Spring June 1st, 2019

Student Perception of Digital Technology Usage in Higher Education Classrooms at Seattle Pacific University

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Student Perception of Digital Technology Usage in Higher Education Classrooms at Seattle Pacific University

by

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Dissertation

Presented to the Faculty of the

Graduate School of Education at

Seattle Pacific University

In Partial

Fulfillment of the Requirement for the

Doctor of Education Degree

January 2019

Student Perception of Digital Technology Usage in Higher

Education Classrooms at Seattle Pacific University by

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A dissertation submitted in partial fulfillment

of the requirement of the degree of

Doctor of Education

Seattle Pacific University

2018

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Program Authorized to Offer Degree SCHOOL OF EDUCATION

Date JANUARY 2019

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Date 1/10/19

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Acknowledgements

There are many people that need to be thanked for supporting me through this entire process. The first and foremost is my wonderful wife, Brenna. Without her final, “Just apply,” this journey through graduate school and this study would not have taken place. Thank you very much for encouraging me to start the journey and giving me as much time as I needed to accomplish my dissertation. I am excited for the adventures that lie ahead now that I have my weekends back!

I need to thank Dr. Nyaradzo Mvududu for all her time and guidance while I walked down the path of accomplishing this study. There were many questions and meetings that helped calm my heart rate and confirmed that I was going in the correct direction. Your kindness and support allowed me to continually keep working through this process. I look forward to having non-dissertation related conversations in the future.

Dr. David Wicks introduced me to ECAR and the Student Technology Survey. Thank you very much. Without your recommendation of replicating the 2015 survey, this study would not have taken place. Thank you for also taking time to meet with me in the beginning steps of establishing this process.

Dr. David Denton is the next person that I need to thank. Your feedback and time spent reading over this study has been greatly valued. Thank you.

Finally, I need to thank my family and friends for continually asking if I was done and how much longer was this whole thing going to take. There were also invaluable dinner study sessions with my peers, Nalline, Jennifer and Heidi. Without those “study” sessions…I don’t know where I would be right now in the process of graduate school.

Seattle Pacific University

Abstract

Student Perception of Digital Technology Usage in Higher

Education Classrooms at Seattle Pacific University

By Jason Profit

Chairperson of the Dissertation Committee: Dr. Nyaradzo Mvududu

School of Education

Since 2004, EDUCAUSE has been assessing the use of digital devices in higher education classrooms. Seattle Pacific University (SPU) had never participated in an ECAR Student Technology Survey until April, 2017. This study aimed to establish a baseline understanding of how SPU undergraduate students compare to other small, private, liberal arts institutions in regard to technology usage in the classroom. The broader purpose of this study was to add to the growing research involving the use of mobile digital devices within higher education classrooms. This study focused on the connectivism learning theory which seeks to explain the complex learning that takes place within all classrooms in a constantly and rapidly changing digital world. The author used the 2017 ECAR Student Technology Survey as the instrument to gather data. This research was a non-experimental, ex post facto study using a convenience sample in which participants provided survey data at one point in time regarding their perception of their instructors' use of digital devices within a classroom, their perception of SPU's learning management system and their preferred learning environment within a course.

The researcher conducted a factor analysis to confirm the existence of factors before conducting a one-way MANOVA.

Chapter One

Introduction

In 2001, Marc Prensky coined the term "digital natives" (2001). He believed that digital natives, those who grew up in the digital era, would be multifaceted in their usage of digital devices. This projection quickly forced school administrators and instructors to review their approaches toward educational technology in classrooms, causing changes in both pedagogy and classroom practices. Though Prensky left his mark within educational technology by coining the phrases "digital natives" and "digital immigrants," his initial prediction that digital natives would be fluid users of technology has not come to complete fruition (Buzzard, Crittenden, Crittenden, & McCarthy, 2011; Greener & Wakefield, 2015; Jones & Shao, 2011; Kennedy, Judd, Dalgarnot, & Waycott, 2010; Margaryan, Littlejohn, & Vojt, 2011). Current undergraduates are appropriately labeled digital natives, yet they are seeking guidance when required to use digital devices within a classroom (Greener & Wakefield, 2015; Margaryan et al., 2011; Rossing, Miller, Cecil, & Stamper, 2012). Digital natives are skilled in many aspects of technology, for example using social media (Al-Bahrani & Patel, 2015; Jones & Shao, 2011; Kassens, 2014; Kassens-Noor, 2012; Kennedy et al., 2010; Prestridge, 2014; West, Moore, & Barry, 2015), yet students lack the confidence or required skills to use programs that will support their academic learning, for example, using presentation software, spreadsheets or an institution's online library resources (Buzzard et al., 2011; Jones & Cross, 2009; Kennedy et al., 2010; Margaryan et al., 2011; Rossing et al., 2012). The future of digital devices in the classroom might seem tenuous due to rapid and constant development of newer devices, yet students and instructors have shown continued interest in using technology within the classroom (Brooks, 2016; Chen, 2015; Greener & Wakefield, 2015; Jones & Shao, 2011; Rossing et al., 2012).

