations in class with her on site to provide feedback and advice. She started to ask her students to create visual presentations using the data she provided instead of presenting the results herself. According to her, all these changes were due to the availability and use of iPads. She also perceived her changes were not only taking place in the iPad class but also in other non-iPad classes. She said she "consciously made more active learning stopping points" in those non-iPad classes. She would ask students in non-iPad courses to use paper cards to imitate the apps she used in the iPad class to participate in the Socratic question activity during her lectures.

Based on Ms. V's self-account, it appears that she experienced big changes in her pedagogy after iPad integration. When asked to describe her experience of using technology to teach before using the iPads, she stated,

> We had the computer and projector in class. That is kind of what I did. I mean, I didn't even use Moodle. I'm not sure if you're familiar with Moodle. Even for the first few years of my teaching, I did not use Moodle. I did not really see the benefit at that time. Or I was not sure how to use it. So I would say it was very minimum. I do lecture on the PowerPoint. I might show it to them with a news clip, something like that, but I was not doing anything in term of having students turn in assignments online. I was not posting content for them online. If I had contents for them, I would just email it to them. I wasn't doing grading online. None of that.

When asked to describe the difference in her teaching before and after iPad integration, Ms. V provided the following examples to demonstrate how the iPad had changed the way she taught:

> I think another example would be just, like these mini-assignments that are due in class. So you know, before they might have had their homework assignment or I might have said, you know, we might have listened to that NPR story and just had a verbal discussion about it, for example, which for a lot of students they may not have participated in or they may, you know, they may talk to a partner but not really go into more detail, for example. So with the iPad now, what I do is I...in the lecture notes, for example, or even just on the fly, I say "OK, get with a partner and answer these questions. Or answer them individually, then share with a partner and then upload to Moodle. I have built in these mini-assignments into each class session, which are holding them a bit more accountable for the content in the class. As before, it would have just been lecture and discussion. Now they're actually submitting their work for credit. So I think it is causing them to do a bit more in class work. Be a bit more active learning that I did not do before. I think the iPads is the tool that allows me to do that. For example, the assignment that I described with the students take their iPad and take pictures and video and put it in that storyboard. I did not have that assignment before iPads. I created the assignment based on having the iPads. Before that it was just a lecture class. I did not do the assignment. We just either did not do, or it was very minor. Oftentimes, I just do, you know, it is five minutes beginning of the class, I might have 3 or 4 questions based on the reading or based on the lecture previous, for example. Now they do it on iPads but before they just did it on paper and pencil. It was not a formal assignment that I have to write instruction for, something like that.

> One of the other things that I do with the iPad for my teaching is that I will put up mini- lectures. I will record many lectures on the iPad and then I'll post those to Moodle, or to YouTube. My students will have access to that link. They will watch the mini-lecture outside of class, not in class time. Those mini-lectures usually has a small assignment, either a reflection question or something like that. And they have to post those mini-assignment back to Moodle for grading, for a course grade. That is how I was able to get around some of the content I usually would have just covered in the lecture. We probably do not have enough to cover it in the lecture because we are doing more quizzes, more exit ticket, more discussion, more small group learning, things like that. So I actually use the iPad to the advantage of covering all the content but covering it in the way that may be not traditional.

It was interesting to note that unlike Dr. G who consciously changed her teaching practices in non-iPad courses based on what she learned from iPad integration experience, Ms. V seemed not to be able to do that:

> I actually teach the same course but the difference sessions of the same course. For example, in the past semester, I had two sessions of iPad classes, and two sessions of non-iPad sessions. So the activities we did in the iPad classes, the non-iPad classes did not even do.

She explained the reason why non-iPad classes did not do the same activities was the lack of access to an iPad. For her, the iPad was not a supplementary but an indispensable tool in her teaching.

Two participants stated their pedagogy shift and iPad integration went hand in hand. Ms. K believed iPad integration changed her way of teaching. She described her teaching as “pretty conventional” before using iPads. After introduced iPads, she changed her class to a flipped classroom, which she called “the inverted model”:

> Mine is sort of go hand-in-hand. I had only been teaching for one semester before I got iPads. So I was pretty conventional, you know. I had PowerPoint slides and I would give a lecture and then I would give some sort of assessment. I mean, it was what I had experienced so I kind of went with what I knew until I was introduced to the iPad and iTunes U, and went out to Apple, and started developing materials. And then I started to shift into kind of the inverted model that I do now.

When asked whether she thought iPad integration influenced her pedagogy, she said,

> Yes. My focus is really on the personalized learning environment. So the iPad provides my students that personalized learning environment. It's basically not only their classroom in the one device but it's also the tools that they need to execute any of the assignments or opportunities… For me, the iPad is an all-inclusive environment, academically speaking but also professionally speaking, to prepare them the skills they need to go out and get journalism job."

Similarly, Dr. D's pedagogical shift and iPad integration went hand in hand. When she started to teach five years ago, the institution she works for had just started an iPad initiative. About the same time, she also started reading more about pedagogy. Dr. D stated one big change for her pedagogy was that she started to use formative assessment as a tool for her teaching. She used to deliver content and then asked students to take a long quiz after class to check student learning outcomes. Now with the iPads, she is able to create some short quizzes for students to take in class during her lectures. She started to integrate more instant, formative assessments into her teaching. In her case, it appeared the pedagogy and technology integration improved simultaneously. Her interest in pedagogy made her think more of how to use the tool to support her teaching and the use of the tool enhanced her reflection of a better way of teaching.

Factors that facilitated the pedagogical shift. When examining the factors that might have facilitated the participants' pedagogical shift, it appeared that their dissatisfaction with previous teaching and actively seeking changes, or personal motivation, was the key factor:

> [Before using the iPad] So I was pretty conventional, you know. I had Power Point slides and I would give a lecture and then I would give some sort of assessment. I mean, it was what I had experienced so I kind of went with what I knew until I was introduced to the iPad and iTunes U, and went out to Apple, and started developing materials. And then I started to shift into kind of the inverted model that I do now. (Ms. K)

> [Before using the iPad] So I would say it was very minimum. I do lecture on the PowerPoint. I might show it to them with a news clip, something like that, but I was not doing anything in term of having students turn in assignments online. I was not posting content for them online. If I had contents for them, I would just email it to them. I wasn't doing grading online. None of that. (Ms. V)

Learning to teach with the iPad provided an opportunity for the participants to get the resources and the support they needed, which facilitated the shift:

> For our program here, we have a summer institute that is one-week long. It is also a preface by a one-semester long training session too. So you spend a lot of time to learn about the apps, and just the technology, and the summer institute really focuses on your syllabus, how you construct your courses. But one part that is still missing is specific how do you evolve your pedagogy with the technology. So you will have this nice device, but if you are not applying it to student learning, it just becomes another add-on. (Dr. G)

> On our campus we have faculty technology center. It is the group that was really in charge of getting iPads to instructors, and having training, something like that. So we maintain a learning communities. I am actually the liaison for my department as well. I have definitely a community of people that I can go to, to ask for feedback, to get new information. (Ms. V)

> I am actually taking an online best practices class right now. And so there is some professional development. …But yeah, very good about offering support in preparing all the teacher a little bit more forward. (Dr. D)

Learning to teach with the iPad also triggered active reflection of current teaching practices that gradually helped evolve their pedagogy:

> That is what I think a lot of faculty, I know I do, at least when I got this technology, I have to think very carefully about how it applies to their learning. It cannot be just an add-on. It has to have some student learning value to it. That is to me where I spend more and more time think about how technology applies. So I just learned something about digital storytelling so I'm trying to think about how I could incorporate that using these devices because then we could be walking around they could be taking pictures and videos of things and getting that experience sort of document it, right. (Dr. G)

> The time I got the iPad, I also got much more interested in reading about pedagogy and reading about...so I think all of the same time really started to understand assessment as a tool for my teaching not only as a tool for understanding where students were. So yeah I think you can use it differently. I think I do teach a little bit more differently. I think as I am planning the class for the fall and trying to find really differentiated videos, like the neuron example, the

> really high level ones, you know. It might be interesting to try to figure out how to do in class time itself instead of just posting a bunch of things on Moodle as a preparation for class. (Dr. D)
> So it has evolved. When I first started teaching with the iPad, I would say it was very limited. The first semester I taught with the iPad, I really did not receive that much training. I felt like I was really thrown into the deep end of the pool. So I will just say how I'm using it now. Because it really has changed over the last few semesters as I've got more comfortable. (Ms. V)

It appeared that maintaining an active learning community helped enhance their pedagogy evolvement. The two participants who had bigger changes in their pedagogy all emphasized the importance of a learning community in improving their knowledge and skills regarding iPad integration:

> Me personally I do not need the Apple Training. I wanted to learn it on my own. What Apple allows me to do was to plug into a system that supported me by having other people who were doing what I do. So at my institution, during the time I was doing what I did, very few people were doing that. So the people I have met in Apple was my support system. I am an Apple distinguished educator now. So I went to Germany to meet with 200 other people who think like I do. That is kind of validate what we do, inspire each of us. We got ideas off each other. (Ms. K)

> On our campus we have a faculty technology center. It is the group that was really in charge of getting iPads to instructors, and having training, something like that. So we maintain a learning community. I am actually the liaison for my department as well. I have definitely a community of people that I can go to, to ask for feedback, to get new information... We are always sharing apps, sharing ideas, something like that. (Ms. V)

Compared to Ms. V and Ms. K, Dr. D and Dr. G appeared to have less of a pedagogical shift and used iPads at lower levels. When asked, “How do you use the iPad to teach?”, Dr. D admitted it was “Not enough.” She was aware her school has been offering professional development opportunities regarding iPad integration and other pedagogical-related topics in the format of one-time workshops or short online courses. She had just started to take a Best Practices class for iPad integration during the time the interview was conducted. Dr. G’s school offered semester-long training sessions for technology training, such as apps, followed by a one-week summer institution in which faculty learned about syllabi and construction of courses. According to Dr. G, “One part that is still missing is specific to how you evolve your pedagogy with the technology.” When comparing these two sets of participants, it appeared maintaining an ongoing active learning community was a more effective way to consolidate and enhance faculty’s pedagogical growth during technology integration than one-shot workshops. Based on the small sample, it was impossible to generalize and draw any conclusions. More research is needed to compare these two professional development strategies.

In summary, equal numbers of participants either did or did not have a pedagogical shift while integrating the iPad into their teaching. A pedagogical shift happened at all integration levels. Learning to teach with the iPad might have triggered a pedagogical shift for some participants but not all of them. Participants who did not show evidence of pedagogical shift used the iPad mainly to support current teaching practices. For those who did shift their pedagogy, personal motivation to improve existing teaching practices appeared to be a key factor that drove the participants to actively seek opportunities and support for learning to teach with the iPad. Resources and support provided through trainings or interactions with a learning community seemed to be able to foster a pedagogical shift better than one-time workshops.

Summary

The results of the study showed iPads were used frequently at the enhancement level, sometimes at the modification level, and rarely at the redefinition level for this sample of the participants who had been using the iPad as an instructional tool for at least two semesters before this study. A weak correlation was found between iPad integration levels defined by the SAMR model and participants’ self-reported TPACK.

A statistically significant difference was found between participants who used the iPad at the enhancement and transformation levels for PK, CK, TPC, CPK, PCK, and TPACK. The transformation group rated their PK, CK, TPC, CPK, PCK, and TPACK greater than the enhancement group. However, no statistically significant difference was detected between these two groups for their TK.

The results obtained from the interviews validated the survey results and provided additional evidence to show a pedagogical difference between participants who used the iPad at different SAMR levels. Participants who used the iPad at higher SAMR levels tended to have more advanced pedagogical knowledge and learning-centered practices. However, the pedagogical knowledge and practices were not always consistent with iPad integration levels. It appeared that learning to integrate iPads in teaching had the potential to facilitate a pedagogical shift in some participants but it did not necessarily happen to everyone. Personal motivation to improve existing pedagogical practices appeared to be the key factor. An active learning community was found to be more effective than one-time workshops in facilitating faculty's pedagogical growth and shift. Chapter V presents the discussion and conclusion based on these results.

CHAPTER V

DISCUSSION AND CONCLUSION

The purpose of this study was to identify how iPads had been used in higher education sectors and the relationship among faculty's knowledge, pedagogy and iPad integration levels. Using a mixed-methods research design, the researcher conducted a survey and then follow-up interviews with faculty members who had been using iPads as an instructional tool for at least two semesters in higher education in the United States before the study. The following research questions were addressed:

Q1 How have iPads been used as an instructional tool by faculty in higher education settings in the United States?

Q2 What is the relationship between faculty iPad integration levels as defined by the SAMR model and TPACK?

Q3 What are the pedagogical differences between faculty members at different levels of iPad integration?

Q4 Has faculty's pedagogy shifted because of iPad integration? If there was a shift in pedagogy represented from the research, what factors facilitated the pedagogical shift?

This chapter presents a review and discussion of the findings regarding the research questions. Implications, limitations, and recommendations for future research are also discussed.

IPad Usage and Integration Levels

Q1 How have iPads been used as an instructional tool by faculty in the higher education settings in the United States?

To answer this research question, a self-designed questionnaire was administrated and 160 valid responses were collected from higher education faculty members who had used an iPad for at least two semesters in their teaching across the United States. The results showed 84.35% of the participants used the iPad at least once a week for instructional purposes. iPads were used more often at the undergraduate level than at the graduate level. iPads were used in a variety of disciplines as an instructional tool to support teaching and learning for different purposes and mainly at the enhancement level of the SAMR model.

The results of the study suggested iPads were often used by instructors to store and read e-text, conduct personal productivity activities, and present lectures. iPads were often used by students to retrieve course material, access online information, take notes, take assessments, share contents with others, and take quizzes. iPads were sometimes used to create multimedia content or facilitate small group activities but rarely used to engage in authentic social learning activities in or outside of class. These findings were consistent with previous studies on iPad initiative evaluations. For example, Yeung and Chung (2011) reported results from Loyola Marymount University's iPad Exploration Project after three months and found participating faculty mainly used the iPad for instant access to course resources and library databases, as a presentation or projection device, and communication with students. Youm et al. (2011) summarized the instructional usage of the iPad in a large medical school after a one-year one-on-one implementation. They found the iPad was mainly used to access course material, present lectures, for student notetaking, online assessments, and sometimes small group activities. Dickel et al. (2013) evaluated a large 1:1 iPad deployment at Creighton College after a six-month deployment and found the majority of faculty did not go beyond the basic usage of the iPad as a presentation tool and an e-reader. Reviewing research on iPad integration, Nguyen et al. (2014) drew a similar conclusion: "The iPad was used in different ways by different users, mainly as a tool to access course resource and library databases, a note-taking tool, a communication tool, a presentation/ projection device and as a device for online assessment" (p. 191). This study confirmed findings from previous studies with first-hand, empirical data collected from a larger group of experienced iPad integrators across multiple iPad initiatives and pilots. Additionally, the study identified the trend of moderate use of the iPad as a multimedia production tool or to support small group discussion.

Results from the current study indicated iPads were often used at the substitution and augmentation levels, sometimes at the modification level, and rarely at the redefinition level. In other words, iPads were used more often at the enhancement level than at the transformation level for this sample who had used iPads for at least two semesters on a weekly basis and reported they were very comfortable in using iPads for instructional purposes. Although all four levels of the integration are necessary, the transformation level of technology integration was determined to have higher potential in enhancing more active and deeper learning (Bloemsma, 2013; Cochrane et al., 2013). An explanation for this finding might be unstructured personal iPad usage could happen at the enhancement level without intentional instructional design, requirements, and guidance. However, the transformation level is a more structured use of the iPad and needs an intentional design by instructors. For example, students could take notes, annotate on their e-book, or access digital content without being guided or required by their instructors. However, creating a digital story with the iPad to demonstrate learning had to be a mandatory learning activity designed and required by the instructor so students would do it. If the instructor did not use those instructional strategies or did not use the iPad to support those instructional strategies, students were not likely to do them. Student learning is greatly influenced by how their instructors teach (Entwistle & Entwistle, 1991; Kirschner, Meester, Middelbeek, & Hermans, 1993; Trigwell & Prosser, 1991; Wierstra, Kanselaar, van der Linden, Hans, & Vermunt, 2003; Wilson & Fowler, 2005). Without the instructor's requirement and guidance, students tend not to use the iPad beyond the enhancement level (Alyahya & Gall, 2012; Dickel et al., 2013; Geist, 2011; Hesser & Schwartz, 2013).

The absence of structured iPad usage implied the participants might lack the knowledge and/or were reluctant to change their existing teaching practices. The independent *t*-test showed faculty who used the iPad at the transformation level perceived their TPACK levels significantly higher than those at the enhancement level for all TPACK constructs except TK, indicating the TPACK level influenced iPad integration levels. Lack of structured iPad usage might also imply most of the participants were reluctant to change previous teaching practices. They mainly used the iPad as an add-on to support access to assigned learning materials or online information, improve personal productivity, or facilitate communication. Usage at the enhancement level required almost no change in faculty's existing instructional strategies or a redesign of learning activities. Hence, they were conducted more often to increase the efficiency of the learning or teaching process because of their less disruptive natures. The results suggested improving faculty's TPACK could potentially increase their iPad integration levels. At the same time, faculty also have to be convinced the results of using the iPad at the transformation level are worth their effort so they are willing to adjust their existing teaching practices.

Training was one of most often cited extrinsic factors that influenced technology adoption and integration by faculty (Georgina & Hosford, 2009; Lacey et al., 2014; Rienties, Brouwer & Lygo-Baker, 2013). To encourage technology integration, the majority of universities in the United States provide some training for their faculty (Eagan et al., 2014; Georgina & Hosford, 2009). However, the effect of these trainings on technology integration practices has been undetermined. Training program evaluations usually showed trainings were able to improve teachers' knowledge and sometimes even changed their beliefs (Steinert et al., 2006). However, the impact of training on teaching practices was not often observed (Brinkerhoff, 2006; Georgina & Hosford, 2009; Steinert et al., 2006).

Data from this study showed levels of iPad integration were not found to be associated with training; half of the participants received some training before and/or during their iPad integration process. However, no statistical difference was found between the trained and untrained groups in terms of integration levels. One explanation might be the special characteristics of this sample--they were a group of early adopters with characteristics of being visionary with a strong technology focus, risk takers, experimenters, and generally self-sufficient (Zayim et al., 2006). Training programs targeting mainstream adopters did not appeal them because of their high self-efficacy for personal technology use and expertise in technology integration (Zayim et al., 2006).

The results suggested early adopters had different needs; trainings should take those needs into consideration. The results also indicated whatever content these trainings covered, they did not effectively promote iPad integration at the transformation level. The results did not imply the trainings should not be provided since many research showed trainings were necessary in promoting the adoption of technology (Steinert et al., 2006). Instead, the results raised questions on why current trainings did not work and what types of trainings would be more effective in promoting iPad integration at the transformation level. Future research is needed to explore these questions to help faculty improve their iPad integration.

Participants who integrated the iPad in a 1:1 environment in and out of the classroom were found to use the iPad more at the enhancement level than those who used the iPad in a non-1:1 environment, e.g., iPad carts, BYOD, or other models. However, no significant difference was found between the groups in their frequency of using iPads at the modification or redefinition levels. Both groups showed a lack of iPad integration at these two transformation levels. The findings indicated time of adoption, frequency of use, enthusiasm, or comfortableness of using the iPad might not necessarily result in higher-level iPad integration. Unlimited access to the device encouraged its adoption at the enhancement level but did not promote its integration at the transformation level.

These findings suggested higher education institutions should continue increasing access to the mobile device to encourage its adoption and further increase the efficiency of the teaching and learning process. At the same time, since the transformation level of integration usually required the change of existing teaching strategies or redesign of current learning activities, supports need to be in place to promote the transition from enhancement to transformation.

IPad Integration Levels and Technological, Pedagogical, and Content Knowledge

Q2 What is the relationship between faculty iPad integration levels and their TPACK?

Participants were grouped into enhancement and transformation groups based on mean values of their responses to the iPad Usage survey. High mean values of the TPACK survey results showed most of the participants were very confident about their TPACK. An independent *t*-test was conducted between the enhancement and transformation groups. The results indicated the transformation group perceived their TPACK was greater than the enhancement group for total TPACK scores and six sub-constructs (PK, CK, TPK, TCK, PCK, and TPACK). Technical knowledge was the only construct found to have no significant difference between the two groups. A Pearson product-moment test was conducted using the sum of iPad scores and the sum of TPACK scores of individual participants. The results indicated a weak positive correlation between iPad integration levels and TPACK total scores.

These findings confirmed conclusions of many previous studies and suggested high levels of technology integration required more balanced and integrated TPACK (Agyei & Voogt, 2011; Benson & Ward, 2013; Mishra & Koehler, 2006; Pierson, 2001). This result suggested TPACK was very critical in increasing levels of technology integration. Supports and trainings for faculty need to focus on enhancing both the balance among individual constructs and the integration of all constructs in the TPACK framework.

The findings also suggested TK was not the discriminate factor that influenced levels of iPad integration. It might be because of the special characteristics of this study's sample--the participants were not novice users of the iPad. Instead, they have already had at least two-semester experience of using the iPad to teach before the study. They might have developed a similar level of confidence and comfortableness in using it. Previous studies showed teachers with high technological self-efficacy tended to use technology more in their teaching (Georgina & Olson, 2008; Spotts, 1999; Zayim et al., 2006). This explained the high frequency of the iPad usage among the participants. The results also indicated participants who had similar levels of TK used the iPad at different levels, which meant TK level was not the decisive factor that influenced their integration levels. As previous studies suggested, high TK alone did not guarantee a high level of integration (Benson & Ward, 2013). Pedagogical knowledge was found to be key to the development of balanced and integrated TPACK (Benson & Ward, 2013). This study echoed the findings from Benson and Ward (2013) about the role of TK in the technology integration process.

Although TPACK was determined to be important, a weak positive correlation also indicated TPACK was not the only factor that influenced levels of iPad integration. As summarized in Chapter II, technology integration is a complicated process. Many extrinsic and intrinsic factors were determined to influence the adoption and integration of technology into teaching by previous research. In this study, iPad integration levels were most likely influenced by a combination of both extrinsic and intrinsic factors.

About 23% of the participants in this study did not use the iPad in a 1:1 implementation environment. For them, iPad integration levels might have been more directly related to the availability of the device rather than their TPACK. As discussed in the previous section, lack of access to the device influenced participants' adoption and integration of the iPad. Availability of the technology did not enhance the transformative level but did promote the enhancement level of usage. For those who used the iPad in a 1:1 implementation environment, iPad integration levels were more likely influenced by intrinsic factors such as teachers' knowledge and beliefs. Data from this study already confirmed TPACK was one of those factors. Another factor might be their beliefs of the perceived value of iPads for particular teaching activities or instructional strategies as revealed in the interview data from the second phase of this study. It was less likely that faculty would use the iPad to support the transformation level of learning activities unless they perceived the value and were willing to devote time and energy to redesigning existing learning activities. Another factor might be time. The transformation level of iPad integration usually involves a redesign of learning activities or even a change in existing instructional strategies. Even if participants perceived the value and had sufficient knowledge, they might not change their teaching practices due to the lack of time to make the shift. A weak correlation between iPad integration levels and TPACK might have resulted because some participants overestimated their TPACK as reported by some previous studies (Agyei & Voogt, 2011; Garret, 2014). The findings suggested the transformation level of iPad integration required the availability of multiple extrinsic and intrinsic factors. Future research should include all these factors to determine the relationship between them and their contributions to the levels of integration.

IPad Integration Levels and Pedagogy

Q3 What are the pedagogical differences between faculty members at different levels of iPad integration?

To determine the relationship between iPad integration levels and pedagogy, two participants from each SAMR level were interviewed. For the eight interviewees, their SAMR level was identified by survey results and confirmed by their interview data, which triangulated the survey results and implied the iPad Usage survey was valid and reliable in identifying the participants' levels of iPad integration. Average mean values of TPACK for the transformation group were higher than those of the enhancement group across all constructs. There was a bigger difference among their TPK, TCK, and TPACK than other constructs. This might imply the difference in integration levels between the two groups was associated with their TPACK, especially with the degree of integration among TK, PK, and CK. The qualitative study data indicated participants who used the iPad at the transformation level demonstrated a learning-centered pedagogical preference while participants who used the iPad at the enhancement level were more content-centered.