There has been a constant increase of mobile devices appearing in college classrooms (Brooks, 2016; Coffin, Lyle, & Evans, 2015; Dahlstrom, Brooks, Grajek, & Reeves, 2015). One could speculate that the trend of taking notes on laptops during class began in the late 1990s as laptops became more accessible and cost effective. Then in 2010, Apple released the first iPad. Though it was suggested that this smaller, more compact device would be able to fully immerse education into the 21st century, Brooks (2016) showed a decline in tablet ownership with higher education students compared to an increase in laptops or smartphones. The iPhone was released a few years earlier and was already making its way into the classroom when the iPad emerged. One could argue that the release of the iPhone expedited the evolution of a more user friendly device. Current undergraduates have, on average, two to three mobile devices with them during class (Alden, 2013; Brooks, 2016; Brooks & Pomerantz, 2017; Coffin et al., 2015; Dahlstrom et al., 2015; Martin, Diaz, Sancristobal, Gil, Castro & Peire, 2011).

With so many mobile devices available in a typical college classroom, one may wonder why higher education has not fully integrated technology into the classroom (Dahlstrom et al., 2015; Nguyen, Barton, & Nguyen, 2015). At first glance, the literature appears to be inundated with discouraging research findings that present students' use of mobile devices as causing multitasking, being a distraction to themselves and others and possibly contributing to lower grade point averages (Lepp, Barkley, & Karpinski, 2015; Sana, Weston & Cepeda, 2013; Wood et al., 2012). One way mobile devices are being utilized, both in the classroom and outside the classroom, is with social media (Al-

Bahrani & Patel, 2015; Buzetto-More, 2012; Kassens, 2014; Kassens-Noor, 2012; Prestridge, 2014; West et al., 2015). When a student is using a mobile device it is likely to check their email, use instant messenger, check social media or surf the internet (Coffin et al., 2015; Kuznekoff, Munz, & Titsworth, 2015; Lepp et al., 2015; McCoy, 2013; Nguyen et al., 2015; Wood et al., 2012). Lastly, instructors and university administrators are beginning to identify what students actually want regarding the use of digital devices within the classroom (Buzzard et al., 2011; Kennedy et al., 2010; Margaryan et al., 2011). Multiple studies have indicated that students prefer limited use of digital devices within the classroom and that they continue to prefer lecture based classes with small group discussions (Buzzard et al., 2011; Buzetto-More, 2012; Finn & Ledbetter, 2013; Jackson, Helms, Jackson, & Gum, 2011; Jones & Shao, 2011; Kennedy et al., 2010).

A brief review of literature on digital devices in higher education classrooms could lead one to place blame on students for not controlling their usage of these devices. However, this blame for not using technology efficiently does not fully land on the students' shoulders as instructors and university administrators have to learn to embrace mobile devices (McCoy, 2013; Tindell & Bohlander, 2012). There is an ongoing debate about the need to adjust an instructor's pedagogical beliefs within the classroom to truly incorporate digital devices (Greener & Wakefield, 2015; McCoy, 2016; Tapscott & Williams, 2010; Ting, 2012; Wood et al., 2012). Instructors are confused or have a misunderstanding about what students are actually doing with their mobile devices during class (Coffin et al., 2015; Dahlstrom et al., 2015; McCoy, 2013; Nguyen et al., 2015; Tindell & Bohlander, 2012). It is evident that universities are not providing enough instructional support through training, professional development or IT support for their instructors (Alden, 2013; Dahlstrom et al., 2015; Greener & Wakefield, 2015; Nguyen et al., 2015). In addition to the lack of professional development, there is also concern over the lack of technology training for educators to better integrate digital devices into their curriculum (Ertmer, Ottenbriet-Letwich, Sadik, Sendurur, & Sendurur, 2012; Hawkes & Hategekimana, 2009; Kumar & Vigil, 2011). Neither the administrators nor the instructors fully understand how to institute technology policies within classrooms. This in turn leaves students unclear on expectations regarding the use of mobile devices during class (Coffin et al., 2015; McCoy, 2013; Tindell & Bohlander, 2012).

Though there are negative perceptions of the usage of mobile devices in the classroom, multiple studies showcase the benefits of mobile devices within a college classroom. Instructors are trying to embrace mobile devices and their multiple capabilities by utilizing different applications and establishing technology usage policies within a classroom (Blessing, Blessing, & Fleck, 2012; Halverson & Smith, 2009; McArthur & Bostedo-Conway, 2012; Tyma, 2011). For example, Twitter has been successfully integrated into classes, allowing students to ask questions anonymously during classes (Buzetto-More, 2012; MacArthur & Bostedo-Conway, 2012; Prestridge, 2014; Tyma, 2011; West et al., 2015). Instructors have used Twitter to continue conversations related to the content outside of class (Kassens, 2014; Kassens-Noor, 2012; Prestridge, 2014; Tyma, 2011; West et al., 2015) or for students to simply receive information about topics in the class (Blessing,et al., 2012). The use of Twitter within a classroom has been associated with an increase in student understanding of concepts and in their grade point average. Other benefits of mobile devices include the ability for students to personalize their experience with the use of their mobile device (Alden, 2013; Halverson & Smith, 2009; Martin et al., 2011), the fluidity of note taking using apps like Evernote, Dropbox or Google Docs, and the versatility that allows students to alternate between different mobile devices that offer a vast diversity of apps and can meet a student's particular needs (Kuznekoff et al., 2015; McArthur & Bostedo-Conway, 2012).

With technology and mobile devices being a prominent piece of higher education, instructors are using a blended, flipped or Active Learning Classroom (ALC) approach toward integrating technology into their classes. Blended classrooms can possess aspects where instructors encourage students to utilize technology during lectures, group discussions or small group projects to further the students' learning (Rossing et al., 2012). Students in flipped classrooms traditionally meet less frequently than a traditional class, yet students are expected to read, watch, listen to or interact with digital materials outside of class before the next meeting. The purpose of this is to allow teachers to present real-world problems or to go deeper with subjects presented in the online materials rather than going over a PowerPoint presentation, for example, repeating what was already studied (Hudson et al., 2015; McLaughlin, White, Khanova, & Yuriev, 2016; Porter & Graham, 2016). Recently, ALCs have been embraced as the next step toward integrating mobile devices within the classroom. ALCs allow students to collaborate in small groups while using mobile devices to propel their learning forward (Chen, 2015; Cotner, Loper, Walker, & Brooks, 2013; Gebre, Saroyan, & Aulk, 2015; Park & Choi, 2014). An ALC is typically set up with multiple round tables, usually having eight to ten seats per table, placed around the room. Each group has access to a large screen monitor through various computer connections. The typical teacher centered podium is replaced by a lectern that could be mobile or set off to the side of the room. Park and Choi (2014) pointed out that the educational space makes a difference in how students learn.

In this study, the author first reviewed literature on the use of mobile devices within the college classroom. Though mobile devices are relatively young in the larger sphere of digital technology (Nguyen et al., 2015), they have made an overwhelming appearance in college classrooms in a short amount of time (Brooks, 2016; Dahlstrom et al., 2015).

Purpose of Study

The purpose of this study was to add to the growing research involving the use of mobile digital devices within higher education classrooms. Before April, 2017, Seattle Pacific University (SPU) had yet to assess the mobile device usage of its students and/or professors within its classrooms. In April of 2017, SPU administered the ECAR (EDUCAUSE Center for Analysis and Research) 2017 Student Technology Survey to their undergraduates. In this study, the author utilized the survey to assess SPU's undergraduates' perceptions of their instructors' use of technology during a course, the students' perceptions of the institution's learning management system (LMS) and the students' preferred learning environment compared to undergraduates from other small, private, liberal arts institutions. The goal of this research was to support SPU administrators and IT professionals in meeting the digital needs of undergraduates.