One explanation for the association between pedagogical preference and integration levels might be because learning-centered pedagogy focuses on providing chances for students to construct their own knowledge. Students are encouraged to research, construct their own content, and apply it to authentic contexts through individual or group projects. The iPad was mainly used by students to support inquiry-learning activities, e.g., do research, interview, create multimedia content, interact with field experts or a global audience. All these activities fell into the transformation level of integration. In content-centered pedagogy, direct instruction was used more often.Faculty usually used technology to support and enhance the dissemination of content during teacher presentations and demonstrations. Instructors also used the iPad more often in facilitating cognitively active learning activities at the enhancement level, e.g., in-class quizzes. Because the transformation level of learning activities was not designed and implemented by the instructors, students were not likely to use the iPad at that level themselves. The findings indicated when external and internal conditions for adopting the iPad were ready, instructors' pedagogical inclinations might decide how they integrated the iPad into their teaching and further decided the levels of integration. The interview data showed it was not just any type of pedagogy but learning-centered pedagogy that encouraged higher levels of iPad integration. This finding suggested faculty developers or administrators might focus on providing supports that promotes faculty's learning-centered pedagogy.

The results also indicated pedagogy was the necessary but insufficient condition for technology integration. Instructors with similar pedagogical knowledge and practices might use the iPad at different levels. The findings implied some other factors influenced participants' technology integration levels at the same time. As described in the literature review in Chapter II of this study, two big categories of factors usually impacted the adoption and integration of technology: extrinsic factors (e.g., access to the device, resources) and intrinsic factors (e.g., beliefs, knowledge). In this study, the interviews did not reveal external contextual constraints that hindered adoption except occasional technical problems encountered in classrooms. This implied environmental conditions were not perceived as barriers that hindered integration levels. The interviews also did not reveal internal beliefs that hindered the integration process. They all shared similar beliefs that learning should be an active process. All participants chose to use the iPad voluntarily and held positive attitudes toward using iPad for teaching, which implied positive beliefs. This finding implied participants' attitudes toward the value of the iPad did not hinder their integration. Differences in integration levels for the instructor who shared similar pedagogical preferences were more likely because of the differences between their TPACK as indicated by TPACK average mean values. Participants who used the iPad at the enhancement levels appeared to have much lower TPK, TCK, and TPACK scores that those at the transformation levels. This result echoed findings in the previous section suggesting TPACK, especially integrated TPACK, was necessary for the transformation level of iPad integration.

Another explanation might be due to the perceived value of the iPad for certain instructional purposes. For example, Dr. L did not intend to use the iPad to support her own teaching. Instead, her purpose was to familiarize her students with assistive technology run on the iPad so they could use it in K-12 schools. Mr. B did not use the iPad in his higher level photography class except for processing photos because the iPad's camera did not meet the professional requirement. Dr. W only used the iPad to support her own lectures and student in-class simulations. She had many other active learning activities that did not need the support of the iPad. Dr. M only used the iPad for one course she taught. When asked why she did not use the iPad in the other courses, she said the other classes already had their own structure and the iPad would not add much value to them. These examples showed the instructors chose whether or not to use the iPad based on a perceived value of the iPad for certain instructional purposes. If instructors do not see much value of the iPad for certain instructional purposes, they might choose not to use it for those activities although they have the knowledge and pedagogy to do so. Previous studies showed technology integration was associated with a perceived value of technology for teaching and learning (Lucas, 2005; Spotts, 1999). This study confirmed those findings and suggested that to promote high levels of integration, it is important to convince faculty the value of using the iPad at the transformation levels.

IPad Integration and Pedagogical Shift

Q4 Has faculty's pedagogy shifted because of iPad integration? If there is a shift in pedagogy represented from the research, what factors facilitated the pedagogical shift?

Half of the interview participants had some pedagogical shifts due to their iPad integration experience but the remaining half of participants did not. Pedagogical shift was in the learning-centered direction and took place at all integration levels. Some participants experienced a greater shift than others. Personal motivation to seek pedagogical changes might have been the fundamental reason why the shift occurred. No matter whether a shift took place, all participants believed the iPad enhanced their teaching and student learning.

An explanation for no pedagogical shift might be the enhancement level of iPad usage fit into participants' existing teaching practices. Instructors adopted the iPad because it could help with what they are already doing instead of fundamentally changing their teaching practices. As previous studies suggested, the majority of faculty mostly used technology to replicate or supplement existing teaching practices rather than radically change them (Kirkup & Kirkwood, 2005). In this study, three participants did not have a pedagogical shift because they used the iPad to support similar activities they were already doing. Another reason might be the participants used the iPad as an add-on.

Use of the iPad was separate from existing teaching or learning activities and, thus, had not influenced main teaching strategies. For example, one participant added the iPad to her class to show the assistive features of the tool for special education students in K-12 schools. She did not integrate the device into her own teaching practices except as an e-reader occasionally and for spreadsheets. Another explanation might be some instructors already had high-level technology integration experience before using the iPad. They just transferred previous skills onto this new tool instead of changing their current pedagogy and teaching practices. As interview data showed, one participant already used technology at the transformation level before using the iPad. She did not experience a pedagogical shift but just transferred her skills to the new tool. In addition, it might be the participants were not equipped with knowledge regarding technology integration that could trigger different ways of use and further promote any pedagogical shift. One participant stated her university did not provide any trainings for iPad integration. She basically used the iPad to present her lectures and run simulations, akin to what she did with other technology before using the iPad. It might be she was not aware of other ways of using the iPad and did not extend her pedagogy because of the integration experience.

Although there were various reasons why the pedagogical shift did not occur, a common characteristic of these non-shift participants was that they expressed relative satisfaction about their current pedagogy. They revealed no desire to change it. The findings suggested the pedagogical shift might not occur during the iPad integration. Whether there was a shift depended on many factors including but not limited to the purpose, previous experience, and knowledge of the integration. No assumption should be made that faculty's pedagogy would be naturally improved because of their adoption of technology to teach. To facilitate a desired pedagogical shift, intentional interventions are needed.

An explanation for a pedagogical shift might be personal motivation. All participants who showed evidence of a pedagogical shift expressed some degree of dissatisfaction toward previous teaching practices. Their personal motivation for changes encouraged them to actively seek profession development opportunities. Availability of the device and the experience of actively learning to teach with it triggered their reflection of the pre-existing pedagogy, broadened their imagination, and enabled them to evolve their pedagogy through participating in professional development activities, connecting with a learning community, and experimenting in a real teaching context. This finding indicated learning to teach with technology could be used as a catalyst to trigger a pedagogical shift. Intrinsic motivations to improve the pre-existing pedagogy played a very important role in encouraging active participation in and learning from professional development activities and further enhanced the shift.

These findings were consistent with some previous studies. For example, when surveying 27 instructors after the second year of iPad deployment, the University of Minnesota CEHE iPad report (Yeung & Chung, 2011) suggested 43% of the instructors indicated participating in the iPad initiative transformed their teaching; 75% of the instructors strongly agree or agreed that iPads in the classroom encouraged the use of inquiry, active learning, and/or experiential learning methods; learning to teach with the iPad facilitated the pedagogical change of some but not faculty. They did not explore the reasons for change or non-change. Cavanaugh et al. (2013) examined abstracts submitted by faculty members who attended two professional development workshops in six months during a national iPad deployment with the TPACK framework. They found no significant changes in TCK, PK, and TPACK, although there was a tendency to shift from novice to higher levels. For example, there was a notable decrease in the proportion of abstracts focused on apps and an increase in using more web-resources and focusing more on active learning. There is a significant shift in TPK from entry and adoption to adaption and infusion. Cavanaugh et al. argued these results indicated faculty's more sophisticated ways of using iPads in teaching. No matter whether a shift took place or at what levels they used the iPad, all interviewed participants believed the device had added some value to their teaching and student learning. This might be due to the bias of the voluntary participants. All the participants accepted the interview because they saw the value and wanted to share their positive experiences with others. These findings may also indicate the iPad could be a valuable tool to enhance teaching and learning at all integration levels. Based on the data obtained from this study, the researcher could not answer the question. Future research would be needed to further explore the topic.

In conclusion, the results suggested technology itself might not bring about a pedagogical shift. Learning to teach with technology could be a catalyst that triggers changes in teaching practices. However, the teacher must act as the agent for change. The results of the qualitative data also suggested continuous guidance and support were needed during the integration process (Andzenge & North, 2013; Cavanaugh et al., 2013; Dickel et al., 2013). Ongoing support in the format of a learning community might be more effective in facilitating changes in teaching practices than one-shot workshops as reported by some previous studies (Finley & Hartman, 2004; Glazer, Hannafin, & Song, 2005).

Implications

Theoretical Implications

The SAMR model was used in this study as a theoretical framework to identify and analyze participants' levels of iPad integration. It appeared the model provided a sufficient foundation to identify participants' general integration levels based on the frequency of iPad usage at different levels. It should be noted the cut-off point to determine the levels was an arbitrary decision the researcher had to make. Secondly, it was hard to discriminate the levels with only close-ended questions. There are many different situations in which the iPad could be used at each level. It was difficulty to capture all of them with just the close-ended questions. Providing an opportunity for participants to elaborate freely with open-ended questions was the method used to expand and supplement the close-ended questions in this study and is recommended for future research. Thirdly, the model was appropriate when it was used to determine integration levels based on how digital technologies were used to support or encourage the redesign of pre-existing traditional learning activities. However, it appeared not appropriate in situations where learning activities were supported by other digital technologies. For example, using iPads to create a digital story might be considered as a modification level of integration compared to writing a composition with pencil and paper. But it is a substitution level if it is compared to using a laptop to create a digital story. In this case, the iPad was just a substitution for the laptop with no functional improvement or redesign of the activities. This finding raised concerns about the sustainability of the model. It is expected that more technology-enhanced instructions and learning activities will be used in the classroom with increasing use of digital technologies in education. If the model does not adjust its definitions for the levels to fit the new situation, it will be inappropriate to be used in many situations in the future. Fourthly, because the model defines the levels of technology integration based on pedagogical reasons of using the technology, it was hard to separate the technology integration levels from pedagogical preferences. This model has already built in the learning-centered pedagogical consideration into its evaluation of the integration levels. This means participants who use the iPad at the transformation level should already have a learning-centered pedagogy. The technology integration levels reflect pedagogical preference, indicating this model could be used to promote learning-centered pedagogy before and during technology integration as many institutions and professional programs are doing. However, its limitations mentioned in this section should also be taken into consideration

The study confirmed the importance of balanced and integrated TPACK for higher levels of technology integration. However, the results also suggested the type of pedagogical knowledge was also an important factor that influenced integration levels. Teachers need to have learning-centered pedagogical knowledge to achieve higher levels of technology integration. The results of this study raised the question about the definition of PK in the TPACK framework. It might need to be revised for more accurate description of the relationship between pedagogical knowledge and technology integration levels.

Application Implications

This study presented a wide variety of learning activities that could be supported by the iPad to enhance student learning. The results could be informative for faculty members who are implementing or will implement the iPad into their teaching. The study confirmed the importance of balanced and integrated TPACK for higher levels of technology integration and further identified a learning-centered pedagogy, instead of any other type of pedagogical knowledge, could enhance higher levels of iPad integration.

Faculty developers or instructional designers should take these aspects into consideration when designing professional programs for iPad integration. More emphasis needs to be put on promoting the integration of all elements from the TPACK framework and learning-centered pedagogy. Neither TPACK nor learning centered pedagogy alone are sufficient conditions for higher level integration. Actual integration levels appeared to be also influenced by a perceived value of the technology for certain instructional purposes, implying professional development programs or teacher education programs should also introduce pedagogical strategies that could help faculty and teacher candidates see the value of the device for different instructional purposes in real content-specific contexts. Strategies using technology at the transformation level should also be emphasized. This study used the iPad as a representative of various mobile devices available for faculty and students in higher education. Results of this study might be transferred to the situations where other mobile devices are used.