Undergraduate students prefer a moderate amount of technology usage within the classroom (Finn & Ledbetter, 2013; Jackson et al., 2011; Margaryan et al., 2011). In other words, students continue to prefer lecture based classes where an instructor uses technology in a manner that supports the content being taught (Barnes & Jacobson, 2015;

Brooks, 2016; Jackson et al., 2011; Margaryan et al., 2011). The 2016 ECAR Student Technology Survey results indicated that 10% of the students surveyed wanted only face-to-face lecture-based classes while 7% wanted only online courses (Brooks, 2016). Though some students want heavy technology integration within their classes, this is a minimal percentage of the population (Buzzard et al., 2011). There is a wide range of skill levels in using technology when undergraduates enter higher education and instructors need to be aware of these differences (Jones & Shao, 2011; Kennedy et al., 2010).

The current study is based on the connectivism learning theory that seeks to explain complex learning in a constant and rapidly changing digital world where learning occurs through the formation of connections within digital networks (Downes, 2008; Siemens, 2005). This learning theory is promoted by Stephen Downes and George Siemens who both posited that the traditional learning theories of constructivism, behaviorism and cognitivism are still vital but do not completely align with 21st century skills that are part of the everyday environment to which students are accustomed (Siemens, 2005). Currently, students are able to acquire information and knowledge from a variety of sources, what Siemens and Downes called nodes, via the internet at an "anytime and anywhere" basis. Through nodes, people make connections with other sources of information, establishing potential social networks for future knowledge acquisition. One might argue that learning ceased to be linear once the internet became an integral part of the educational system. Students and instructors are now able to search for information at any given point in time when attempting to solve a problem, developing a project or working within a group.

There are conflicting opinions about connectivism as a learning theory and its place within higher education classrooms. Verhagen (2006) could be considered one of the most outspoken critics of connectivism as he stated that:

> this is not a learning theory, but a pedagogical view on education with the apparent underlying philosophy that pupils from an early age need to create connections with the world beyond the school in order to develop the networking skills that will allow them to manage their knowledge effectively and efficiently in the information society. (Verhagen, 2006, p. 1)

Verhagen (2006) further noted that the skills Siemens and Downes promoted are life-long learning skills that all people should know. Another concern with connectivism is that it requires students to self-regulate their use of digital devices to meet their end goals. Rossing et al. (2012) reported that students stated they lack the willpower to not look at social networks of other programs during class time. Yet, when students understand the educational impact mobile devices can present to their education, they are more likely to stay engaged in the class and less likely to use mobile devices for multitasking or other forms of distraction (Brooks, 2016; Kassens, 2014; Tyma, 2011; West et al., 2015). Additionally, Duke, Harper, and Johnston (2013) supported connectivism but viewed "it as a tool to be used in the learning process for instruction or curriculum rather than a standalone learning theory" (p. 10).

Siemens (2005) stated that as global knowledge continues to grow and evolve, having access to new information is more important than the knowledge the learner already possesses. Siemens and Downes connected their learning theory to Piaget's two principles of learning: learning is presented actively and learning must be authentic and connected to real life (Piaget, 1977). One of the goals of connectivism, as a learning theory, was to help connect 21st century learning skills with other learning theories, for example, constructivism, behaviorism and cognitivism.

One way the connectivism learning theory is being utilized is in Active Learning Classrooms (ALC). One goal of an ALC is to allow students to work on group projects within the class using 21st century devices at their own tables. Instructors are able to roam the room supporting student progress while helping guide students toward an end goal. Kop and Hill (2008) suggested that higher education is adjusting its approach to meet the needs of the students through the use of ALC's. Chen (2015) supported ALCs as an option to facilitate open-minded thinking in the classroom by allowing students to participate in collaborative learning environments while increasing their 21st century skills. Foroughi (2015) suggested a variety of pedagogical practices that would support connectivism through an ALC including using blogs, listservs, discussion forums, personal and digital tutorials and modeling research strategies. In theory this seems simplistic, yet these are large steps as students and instructors come to the classroom with a wide range of skills and abilities in using digital devices to deepen their learning (Jones & Shao, 2011; Kennedy et al., 2010). Within an ALC, students can access information on the spot and have the ability to share information more freely and easily. Cotner et al. (2013) presented results based on science courses that "new, technology-enhanced learning environments positively and independently affect student learning" (p. 82). Gebre et al. (2015) stated that for an ALC to be effective, three parts must be in place: the transmission of knowledge, engagement of students and the ability to develop learning independence.