Limitations

Some limitations were identified for this study. Firstly, convenience sampling might have hindered the generalizability of the study results. The research method was chosen because a particular population was needed from faculty who used the iPad for at least two semesters in higher education across the United States). Self- selected, voluntary participation was the best way to obtain these participants. Because the participants were selected based on their voluntariness, variations in the sample might not have reflected the real characteristics of the target population (Ary et al., 2010). Secondly, most of the qualitative and quantitative data were collected through self-reporting techniques. This form of data might lead to response errors due to the ability and/or willingness of participants to provide truthful responses (Ary et al., 2010). To increase the validity of the data, survey questions were randomized and artifacts were collected. The concurrent mixed-methods design for this study also provided secondary sources of data to triangulate and strengthen findings obtained through individual methods. Future research might combine other measures to further triangulate the self-reported data, e.g., direct observation in classroom, student evaluations. Thirdly, although the qualitative study approach was appropriate and valuable in obtaining an in-depth understanding and perspectives of the phenomenon, it was also subjected to the influence of the researcher's personal bias and representativeness of the cases (Merriam, 2009). The intent of this qualitative study was to provide rich descriptions of participants' pedagogy and its influence on iPad integration. The results should not be taken as representative of all members of the target population.

Suggestions for Future Research

This study focused on exploring the relationship among faculty's knowledge, pedagogy, and iPad integration levels. Several suggestions are made for future research based on the results of this study. In terms of research design, future research might consider controlling for compounding variables (e.g., disciplines, integration contexts) with a more robust research design that combines direct observation, pre- and post-tests, or students' evaluations. In terms of clarifying the findings, future research might include more factors, such as perceived values of iPad for certain instructional purposes as one of the variables, to obtain a more comprehensive understanding of the interplay of various factors for the integration levels. This study found enthusiasm, frequency of usage, and length of the iPad adoption did not necessarily translate into high level integration. Early adopters in this study used the iPad at different levels. More studies are needed to identify characteristics among early adopters to discover reasons that promoted or hindered the quality of technology integration for this particular group. This study focused on instructors who had used the iPad for at least two semesters. Future research might broaden the scope to instructors who had used the iPad or mobile devices for different lengths of time to detect differences and trace changes over time. This study investigated levels of integration after adoption. More studies need to identify instructors' decision-making process to determine underlying factors that influenced their ways of using mobile devices after the adoption.

Conclusion

This study was one of the first empirical studies that investigated faculty's pedagogy, knowledge, and integration levels in the implementation of the iPad as an instructional tool. Results of the study confirmed an association among knowledge, pedagogy, and iPad integration levels as defined by the SAMR model. Balanced TPACK and learning-centered pedagogy were identified as necessary conditions for high integration levels, although they were not sufficient conditions. Perceived value of the device for certain instructional purposes was suggested as another important factor that impacted instructors' decisions of whether or not to use the iPad for certain instructional activities and further impacted the levels of integration in general. The study confirmed technology itself might not bring about a pedagogical shift. Learning to teach with technology could be a catalyst that triggers changes in teaching practices. However, it has to be the teacher who acts as the agent for change. The study suggested professional development programs should place an emphasis on promoting the integration of all elements from the TPACK framework instead of individual elements. Learning-centered pedagogy should also be promoted. Continuous training and support should be provided throughout the integration process. The focus should be on pedagogy, knowledge, and strategies to integrate the technology at the transformation level.

It should be noted that the adoption of one-on-one technology into teaching is already a progress in itself. Levels of technology integration do not define teaching competence or performance of an instructor. The intention of this study was to explore factors that might help faculty members improve their integration levels after they had already adopted the technology into teaching in order to release the potential of the tool in enhancing student learning.

REFERENCES

Adler, R. W., Milne, M. J., & Stringer, C. P. (2000). Identifying and overcoming obstacles to learner-centered approaches in tertiary accounting education: A field study and survey of accounting educators' perceptions. *Accounting Education*, *9*(2), 113–134.

Agyei, D. D., & Voogt, J. (2011). Determining teachers' TPACK through observations and self-report data. In M. Koehler & P. Mishra (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2011.* (pp. 2314-2319). Chesapeake, VA: Association for the Advancement of Computing in Education.

Aiyegbayo, O. (2015). How and why academics do and do not use iPads for academic teaching? *British Journal of Educational Technology*, *46*(6), 1324-1332.

Ajjan, H., & Hartshorne, R. (2008). Investigating faculty decisions to adopt Web 2.0 technologies: Theory and empirical tests. *The Internet and Higher Education*, *11*(2), 71–80.

Allison, R. D., & Scott, D. C. (1998). Faculty compensation and obligation: The necessity of a new approach triggered by technology integration. *New Directions for Community Colleges, 1998*(101), 69-78.

Alyahya, S., & Gall, J. E. (2012). iPads in education: A qualitative study of students' attitudes and experiences. In T. Amiel & B. Wilson (Eds.), *Proceedings of EdMedia: World conference on educational media and technology 2012* (pp. 1266-1271). Retrieved from http://www.editlib.org/p/40913

Anderson, T., Varnhagen, S., & Campbell, K. (1998). Faculty adoption of teaching and learning technologies: Contrasting earlier adopters and mainstream faculty. *The Canadian Journal of Higher Education*, *28*(2), 71–98.

Andzenge, S. T., & North, S. F. (2013). Experiences of a faculty-driven iPad integration initiative in teacher education. In J. Herrington, A. Couros, & V. Irvine (Eds.), *Proceedings of EdMedia: World conference on educational media and technology 2013* (pp. 1616-1622). Retrieved from https://www.learntechlib.org/p/112182

Archibald, D., Macdonald, C. J., Plante, J., Hogue, R. J., & Fiallos, J. (2014). Residents' and preceptors' perceptions of the use of the iPad for clinical teaching in a family medicine residency program. *BMC Medical Education*, *14*(1), 174.

Ary, D., Jacobs, L. C., Sorensen, C., & Razavieh, A. (2010). *Introduction to research in education* (8th ed.). Belmont, CA: Wadsworth Cengage Learning.

Benson, S. N. K., & Ward, C. L. (2013). Teaching with technology: Using TPACK to understand teaching expertise in online higher education. *Journal of Educational Computing Research*, *48*(2), 153–172.

Bloemsma, M. S. (2013). *Connection with millennials: Student engagement, 21st century skills, and how the iPad is transforming learning in the classroom.* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Database. (No. 3566043).

Brinkerhoff, J. (2006). Effects of a long-duration, professional development academy on technology skill, computer self-efficacy, and technology integration beliefs and practices. *Journal of Research on Technology in Education*, *39*(1), 22–43.

Brownell, S. E., & Tanner, K. D. (2012). Barriers to faculty pedagogical change: Lack of training, time, incentives, and tensions with professional identity? *Cell Biology Education*, *11*(4), 339–346. doi:10.1187/cbe.12-09-0163

Bulmer, M. G. (1979). *Principles of statistics*. New York: Dover.

Bush, M. H., & Cameron, A. H. (2011). *Digital course materials: A care study of the Apple iPad in the academic environment* (Doctoral dissertation). Retrieved from http://pepperdine.contentdm.oclc.org/cdm/ref/collection/p15093coll2/id/139

Calderhead, J. (1996). Teachers' beliefs and knowledge. In R. C. Calfee & D. C. Berliner (Eds.), *Handbook of educational psychology* (pp. 709-725). New York: Simon & Schuster.

Capdarest-Arest, N. A. (2013). Implementing a tablet circulation program on a shoestring. *Journal of Med Library Association, 101*(3), 220–224.

Casanave, C., & Li, Y. (2015). Novices' struggles with conceptual and theoretical framing in writing dissertations and papers for publication. *Publications*, *3*(2), 104–119. doi:10.3390/publications3020104

Cavanaugh, C., Hargis, J., Kamali, T., & Soto, M. (2013). Substitution to augmentation: Faculty adoption of iPad mobile learning in higher education. *Interactive Technology and Smart Education, 10*(4), 270–284. doi:10.1108/ITSE-01-2013-0001

Chang, Y.,Ja ng, S.-J., & Chen, Y.-H. (2014). Assessing university students' perceptions of their physics instructors' TPACK development in two contexts. *British Journal of Educational Technology*, *46*(6), 1236–1249. doi:10.1111/bjet.12192

Chen, B. Y., & Denoyelles, A. (2013, October 7). Exploring students' mobile learning practices in higher education. Retrieved Dec 8, 2015, from http://er.educause.edu/articles/2013/10/%20exploring-students-mobile-learning-practices-in-higher-education

Cheng, R. (2013, October, 13). Apple CEO: We've locked up 94% of education tablet market. Retrieved Dec 8, 2015, from https://www.cnet.com/news/apple-ceo-weve-locked-up-94-of-education-tablet-market/

Chou, C. C., Block, L., & Jesness, R. (2012). A case study of mobile learning pilot project in K-12 schools. *Journal of Educational Technology Development and Exchange*, *5*(2), 11–26.

Churchill, D., & Wang, T. (2014). Teacher's use of iPads in higher education. *Educational Media International*, *51*(3), 14–25. doi:10.1080/09523987.2014.968444

Cobcroft, R. S., Towers, S., Smith, J., & Bruns, A. (2006). Mobile learning in review: Opportunities and challenges for learners, teachers and institutions. In Proceedings at Online Learning and Teaching (OLT) conference at Queensland University of Technology, Brisbane, Australia. Retrieved Dec 8, 2015, from http://eprints.qut.edu.au/5399/1/5399.pdf.

Cochrane, T., & Bateman, R. (2010). Smartphones give you wings: Pedagogical affordances of mobile web 2.0. *Australasian Journal of Educational Technology, 26*(1), 1-14. Retrieved Dec 8, 2015, from http://www.ascilite.org.au/ajet/ajet26/cochrane.pdf

Cochrane, T., Narayan, V. & Oldfield, J. (2013). iPadagogy: Appropriating the iPad within pedagogical contexts. *International Journal of Mobile Learning and Organisation, 7*(1), 48–65.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education (6th ed.).* New York; London: Routledge/Falmer.

Communications Team (2015, March 9). Report: New McGraw-Hill education research finds more than 80 percent of students use mobile technology to study. Retrieved Dec 8, 2015, from http://www.mheducation.com/news-media/press-releases/report-new-mcgraw-hill-education-research-finds-more-80-percent-students-use-mobile.html

Compomizzi, J. (2013). *The influence of iPad technology on the academic and social experiences of veteran and military students: Academic preparation, collaboration socialization, and information access* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Database. (No. 3565603)

Cooper-Fisher, S. U. (2015). *A comparison of preschool teachers' beliefs regarding student-centered learning, self-efficacy regarding technology use, and perceived value of computers* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Database. (No. 3727112).

Cox, B. S., & Graham, C. R. (2009). Using an elaborated model of the TPACK framework to analyze and depict teacher knowledge. *Tech Trends*, *53*(5), 60.

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches* (3th ed.). Thousand Oaks, CA: SAGE Publications.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Thousand Oaks, CA: SAGE Publications.

Crompton, H. (2013). The benefits and challenges of mobile learning. *Learning & Leading with Technology*, *41*(2), 38-39.

Dahlstrom, E., Walker, J. D., & Dziuban, C. (2013). ECAR study of undergraduate students and information technology, 2013 (Research Report). Louisville, CO: EDUCAUSE Center for Analysis and Research.

Davies, M. (2014). Using the Apple iPad to facilitate student-led group work and seminar presentation. *Nurse Education in Practice*, *14*(4), 363–367. doi:10.1016/j.nepr.2014.01.006

Deaton, C. C. M., Deaton, B. E., Ivankovic, D., & Norris, F. A. (2013). Creating stop-motion videos with iPads to support students' understanding of cell processes. *Journal of Digital Learning in Teacher Education*, *30*(2), 67–73.

Dede, C. (2004). If design-based research is the answer, what is the question? *The Journal of the Learning Sciences,13*(1), 105-114.

Dickel, C., Khanna, M. M., Ishii-Jordan, S. R. & Turner, M. (2013). Preparing the faculty: Ongoing pedagogical issues in iPad-only university courses. In T. Bastiaens & G. Marks (Eds.), *Proceedings of E-learn: World conference on e-learning in corporate, government, healthcare, and higher education 2013* (pp. 314-319). Chesapeake, VA: Association for the Advancement of Computing in Education.

Eagan, K., Stolzenberg, E. B., Lozano, J. B., Aragon, M. C., Suchard, M. R., & Hurtado, S. (2014). *Undergraduate teaching faculty: The 2013-2014 HERI faculty survey*. Retrieved Dec 8, 2015, from http://www.heri.ucla.edu/monographs/HERI-FAC2014-monograph.pdf

Ebert-May, D., Derting, T. L., Hodder, J., Momsen, J. L., Long, T. M., & Jardeleza, S. E. (2011). What we say is not what we do: Effective evaluation of faculty professional development programs. *BioScience*, *61*(7), 550–558. doi:10.1525/bio.2011.61.7.9

Elen, J., Lindblom-Ylanne, S., & Clement, M. (2007). Faculty development in research-intensive universities: The role of academics’ conceptions on the relationship between research and teaching. *International Journal for Academic Development*, *12*(2), 123–139. doi:10.1080/13601440701604948

Ellis, E. M. (2000). Faculty participation in the Pennsylvania State University World Campus: Identifying barriers to success. *Open Learning*, *15*(3), 233–242.

Entwistle, N. J., & Entwistle, A. (1991). Contrasting forms of understanding for degree examinations: The student experience and its implications. *Higher Education 22,* 205–227.

Entwistle, N., & Walker, P. (2002). Strategic alertness and expanded awareness within sophisticated conceptions of teaching. In N. Hạ tivah & P. Goodyear (Eds.), *Teacher thinking, beliefs, and knowledge in higher education* (pp. 15-39). Dordrecht, Boston: Kluwer Academic Publishers.

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

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development*, *53*(4), 25–39. doi:10.1007/BF02504683

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.

Etherington, D. (2013). Apple has sold over 8M iPads direct to education worldwide, with more than 1B iTunes U downloads. Retrieved Dec 8, 2015, from http://techcrunch.com/ 2013/02/28/apple-has-sold-over-8m-ipads-direct-to-education-worldwide-with- more-than-1b-itunes-u-downloads/

Eynon, R. (2008). The use of the World Wide Web in learning and teaching in higher education: Reality and rhetoric. *Innovations in Education and Teaching International, 45*(1), 15-23. doi:10.1080/14703290701757401

Faris, M. J., & Selber, S. A. (2013). iPads in the technical communication classroom: An empirical study of technology integration and Use. *Journal of Business and Technical Communication*, *27*(4), 359–408. doi:10.1177/1050651913490942

Feixas, M., & Zellweger, F. (2010). Faculty development in context: Changing learning cultures in higher education. In U. Ehlers & D. Schneckenberg (Eds.), *Changing cultures in higher education: Moving ahead to future learning* (pp. 85-102). Berlin: Springer.

Finley, L., & Hartman, D. (2004). Institutional change and resistance: Teacher preparatory faculty and technology integration. *Journal of Technology and Teacher Education, 12*(3), 319-337.

Fisher, T. (2006). Educational transformation: Is it like "beauty" in the eye of the beholder, or will we know it when we see it? *Education and Information Technologies, 11,* 293-303.

Fisher, B., Lucas, T., & Galstyan, A. (2013). The role of iPads in constructing collaborative learning spaces. *Technology, Knowledge and Learning*, *18*(3), 165–178. doi:10.1007/s10758-013-9207-z

Fives, H., & Buehl, M. M. (2011). Spring cleaning for the “messy” construct of teachers’ beliefs: What are they? Which have been examined? What can they tell us? In Harris, K. R., Graham, S., & Urdan, T. C. (Eds.), *APA educational psychology handbook, Vol. 2: Individual differences and cultural and contextual factors* (pp 471–499). Washington, DC: American Psychological Association. doi:10.1037/13274-000

Garrett, K. N. (2014). *A quantitative study of higher education faculty self-assessments of technological, pedagogical, and content knowledge (TPaCK) and technology training* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Database. (No. 3639104)

Gawelek, M. A., Spataro, M., & Komarny, P. (2011). Mobile perspective: iPads. *Educause Review*, March/April, 29–32.

Geist, E. (2011). The game changer: Using iPads in college teacher education classes. *College Student Journal*, *45*(4), 758–768.

George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference. 11.0 Update* (4th ed.). Boston: Allyn & Bacon.

Georgina, D. A., & Hosford, C. C. (2009). Higher education faculty perceptions on technology integration and training. *Teaching and Teacher Education*, *25*(5), 690–696. doi: 10.1016/j.tate.2008.11.004

Georgina, D. A., & Olson, M. R. (2008). Integration of technology in higher education: A review of faculty self-perceptions. *Internet and Higher Education*, *11*(1), 1–8. doi: 10.1016/j.iheduc.2007.11.002

Gertner, R. T. (2011). *The effects of multimedia technology on learning* (Master thesis). Retrieved Dec 8, 2015, from http://www.acu.edu/technology/mobilelearning/documents/ research/effects-of-technology-on-learning.pdf

Giunta, C. (2012). iPad and Web 2.0 pedagogic innovations in marketing: Utilization of entrepreneurial skills. *Journal of Marketing Development and Competitiveness, 6*(5), 107–115.

Glazer, E., Hannafin, M. J., & Song, L. (2005). Promoting technology integration through collaborative apprenticeship. *Educational Technology Research and Development, 53*(4), 57-67. doi:10.1007/BF02504685

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

Green, L. S. (2014). Through the looking glass: Examining technology integration in school librarianship. *Knowledge Quest, 43*(1), 36-43.

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis*, *11*(3), 255–274. doi:10.3102/01623737011003255

Grimmett, P. P., & MacKinnon, A. M. (1992). Craft knowledge and the education of teachers. *Review of Research in Education*, *18*(1992), 385–456. doi:10.3102/0091732X018001385

Groves, M. M., & Zemel, P. C. (2000). Instructional technology adoption in higher education: An action research case study. *International Journal of Instructional Media*, *27*(1), 57-65.

Hahn, J., & Bussell, H. (2012). Curricular use of the iPad 2 by a first-year undergraduate learning community. In R. Miller, C. Meier, & H. Moorefield-Lang (Eds.), *Library technology reports: Rethinking reference and instruction with tablets* (pp. 42–47). Retrieved Dec 8, 2015, from https://journals.ala.org/ltr/article/view/4285/4914

Hancock, D. R., Bray, M., & Nason, S. A. (2002). Influencing university students' achievement and motivation in a technology course. *The Journal of Educational Research, 95*(6), 365-372. doi:10.1080/00220670209596611

Hannafin, R. D., & Savenye, W. C. (1993). Technology in the classroom: The teacher's new role and resistance to it. *Educational Technology, 33,* 26-31.

Hargis, J., Cavanaugh, C., Kamali, T., & Soto, M. (2014). A federal higher education iPad mobile learning initiative: Triangulation of data to determine early effectiveness. *Innovative Higher Education, 39*(1), 45•57. doi:10.1007/s10755•013•9259•y

Hayes, M. H., & Jamrozik, M. L. (2001). Internet distance learning: The problems, the pitfalls, and the future. *Journal of VLSI Signal Processing*, *29*(1/2), 63–69.

Hesser, T. L., & Schwartz, P. M. (2013). iPads in the science laboratory: Experience in designing and implementing a paperless chemistry laboratory course. *Journal of STEM Education*, *14*(2), 5–10.

Hora, M. T., & Holden, J. (2013). Exploring the role of instructional technology in course planning and classroom teaching: Implications for pedagogical reform. *Journal of Computing in Higher Education*, *25*(2), 68–92. doi:10.1007/s12528-013-9068-4

Houston Community College. (2013). *iPad mini innovating learning at HCC Southwest.* Retrieved Dec 8, 2015, from http://www.yourhoustonnews.com/west_university/news/ipad-mini-innovating-learning-at-hcc-southwest/article_e0027032-3f26-57ad-9fde- 3b6761c36515.html

Hsu, Y. C. (2003). *The effectiveness of computer-assisted instruction in statistics education: A meta-analysis* (Doctoral dissertation). Retrieved Dec 8, 2015, from http://arizona.openrepository.com/arizona/handle/10150/289887

Illinois Institute of Technology. (2011, April). *Illinois Institute of Technology confirms iPads for undergraduates each year*. Retrieved Dec 8, 2015, from https://web.iit.edu/ mediaroom/press-releases/2011/apr/14/illinois-institute-technology-confirms- ipads-undergraduates

iPad studies. (n.d.). Retrieved Dec 8, 2015, from http://www.acu.edu/legacy/technology/mobilelearning/research/ipad-studies.html

Johnson, L., Adams Becker, S., Cummins, M., Estrada, V., Freeman, A., & Ludgate, H. (2013). *NMC horizon report: 2013 higher education edition*. Austin, Texas: The New Media Consortium.

Johnson, B. R., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher, 33*(7), 14–26.

Johnston, N., & Marsh, S. (2014). Using iBooks and iPad apps to embed information literacy into an EFL foundations course. *New Library World*, *115*(1/2), 51–60. doi:10.1108/NLW-09-2013-0071

Jude, L., Kajura, M., & Birevu, M. (2014). Adoption of the SAMR Model to assess ICT pedagogical adoption: A Case of Makerere University. *International Journal of E-Education, E-Business, E-Management and E-Learning*, *4*(2), 106-115. doi:10.7763/IJEEEE. 2014.V4.312

Kalonde, G. (2014). *Teacher educators' technology decisions and the extent to which they model technologies for inclusive classrooms in teaching method courses* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Database. (No. 3643631).

Keengwe, J., Kidd, T., & Kyei-Blankson, L. (2009). Faculty and technology: Implications for faculty training and technology leadership. *Journal of Science Education and Technology*, *18*(1), 23–28. doi:10.1007/s10956-008-9126-2

Kember, D., & Kwan, K. (2000). Lecturers' approaches to teaching and their relation-ship to conceptions of good teaching. *Instructional Science, 28,* 469-490.

Kember,D., & Kwan, K. (2002). Lecturers' approaches to teaching and their relationship to conceptions of good teaching. Instructional Science. *Special Issue: Teacher Thinking, Beliefs and Knowledge in Higher Education*, *28*(5-6), 469-490.

Kereluik, K., Fahnoe, C., & Karr, J. A. (2013). What knowledge is of most worth: Teacher knowledge for 21st century learning. *Journal of Digital Learning in Teacher Education 29(*4), 127–140.

Kim, C., Kim, M. K., Lee, C., Spector, J. M., & DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education*, *29*(1), 76–85. doi: 10.1016/j.tate.2012.08.005

Kinash, S., Brand, J., Mathew, T., & Kordyban, R. (2011). Uncoupling mobility and learning: When one does not guarantee the other. *Communications in Computer and Information Science*, *177 CCIS*, 342–350. doi:10.1007/978-3-642-22383-9_28

King, K. P. (2002a). Educational technology professional development as transformative learning opportunities. *Computers & Education, 39*(3), 283-297. doi:10.1016/S0360-1315(02)00073-8

King, K. P. (2002b). Technology catalyzing change in how faculty teach and learn. *The Journal of Continuing Higher Education, 50*(2), 26-37.

King, K. P. (2004). Both sides now: Examining transformative learning and professional development of educators. *Innovative Higher Education, 29*(2), 155–174.

Kirkup, G., & Kirkwood, A. (2005). Information and communications technologies (ICT) in higher education teaching: a tale of gradualism rather than revolution. *Learning, Media and Technology, 30*(2), 185-199. doi:10.1080/17439880500093810

Kirschner, P., Meester, M., Middelbeek, E., & Hermans, H. (1993). Agreement between student expectations, experiences and actual objectives of practicals in the natural sciences at Open University of the Netherlands. *International Journal of Science Education, 15*(2), 175–197.

Kitchenham, A. (2006). Teachers and technology: A transformative journey. *Journal of Transformative Education*, *4*(3), 202–225. doi:10.1177/1541344606290947

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

Kruger-Ross, M. J. (2014). Connecting critical theory of technology to educational studies. *Journal of Transformative Education, 11*(4), 297–311. doi:10.1177/1541344614538521

Lacey, C. H., Gunter, G. A., & Reeves, J. (2014). Mobile technology integration. *Distance Learning*, *11*(1), 1–8.