Instrument

The author used the EDUCAUSE Center for Analysis and Research (ECAR) 2017 Student Technology Survey to collect data for the study. EDUCAUSE is a nonprofit organization that helps higher education institutions manage and use information technology (IT) to guide strategic IT decisions at every level within a higher education institution. EDUCAUSE was formed in 1998 as a result of a merger of two long standing organizations in higher education, CAUSE and Educom. The first ECAR Student Technology Survey was administered in 2004 at 13 institutions in five states. The survey has been administered annually since 2004 (https://www.educause.edu/). The 2017 Student Technology Survey consisted of 124 institutions from 40 states and 10 countries for a total of 43,559 undergraduate respondents. Some of the benefits of using this particular survey include providing IT professionals and higher education administrators a glimpse of the various types of technological devices students are using on campus. This can allow for effective management of the internal infrastructure of higher education institutions and strengthening of their cybersecurity. An added benefit of the survey is it allows for comparisons to other institutions, with regard to the types of technological devices used and the additional bandwidth needed to support the devices. The survey also provides the experts with information on how technology is being used within classrooms and for course work.

Upon extensive research of the EDUCAUSE website, no research articles were found that focused on the reliability and validity of the survey instruments. Emails were exchanged with D. Christopher Brooks, PhD, Senior Research Fellow for ECAR, regarding the reliability and validity of the survey instrument. This survey is recursive and has been implemented annually since 2004. Each year a team of EDUCAUSE researchers, IT experts and "higher education institution-based subject matter experts" (D. Brooks, personal communication, December 5, 2016) revise the survey to reflect current trends in the literature and in "behavioral or perceptual shifts in the IT market" (D. Brooks, personal communication, December 5, 2016), thus establishing the reliability and validity of the instrument.

Academic Concerns

As laptops began to emerge more frequently in the college classroom, instructors and administrators noted multiple areas of concerns. One of the most common concerns was a fall in students' grade point averages (GPA) with the use of digital devices in class (Kraushaar & Novak, 2010; Lepp et al., 2015; McCoy, 2013; Sana et al., 2013; Wood et al., 2012). Another concern was how digital devices could be distracting to not just the user but also to students sitting nearby (Coffin et al., 2015; Dahlstrom et al., 2015; Kraushaar & Novak, 2010; Kuzenkoff et al., 2015; Lepp et al., 2015; McCoy, 2013; Nguyen et al., 2015; Tindell & Bohlander, 2012; Wood et al., 2012). Furthermore, digital devices in the classroom involved student multitasking, thus taking their attention away from the class and potentially lowering their overall grade (Kraushaar & Novak, 2010; Kuznekoff et al., 2013; Ragan, Jennings, Massey, & Doolittle, 2014; Sana et al., 2013; Wei, Wang, & Klausner, 2012).

Concerns have also emerged regarding the lack of understanding of technology policies on college campuses between administrators, instructors and students on the use of mobile devices during class time (Coffin et al., 2015; Dahlstrom et al., 2015; McCoy, 2013). Higher education institutions might have an overall technology policy, but it might not be implemented in a classroom, or instructors might choose to make their own policy disregarding the overall institution's policy. Since there is uncertainty about technology policies, students are unsure how to proceed. Though this uncertainty around technology could exist, Finn and Ledbetter (2013) reported that when an instructor implements a technology policy and encourages students to use mobile devices in class, the instructor's credibility increases as does student engagement and productivity.

Seattle Pacific University Undergraduates

Prior to 2017, SPU had never administered a student technology survey. Working with EDUCAUSE to gain insight on how undergraduates, nationally and internationally, utilize mobile devices within the classroom would be beneficial for both the institution and the students. Through this study, the author compared SPU to other small, private, liberal arts institutions. This comparison will provide SPU with the opportunity to see where it is successfully meeting students' technological needs in the classroom, where it needs to provide support or guidance for both instructors and students and where internal infrastructure might be needed.

It can be seen on any given day at SPU, or any other higher education institution, that students have a wide range of mobile devices with them. What percentage of undergraduates have mobile devices and how are they being used for their own education? Henderson, Finger and Selwyn (2016) reported that 92% of the participants in their study used their own personal devices for their education. Additionally, the 2016 ECAR Student Technology Survey (Brooks, 2016) survey reported that 95% of the students surveyed stated that they used their personal laptops for school work, two-thirds of those respondents indicating they used their laptops for every class. Out of that 95% of respondents, 93% stated their laptops were very to extremely important for their academic success.