Laouris, Y., & Eteokleous, N. (2005). We need an educationally relevant definition of mobile learning. Retrieved Dec 8, 2015, from http://www.mlearn.org.za/CD/papers/ Laouris%20&%20Eteokleous.pdf

Lee, H. W., & Lim, K. Y. (2012). Does digital handwriting of instructors using the iPad enhance student learning? *The Asia-Pacific Education Researcher*, *22*(3), 241–245. doi:10.1007/s40299-012-0016-2

Lehman, A. (2014). *Engineering, teaching, and technology: A nationwide assessment of instructional internet use by engineering faculty* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Database. (No. 3581651)

Leveson, L. (2004). The things that count: Negative perceptions of the teaching environment among university academics. *The International Journal of Educational Management*, *18*(6/7), 368–373. doi:10.1108/09513540410554022

Lewis, A. J. (2013). *A case study of modern computing: Importance for tablet computers* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Database. (No 3585972)

Lindsay, L. (2015). Transformation of teacher practice using mobile technology with one-to-one classes: M-learning pedagogical approaches. *British Journal of Educational Technology*, *47*(5), 883–892. doi:10.1111/bjet.12265

Linderoth, J. (2013, October). *Open letter to Dr. Ruben Puentedura*. Retrieved Dec 8, 2015, from http://spelvetenskap.blogspot.com/2013/10/open-letter-to-dr-ruben-puentedura.html

Lucas, S. B. (2005). *Who am I? The influence of teacher beliefs on the incorporation of instructional technology* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Database. (No. 3193807).

Lys, F. (2013). The development of advanced learner oral proficiency. *Language Learning & Technology*, *17*(3), 94–116.

Maloney, M. M., & Wells, V. A. (2012). iPads to enhance user engagement during reference interactions. *Library Technology Reports: Rethinking Reference and Instruction with Tablets*, *48*(8), 11–17.

Mang, C. F., Wardley, L. J., & Bay, N. (2012). Effective adoption of tablets in post-secondary education: Recommendations based on a trial of iPads in university classes. *Journal of Information Technology Education: Innovations in Practice*, *11*, 302–316.

Manuguerra, M., & Petocz, P. (2011). Promoting student engagement by integrating new technology into tertiary education: The role of the iPad. *Asian Social Science*, *7*, 61–65. doi:10.5539/ass. v7n11p61

Marmarelli, T., & Ringle, M. (2011). *The Reed College iPad study*. Retrieved Dec 8, 2015, from https://www.reed.edu/cis/about/ipad_pilot/Reed_ipad_report.pdf

McAlpine, L., & Weston, C. (2000). Reflection: Issues related to improving professors' teaching and students' learning. *Instructional Science, 28*(5/6), 363-385. doi:10.1023/A:1026583208230

Mcgowan, S. (2012). Obstacle or opportunity? Digital thresholds in professional development. *Journal of Faculty Development, 26*(3), 25-28.

McKissic, S. C. (2012). *Examining transformative faculty development factors to advance technology adoption and diffusion at a campus-based institution* (Doctoral dissertation). Retrieved from http://eric.ed.gov/?id=ED547934

McQuiggan, C. A. (2011). *Preparing to teach online as transformative faculty development*. (Doctoral dissertation). Retrieved from Dec 8, 2015, https://etda.libraries. psu.edu/catalog/11670

Melhuish, K., & Falloon, G. (2010). Looking to the future: M-learning with the iPad. *Computer in New Zealand Schools: Learning, Leading, Technology*, *22*(3), 1–16.

Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation* (2nd ed.). San Francisco, CA: Jossey-Bass.

Mertz, N., & McNeely, S. (1990, April). How professors "learn" to teach: Teacher cognitions, teaching paradigms and teacher education. Retrieved Dec 8, 2015, from http://eric.ed.gov/?id=ED320471

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

Morrone, A. S., Gosney, J., & Engel, S. (2012). Empowering students and instructors: Reflections on the effectiveness of iPads for teaching and learning. Retrieved Dec 8, 2015, from http://www.educause.edu/library/resources/empowering-students-and- instructors-reflections-effectiveness-ipads-teaching-and-learning

Mumtaz, S. (2000). Factors affecting teachers' use of information and communications technology: A review of the literature. *Journal of Information Technology for Teacher Education*, *9*(3), 319–342. doi:10.1080/14759390000200096

Murphy, G. D. (2011). Post-PC devices: A summary of early iPad technology adoption in tertiary environments. *E-Journal of Business Education & Scholarship of Teaching*, *5*(1), 18–32.

Ng'Ambi, D. (2013). Effective and ineffective uses of emerging technologies: Towards a transformative pedagogical model. *British Journal of Educational Technology*, *44*(4), 652–661. doi:10.1111/bjet.12053

Nguyen, L., Barton, S. M., & Nguyen, L. T. (2014). iPads in higher education: Hype and hope. *British Journal of Educational Technology*, *46*(1), 190–203. doi:10.1111/bjet.12137

Northcote, M. (2010). Educational beliefs of higher education teachers and students: Implications for teacher education. *Australia Journal of Teacher Education*, *34*(3), 69-81.

Oklahoma State University. (2011). *iPad study released by Oklahoma State University*. Retrieved Dec 8, 2015, from https://news.okstate.edu/articles/ipad-study-released-oklahoma- state-university

Olcott, Jr., D., & Wright, S. J. (1995). An institutional support framework for increasing faculty participation in postsecondary distance education. *The American Journal of Distance Education*, *9*(3), 5–17.

O'Malley, C., Vavoula, G., Vavoula, G., Glew, J., Taylor, J., Sharples, M., & Lefrere, P. (2003). *MOBIlearn WP4: Guidelines for learning/teaching/tutoring in a mobile environment*. Retrieved Dec 8, 2015, from http://kn.open.ac.uk/public/getfile.cfm? documentfileid=7488

Onwuegbuzie, A. J., & Johnson, R. B. (2006). The validity issue in mixed research. *Research in the Schools, 13*(1), 48–63. doi: 10.1016/j.jsis.2005.08.002

Paczkowsky, J. (2013, Feb. 28). *Apple's iTunes hits one billion downloads*. Retrieved Dec 8, 2015, from http://allthingsd.com/20130228/apples-itunes-u-hits-1-billion-downloads/ Pajares, M. F. (1992). Teachers' beliefs and educational research: Cleaning up a messyconstruct. *Review of Educational Research*, *62*(3), 307–332. doi:10.3102/00346543062003307

Pearson Student Mobile Device Survey. (2015). *National report: College students.* Retrieved Dec 8, 2015, from http://www.pearsoned.com/wp-content/uploads/2015-Pearson- Student-Mobile-Device-Survey-College.pdf

Perrenet, J. C., Bouhuijs, P. A. J., & Smits, J. G. M. M. (2000). The suitability of problem-based learning for engineering education: Theory and practice. Teaching in Higher Education, 5(3), 345-358.

Pierson, M. E. (2001). Technology integration practice as a function of pedagogical expertise. *Journal of Research on Technology in Education*, *33*(4), 413–430.

Prosser, M., & Trigwell, K. (1997). Relations between perceptions of the teaching environment and approaches to teaching. *The British Journal of Educational Psychology*, *67*(1), 25–35. doi:10.1111/j.2044-8279. 1997.tb01224.x

Puentedura, R. (2006). *Transformation, technology, and education*. Retrieved Dec 8, 2015, from http://hippasus.com/resources/tte/

Puentedura, R. (2010). *SAMR and TPCK: Intro to advanced practice*. Retrieved from http://hippasus.com/resources/sweden2010/SAMR_TPCK_IntroToAdvancedPractice.pdf

Puentedura, R. R. (2012, September 14). *Building upon SAMR*. Presentation at Presbyterian Ladies' College, Perth, Australia. Retrieved Dec 8, 2015, from http://www.hippasus.com/rrpweblog/archives/2012/09/03/BuildingUponSAMR.pdf

Rachel, S., Cobcroft, R., Towers, S., Smith, J., & Bruns, A. (2006). *Mobile learning in review: Opportunities and challenges for learners, teachers, and institutions.* Retrieved Dec 8, 2015, from http://eprints.qut.edu.au/5399/1/5399.pdf

Rienties, B., Brouwer, N., & Lygo-Baker, S. (2013). The effects of online professional development on higher education teachers' beliefs and intentions towards learning facilitation and technology. *Teaching and Teacher Education*, *29*(1), 122–131. doi: 10.1016/j.tate.2012.09.002

Rienties, B., Brouwer, N., Bohle Carbonell, K., Townsend, D., Rozendal, A.-P., van der Loo, J., & Lygo-Baker, S. (2013). Online training of TPACK skills of higher education scholars: A cross-institutional impact study. *European Journal of Teacher Education*, *36*(4), 480–495. doi:10.1080/02619768.2013.801073

Rockwell, S. K., Schauer, J., Fritz, S. M., & Marx, D. B. (1999). Incentives and obstacles influencing higher education faculty and administrators to teach via distance. *Online Journal of Distance Learning Administration, 2*(4), 1-11.

Rosen, L., Carrier, L., & Cheever, N. (Eds.). (2010). An explosion of WMDs: Wireless mobile devices. In *Rewired: Understanding the iGeneration and the way they learn* (Chapter 3 Kindle version). New York, NY: Palgrave Macmillan.

Rossing, J. P., Miller, W. M., Cecil, A. K., & Stamper, S. E. (2012). iLearning: The future of higher education student perceptions on learning with mobile tablets. *The Journal of Scholarship of Teaching and* Learning*, 12*(2), 1-26.

Sachs, L., & Bull, P. H. (2013). Using iPad2 for a graduate practicum course. *I-Manager's Journal on School Educational Technology*, *7*(3), 39–46.

Sahin, I. (2011). Development of survey of technological pedagogical and content knowledge (TPACK). *The Turkish Online Journal of Educational Technology, 10*(1), 97-105.

Sahin, I., & Thompson, A. (2006). Using Rogers' theory to interpret instructional computer use by COE faculty. *Journal of Research on Technology in Education, 39*(1), 81.

Samuelowicz, K., & Bain, J. D. (1992). Conceptions of teaching held by academic teachers. *Higher Education, 24*(1), 93–111.

Samuelowicz, K., & Bain, J. D. (2001). Revisiting academics' beliefs about teaching and learning. *Higher Education*, *41*(3), 299–325. doi:10.1023/A:1004130031247

Schenker, J. D. (2007). *The effectiveness of technology use in statistics instruction in higher education: A meta-analysis using hierarchical linear modeling* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Database. (No. 3286857).

Schmid, R. F., Bernard, R. M., Borokhovski, E., Tamim, R., Abrami, P. C., Wade, C. A., Lowerison, G. (2009). Technology's effect on achievement in higher education: a stage I meta-analysis of classroom applications. *Journal of Computing in Higher Education, 21(2),* 95–109.

Schmid, R. F., Bernard, R. M., Borokhovski, E., Tamim, R. M., Abrami, P. C., Surkes, M. A., Wade, A., & Woods, J. (2014). The effects of technology use in postsecondary education: A meta-analysis of classroom applications. *Computers & Education*, *72*(2014), 271–291. doi: 10.1016/j.compedu.2013.11.002

Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education*, *42*(2), 123-149. doi:10.1080/15391523.2009.10782544

Schrum, L. (1999). Technology professional development for teachers. *Educational Technology Research and Development*, *47*(4), 83-90. doi:10.1007/BF02299599

Scott, L. C. (2009). Through the wicked spot: A case study of professors' experiences teaching online. *Dissertation Abstracts International: Section A, 70*(11), AAT 3379753.

Selwyn, N. (2007). The use of computer technology in university teaching and learning: A critical perspective. *Journal of Computer Assisted Learning*, *23*(2), 83–94. doi:10.1111/j.1365-2729.2006. 00204.x

Sharples, M. (2000). The design of personal mobile technologies for lifelong learning. *Computers & Education*, *34*(3-4), 177-193.

Sharples, M., Taylor, J., & Vavoula, G. (2007). A theory of learning for the mobile age. In R. Andrews & C. A. Haythornthwaite (Eds.), *The sage handbook of e-learning research* (pp. 221–247). Thousand Oaks; London: SAGE. doi:10.1007/978-3-531-92133-4_6

Shepherd, I. J., & Reeves, B. (2011). iPad or iFad. Retrieved Dec 8, 2015, from http://www.acu. edu/technology/mobilelearning/documents/research/shepherd-reeves/paperless- classroom.pdf

Shulman, L. S. (1986). Those who understand: knowledge growth in teaching. *Educational Researcher*, *15*(2), 4-14.

Sloan, R. H. (2013). Using an eTextbook and iPad: Results of a pilot program. *Journal of Educational Technology Systems, 41*(1), 87–104.

Smith, S., & Caruso, J. (2010). *The ECAR study of undergraduate students and information technology, 2010*. Retrieved Dec 8, 2015, from http://anitacrawley.net/Resources/ Reports/ECAR%20study%20highlights.pdf

Spotts, T. (1999). Discriminating factors in faculty use of instructional technology in higher education. *Educational Technology & Society*, *2*(4), 92−99.

Steinert, Y., Mann, K., Centeno, A., Dolmans, D., Spencer, J., Gelula, M., & Prideaux, D. (2006). A systematic review of faculty development initiatives designed to improve teaching effectiveness in medical education. *Medical Teacher*, *28*(6), 497–526. doi:10.1080/01421590600902976

Sunal, D., Hodges, J., Sunal, C., Whitaker, K., Freeman, L. Edwards, L., …Odell, M. (2001). Teaching science in higher education: Faculty professional development and barriers to change. *School Science and Mathematics, 101*(5), 246-257.

Surry, D. W., & Land, S. M. (2000). Strategies for motivating higher education faculty to use technology. *Innovations in Education & Training International*, *37*(2), 145–153. doi:10.1080/13558000050034501

Tamim, R. M., Bernard, R. M., Borokhovski, E., Abrami, P. C., & Schmid, R. F. (2011). What forty years of research says about the impact of technology on learning: A second-order meta-analysis and validation study. *Review of Educational Research, 81*(1), 4-28. doi:10.3102/0034654310393361

Teaching Program. (n.d.). Teaching program using iPad mini to prepare teachers. Retrieved Dec 8, 2015, from http://www.georgefox.edu/featured_stories/iPad.html

Thorndike, R. M., & Thorndike-Christ, T. (2009). *Measurement and evaluation in psychology and education* (8th ed.). Boston, MA: Pearson Education.

Timmerman, C. E., & Kruepke, K. A. (2006). Computer-assisted instruction, media richness, and college student performance. *Communication Education, 55,* 73–104. doi:10.1080/03634520500489666

Traxler, J. (2005). Defining mobile learning. In P. Isaias, C. Borg, P. Kommers, & P. Bnanno (Eds.), Proceedings from IADIS International Conference on Mobile Learning, University of Wolverhampton, United Kingdom.

Traxler, J. (2007). Defining, discussing and evaluating mobile learning: The moving finger writes and having writ. *The International Review of Research in Open and Distance Learning*, *8*(2), 1-12.

Traxler, E. J. (2011). Introduction. In E. J. Traxler & J. Wishart (Eds.), *Making mobile learning work: Case studies of practice* (p. 4). Retrieved Dec 8, 2015, from http://escalate.ac.uk/downloads/8250.pdf

Traxler, J., &Wishart, J. (Eds.) (2011). *Making mobile learning work: Case studies of practice*. Bristol: University of Bristol, Graduate School of Education.

Trigwell, K., & Prosser, M. (1991). Improving the quality of student learning: The influence of learning context and student approaches to learning on learning outcomes. *Higher Education, 22*(3), 251-266. doi:10.1007/BF00132290

Trigwell, K., Prosser, M., & Taylor, P. (1994). Qualitative differences in approaches to first year university science. *Higher Education, 27*, 75-84.

Tualla, L. T. (2011). *Mobile engagement at Scottsdale Community College: The Apple iPad in an English honors class* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Database. (No. 3487016).

Van Driel, J. H., Verloop, N., van Werven, H. I., & Dekkers, H. (1997). Teachers' craft knowledge and curriculum innovation in higher engineering education, *Higher Education, 34*, 105–122.

Wagoner, T., Hoover, S. &Ernst, D. (2011). *CEHD iPad initiative year one report fall 2010-spring 2011*. Retrieved Dec 8, 2015, from http://www.cehd.umn.edu/Mobile/ PDF/CEHDiPadReport.pdf

Wagoner, T., Schwalbe, A., Hoover, S., & Ernst, D. (2012). *CEHD iPad initiative: Year two report*. Retrieved Dec 8, 2015, from http://www.cehd.umn.edu/Mobile/PDF/CEHDi PadReportSummaryYear2.pdf

Wakefield, J., & Smith, D. (2012). From Socrates to satellites: iPad learning in an undergraduate course. *Creative Education*, *03*(05), 643–648. doi:10.4236/ce.2012.35094

Watts, M., & Schaur, G. (2011). Teaching and assessment methods in undergraduate economics: A fourth national quinquennial survey. *The Journal of Economic Education*, *42*(3), 294–309. doi:10.1080/00220485.2011.581956

Whitelaw, C., Sears, M., & Campbell, K. (2004). Transformative learning in a faculty professional development context. *Journal of Transformative Education*, *2*(1), 9–27. doi:10.1177/1541344603259314

Wierstra, R. F. A., Kanselaar, G., van der Linden, J. L., Hans, L. G. L. C., & Vermunt, J. D. (2003). The impact of the university context on European students' learning approaches and learning environment preferences. *Higher Education*, 45(4), 503-523. doi:10.1023/A:1023981025796

Wilson, K., & Fowler, J. (2005). Assessing the impact of learning environments on students' approaches to learning: Comparing conventional and action learning designs. *Assessment & Evaluation in Higher Education, 30*(1), 87¬101. doi:10.1080/0260293042003251770

Yeung, M., & Chung, H. (2011). iPEP talk: Pedagogical conversations from the iPad exploration project. In M. Koehler & P. Mishra (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2011* (pp. 3036-3041). Chesapeake, VA: Association for the Advancement of Computing in Education.

Youm, J., Wiechmann, W., Ypma-Wong, M. F., Clayman, R., Maguire, G., Haigler, H., & Lotfipour, S. (2011). Launching an iPad program: Lessons learned from the iMedEd initative, University of California, Irvine, School of Medicine. In C. Ho & M. Lin (Eds.), *Proceedings of E-Learn: World conference on e-learning in corporate, government, healthcare, and higher education 2011* (pp. 1775-1779). Chesapeake, VA: Association for the Advancement of Computing in Education.

Zayim, N., Yildirim, S., & Saka, O. (2006). Technology adoption of medical faculty in teaching: Differentiating factors in adopter categories. *Journal of Educational Technology Society, 9*(2), 213-222.

APPENDIX A

EMAIL INVITATION LETTER

Dear___________,

My name is Xin Wang and I am a doctoral candidate at the University of Northern Colorado. I am conducting my dissertation study with faculty across higher education institutions to understand the relationship between their iPad integration experience, pedagogy, and teachers' knowledge. Through this study I hope to identify some strategies to support faculty members' iPad integration.

I would like to invite you to participate in my study. The respondents who qualify for and complete the questionnaire will have the chance to win one of 10 **$20 e-VISA Gift Cards**. The questionnaire should take approximately 25 minutes to complete.

At the end of the questionnaire, you will also be given an option to participate in a follow-up interview. All participants that are invited and complete an interview with the researcher will receive an additional **$45 e-VISA Gift Card** as a compensation.

Follow this link to the Survey:
Take the Survey

Or copy and paste the URL below into your internet browser:
https://unco.co1.qualtrics.com/SE/?SID=SV_9KtCPaaTrZSZG6N

Thank you for your consideration. I look forward to receiving your input. Please do not hesitate to reach out to me directly should you have any questions.

Sincerely,

Xin Wang
Department of Educational Technology
University of Northern Colorado
Email: wang2049@bears.unco.edu

APPENDIX B

THE VISUAL MODEL FOR DATA COLLECTION AND ANALYSIS

Phase	Step	Procedure	Instrument	Product	Research Question
Phase 1 Survey	Quantitative and Qualitative Collection	• Administrate the Survey	• The Self-designed Questionnaire	• Numeric data • Textual data	• Q1 • Q2
	Data Analysis	• Clean Data • Calculate descriptive statistics (e.g. means, Standard deviation) • Calculate the internal consistency coefficient (Cronbach's α) • Code the textual responses • Correlation (Pearson's r) analysis • Independent t-test analysis	• SPSS • The researcher	• iPad integration SAMR levels • TPACK • The correlation between iPad integration levels and TPACK • The predicators of TPACK on iPad integration levels	
Connecting Phase 1 with Phase 2		• Purposefully select 2 participants from each SAMR level	• The researcher	• 8 Cases	
Phase 2 Case Study	Qualitative Data Collection	• Conduct interviews • Collect artifacts	• The Interview Protocol	• Interview recording and transcripts • Syllabi, lesson plans, activity instructions, assignment instructions, etc.	• Q3 • Q4
	Qualitative Data Analysis	• Coding and thematic analysis of each case • Cross-case analysis • Member check	• The researcher	• Initial analysis report on cross-case analysis	
Discussion & Conclusion	Results	• Interpret and explain the results	• The researcher	• The conclusion of the study	• Q1 • Q2 • Q3 • Q4

APPENDIX C

IPAD INTEGRATION AND TECHNOLOGICAL, PEDAGOGICAL, AND CONTENT KNOWLEDGE QUESTIONNAI

Do you use the iPad as an instructional tool in your courses in higher education?
❍ Yes
❍ No
If No Is Selected, Then Skip to End of Survey- None participants

How long have you been using the iPad as an instructional tool in your courses in higher education?
❍ Less than two semesters
❍ 2-3 semesters
❍ 4-6 semesters
❍ More than 6 semesters
If Less than two semesters Is Selected, Then Skip to End of Survey-None participants

Section 1. IPad Integration

Part 1. Please choose how often iPads are used for the following purposes in your courses.

Direction: In the activities that you included in the specific course content to assist your teaching, iPads have been used for:

	Never	Rarely	Sometimes	Often	Very often
1. conducting personal productivity activities (e.g., calendar, Word documents, notes).	❍	❍	❍	❍	❍
2. storing and reading e-text	❍	❍	❍	❍	❍
3. collecting student work digitally	❍	❍	❍	❍	❍
4. grading assignments	❍	❍	❍	❍	❍
5. presenting lectures and/or digital content to students	❍	❍	❍	❍	❍
6. sharing contents between students and teacher (e.g., dropbox, google drive)	❍	❍	❍	❍	❍

Direction: In the activities that you included in the specific course content to assist your students' learning, iPads have been used by students to:

	Never	Rarely	Sometimes	Often	Very often
1. take notes	❍	❍	❍	❍	❍
2. retrieve assigned learning materials	❍	❍	❍	❍	❍
3. conduct personal productivity activities (e.g., calendar, Word documents)	❍	❍	❍	❍	❍
4. access online information for individual study	❍	❍	❍	❍	❍
5. share contents among classmates or group members (e.g., dropbox, google drive)	❍	❍	❍	❍	❍
6. take quizzes, surveys or tests	❍	❍	❍	❍	❍
7. create multimedia content to demonstrate learning	❍	❍	❍	❍	❍
8. interact in small group activities	❍	❍	❍	❍	❍
9. conduct peer review and evaluation	❍	❍	❍	❍	❍
10. engage with a learning environment outside the classroom through digital apps (e.g., field trip)	❍	❍	❍	❍	❍
11. communicate with discipline experts around the world	❍	❍	❍	❍	❍
12. interact with a with a global audience	❍	❍	❍	❍	❍

Section 2. Teachers' Knowledge

Direction: Please select how much you agree with each statement.

	Strongly disagree	Dis-agree	Neutral	Agree	Strongly agree
1. I am familiar with the common preconceptions and misconceptions in my discipline.	❍	❍	❍	❍	❍
2. I can learn technology easily.	❍	❍	❍	❍	❍
3. I can adapt my teaching style to different learners.	❍	❍	❍	❍	❍
4. I know how to teach a topic with different instructional strategies and technologies.	❍	❍	❍	❍	❍
5. I have sufficient knowledge about my content area.	❍	❍	❍	❍	❍
6. I can select technologies to enhance what I teach, how I teach and what student learn.	❍	❍	❍	❍	❍
7. I know how to assess student learning in multiple ways.	❍	❍	❍	❍	❍
8. I know about technologies enhancing student understanding of the content.	❍	❍	❍	❍	❍
9. I can flexibly incorporate new tools and resources into content and my teaching methods to enhance learning.	❍	❍	❍	❍	❍
10. I can provide leadership in helping my colleagues to integrate the use of content, technologies and teaching approaches at my school.	❍	❍	❍	❍	❍
11. I understand how knowledge in my discipline is organized.	❍	❍	❍	❍	❍
12. I know how to solve my own technology-related problems.	❍	❍	❍	❍	❍
13. I stay abreast of new research related to my discipline in order to keep my own understanding of my discipline updated.	❍	❍	❍	❍	❍
14. I can choose technologies that enhance student learning for a lesson.	❍	❍	❍	❍	❍
15. I can make connections among related subjects in my content area.	❍	❍	❍	❍	❍
16. I have technical skills I need to use technology.	❍	❍	❍	❍	❍

17. I know about technologies enhancing content presentation.	❍	❍	❍	❍	❍
18. I know about technologies enhancing student practice of the content.	❍	❍	❍	❍	❍
19. I know how to organize and maintain classroom management.	❍	❍	❍	❍	❍
20. I am familiar with a lot of different technologies.	❍	❍	❍	❍	❍
21. I know how to prepare learning activities to meet learning objectives.	❍	❍	❍	❍	❍
22. I know how to select appropriate instructional methods and technologies to teach my content area.	❍	❍	❍	❍	❍
23. I know how to use technologies supporting student learning.	❍	❍	❍	❍	❍
24. I know about technologies enhancing the evaluation of student content learning.	❍	❍	❍	❍	❍
25. I can develop appropriate assessments for my learning objectives.	❍	❍	❍	❍	❍
26. I can adapt my teaching based on what students currently understand or do not understand.	❍	❍	❍	❍	❍
27. I know about technologies enhancing content demonstration.	❍	❍	❍	❍	❍
28. I keep up with important new technologies.	❍	❍	❍	❍	❍
29. I am familiar with a wide range of strategies and approaches that I can use in my teaching.	❍	❍	❍	❍	❍
30. I can make connections between the different topics in my discipline.	❍	❍	❍	❍	❍
31. I can adapt the use of the technologies that I am learning about to different teaching activities.	❍	❍	❍	❍	❍
32. I can address students' preconceptions and misconceptions for my discipline.	❍	❍	❍	❍	❍
33. I can select appropriate teaching strategies for my learning objectives.	❍	❍	❍	❍	❍
34. I can choose technologies that enhance the teaching approaches for a lesson.	❍	❍	❍	❍	❍
35. I can evaluate appropriateness of a new technology for teaching and learning.	❍	❍	❍	❍	❍

Part 2. Directions: Please answer the following questions by typing your responses into the text boxes below the questions.

1. Please describe other ways that iPads have been used in your classes but were not included in Part

   ____
   ____
   ____
   ____

2. Please describe the main purposes of iPad integration in your teaching.

   ____
   ____
   ____

Section 3 Demographic Information

Direction: Please choose one option or options that are mostly appropriate for you**.**

1. Age
   - ❍ Below 30
   - ❍ 30-40
   - ❍ 40-50
   - ❍ 50-60
   - ❍ Above 60

2. Gender
   - ❍ Male
   - ❍ Female
   - ❍ Other

3. Education Level
   - ❍ Doctorate
   - ❍ Master
   - ❍ Bachelor
   - ❍ Other (please specify)

4. Teaching experience
   Please choose all the levels you have taught as a full time instructor and specify how many years you taught on that level by typing in the textbox below it.

   - ❍ K-12 _____
   - ❍ Teaching assistant in Higher Education ______________________
   - ❍ Full time faculty in higher education ______________________

5. What is your current job title?
   - ❍ Instructor
   - ❍ Assistant professor
   - ❍ Associate professor
   - ❍ Professor
   - ❍ Other (Please specify)

   ____

6. What discipline do you teach?
   - ❍ Science
   - ❍ Social science
   - ❍ Humanity and Arts
   - ❍ Business
   - ❍ Laws
   - ❍ Medicine
   - ❍ Other (Please enter your discipline in the text box below)

   ____

7. What is the type of the institution in which you are using iPads for teaching?
   - ❍ 2-year community college
   - ❍ Four-year Library Art college
   - ❍ Doctoral research-intensive university
   - ❍ Doctoral teaching-intensive university
   - ❍ Other (Please specify) ______________________

8. At what level(s) of classes have you used iPads as an instructional tool?
   - ❍ Undergraduate
   - ❍ Master
   - ❍ Doctoral
   - ❍ Other (Please specify) ______________________

9. What model of iPad integration are you using?
   - ❍ 1:1 iPad Implementation
   - ❍ Shared iPad Cart
   - ❍ Bring your own device
   - ❍ Other (Please specify) ____________________

10. Averagely, how often do you use iPads for teaching in your courses?
    - ❍ Daily
    - ❍ 2-3 times a week
    - ❍ Once a week
    - ❍ 2-3 times in a month
    - ❍ Less than once in a month

11. How do you rate your comfortable level in using iPads?
    - ❍ Very comfortable
    - ❍ somewhat comfortable
    - ❍ somewhat uncomfortable
    - ❍ Not comfortable at all

12. Have you had any training before iPad integration?
    - ❍ Yes (Please describe the topics of the training.) ____________________
    - ❍ No.

If you would like to participate in a follow-up interview, please provide your name and email address in the following box. A $ 45 eVISA gift card will be given to every participant who has been invited and completed an interview with the researcher. Thank you in advance for your time and cooperation in my research.

____

____

End of the Survey-Participants

We thank you for your time! Your responses have been recorded!

If you would like to be entered into a drawing for a $20 eVisa Gift Card, please leave your email address through the following link:
https://unco.co1.qualtrics.com/SE/?SID=SV_cMyQh6DPgOk9Keh

End of the Survey-None participants:

Sorry that you are not from the target population.

Thank you for your interest and time!

APPENDIX D

THE INTERVIEW PROTOCOL

Warm-up:

1. Tell me about your teaching background.
2. Why did you choose education as your profession?

Pedagogy:

3. What do you believe is most important for you in your teaching?
4. Please describe how you teach.
    a. Follow up questions if the participants don't address pedagogy specifically-
        i. What types of learning activities do you do with students?
        ii. How would you describe your interactions with students?
        iii. What methods do you use?
        iv. What approach do you take in assessing the learning of your students? / How do you evaluate student-learning outcomes/performance?
        v. How do you organize your students for learning (Do they work independently/together? What does that look like in your classroom?)
        vi. How do iPads fit into your teaching?
5. What responsibilities do you think you have as a teacher?
6. What responsibilities do students have as learners?
7. What is your philosophy about learning? And, how does that relate to what you expect your students to learn in your class?

Pedagogy Shift:

8. Why did you decide to integrate iPads into your teaching?
9. What factors promoted or hindered your process of integrating iPad integration?
10. Do you think the experience of iPad integration changed the way you approach teaching in your course?
    a. If yes, what factors promoted or hindered this change in your teaching?
    b. If No, Why or Can you explain?

Closing Questions:

11. Do you have any examples of your iPad integration lessons or activities that you can share? Can I get documents? Can you explain?
12. Is there anything else you'd like to talk about regarding your teaching with iPads?

APPENDIX E

INSTITUTIONAL REVIEW BOARD APPROVAL

UNIVERSITY OF
NORTHERN COLORADO

Institutional Review Board

DATE:	March 21, 2016
TO:	Xin Wang
FROM:	University of Northern Colorado (UNCO) IRB
PROJECT TITLE:	[862760-2] Faculty's Knowledge, Pedagogy and Integration Levels in the Implementation of iPads as an Instructional Tool
SUBMISSION TYPE:	Amendment/Modification
ACTION:	APPROVAL/VERIFICATION OF EXEMPT STATUS
DECISION DATE:	March 21, 2016

Thank you for your submission of Amendment/Modification materials for this project. The University of Northern Colorado (UNCO) IRB approves this project and verifies its status as EXEMPT according to federal IRB regulations.

Xin -

Thank you for swiftly submitting the requested modifications and additions to your IRB application. Your research is now verified/approved exempt and you may proceed with participant recruitment and data collection. Please be sure to use these revised materials in that process.

Best wishes with your research.

Sincerely,

Dr. Megan Stellino, UNC IRB Co-Chair

We will retain a copy of this correspondence within our records for a duration of 4 years.

If you have any questions, please contact Sherry May at 970-351-1910 or Sherry.May@unco.edu. Please include your project title and reference number in all correspondence with this committee.

APPENDIX F

CONSENT FORM FOR HUMAN PARTICIPANTS IN RESEARCH

UNIVERSITY of NORTHERN COLORADO

CONSENT FORM FOR HUMAN PARTICIPANTS IN RESEARCH

UNIVERSITY OF NORTHERN COLORADO

Project Title: Faculty's Knowledge, Pedagogy and Integration Levels in the Implementation of iPads as an Instructional Tool
Researcher: Xin Wang, Department of Educational Technology
Faculty Advisor: Mia Williams, Department of Educational Technology
Phone Number: (602) 677-7199 e-mail: mia.williams@unco.edu

This study is researching the relationship between faculty's iPad integration level, teachers' knowledge and pedagogy. As a participant, you will be asked to complete an online questionnaire first. The questionnaire consists of closed-ended and open-ended questions about your iPad integration activities and teachers' knowledge. The questionnaire will take approximately 25 minutes. Your participation in this survey is voluntary. The respondents who qualify for and complete the questionnaire will have the chance to win one of the 10 $20 e-VISA Gift Cards.

You will be asked whether you would like to accept a follow-up interview at the end of the survey. If you agree to participate in the interview, you will be asked to provide your name and email address. The researcher will contact you for a one-on-one interview in approximately one month. During the interview, you will be asked questions about your pedagogy and your perceptions about how iPad integration experience has or has not impacted your pedagogy. The interview will be conducted at a time that is convenient for both you and the researcher, and using the communication method you prefer (e.g. telephone, Skype). The interview will last about one hour and will be audio recorded using a digital recorder. Every interview participant will be assigned a pseudonym during data collection, analysis and report. Your participation in the interview is voluntary and credential. Participating in the survey does not obligate you to accept the follow-up interview. All interview participants that are invited and complete an interview with the researcher will receive an additional $45 e-VISA Gift Card as a compensation.

Risks to you are minimal. By taking the questionnaire, you will not be asked to provide any personal identification information. Therefore, your responses will be anonymous. If you have agreed to participate in a follow-up interview and provided your contact information, the researcher will assign a file code number that will appear on your questionnaire to replace your contact information during data analysis. A sheet on which your code number and contact information are paired will be stored separately from your questionnaire and used only for the purpose of scheduling the interview. After the interview (if you are not invited to or decline to participate), your contact information will be destroyed. In these ways the anonymity of all your questionnaire data will be ensured. All original data will be kept in a password protected folder in the researcher's computer. Only the researcher will be able to access and examine individual responses. Results of the study will be presented in group form only (e.g., average). All identifiable data will be destroyed in three years following the end of data collection.

Participation is voluntary and confidential. You may decide not to participate in this study, or decide to only participate the first part of the study. If you begin participating you may still decide to stop and withdraw at any time. Your decision will be respected and will not result in loss of benefits to which you are otherwise entitled. Having read the above and having had an opportunity to ask any questions, please indicate your decision by choosing one of the two options below. You may keep this form for future reference. If you have any concerns about your selection or treatment as a research participant, please contact Sherry May, IRB Administrator, Office of Sponsored Programs, Kepner Hall, University of Northern Colorado Greeley, CO 80639; 970-351-1910.

○ Yes, I agree to participate.

○ No, I do not want to participate.