Students appreciate using mobile devices in the classroom along with their institution's learning management system (LMS). Learning management systems are a large part of the modern college experience, empowering students to take more control of their education in the 21st century. In 2011, McCabe reported that students enjoyed using a LMS but did not see it as an effective tool to enhance their education. Five years later, Henderson et al. (2016) report that 97% of the participants used a LMS as part of their studies, with 56% reporting that the LMS was very useful. With all this research pointing toward utilization of mobile devices during a course, how does SPU compare?

With a plethora of mobile devices and programs or applications to be used in a higher education classroom, how do these devices support a student's preferred learning style or environment? Rossing et al. (2012) and Kennedy et al. (2010) pointed out that both students and instructors have a wide range of technology skills within any given higher education classroom. Yet this wide range of skills also comes with a multitude of gaps in both the instructors' and the students' complete understanding and usage of mobile devices (Kennedy et al., 2010; Rossing et al., 2012). These gaps in understanding and usage of mobile devices are possible sources of the disruption in the use of mobile devices within the classroom. Universities need to be aware of these gaps in technology usage and be able to support both student and instructor growth. Some research is pointing toward student preferences for lecture-based classrooms with minimal to moderate technology usage (Barnes & Jacobsen, 2015; Finn & Ledbetter, 2013; Jackson et al., 2011; Jones & Shao, 2011; La Roche & Flanigan, 2013). This preference for lecture-based classroom with moderate technology usage fits well with the use of an ALC to allow for a blended learning environment where students can ask questions, be participants in class discussions, and continue to strengthen their 21st century skills that could benefit them in their future jobs. By utilizing the 2017 ECAR Student Technology Survey, SPU administrators, IT professionals and instructors will be able to gain an understanding of what the undergraduates' perceptions are toward digital device usage within the classroom.

Background on EDUCAUSE

In 2004 EDUCAUSE released its first Student Technology Survey at 13 universities with over 4,500 students participating in the survey. The initial goal was to "create a body of research and analysis on important issues at the intersection of higher education and information technology" (Kvavik, Caruso, & Morgan, 2004, p. 5). In 2017, the most recent survey, 124 institutions participated from 40 states and 10 countries, totaling over 43,559 respondents. The overall goal remained the same; to support higher education and the IT professionals at those institutions to support instructors and students. In 2014, ECAR released the first annual Instructors Technology Survey to further enhance their overall goal.

Over 2,300 institutions are members of EDUCAUSE including higher education institutions in the United States of America, international higher education institutions, major corporations, non-profits and K-12 schools. Starting in 2017, EDUCAUSE began allowing emerging educational technology companies, consultants and private individuals to become members. Any organization that supports higher education and higher education information technology is encouraged to become a member.

There are two major branches of EDUCAUSE; ECAR (EDUCAUSE Center for Analysis and Research) and ELI (EDUCAUSE Learning Initiative). ECAR focuses on uncovering the “experiences and expectations of students and faculty” (educause.com) to help higher education institutions optimize the impact of information technology. ELI is a “community of higher education institutions and organizations committed to the advancement of learning through the innovative application of technology” (educause.com).

Starting in 2014, ECAR developed three constructs that intersect with technology usage in higher education. The three constructs revolved around students’ disposition to technology, students’ attitude toward that technology, and student usage of that technology. Each year this was surveyed, 2014 through 2016, there was a positive response from students on all three constructs showing that higher education students are supportive of technology being used in their education, both inside and outside of the classroom. These three sliding scale questions were not included in the 2017 survey.

Significance of the Study

This survey provides administrators and IT professionals at SPU with a data set that will allow the university to further support the technological needs of instructors and students within the classroom. With the data retrieved from the 2017 ECAR Student Technology Survey, SPU will be able to compare itself to similar, small, private, liberal arts institutions. Within this study, the author compared SPU students’ perceptions of their instructors’ use of technology within the classroom to those of students from other institutions. Furthermore, the author examined how SPU undergraduates’ perceptions of the institution’s learning management system compared to other institutions, and how the student-preferred learning environment at SPU compared to other institutions. One hope for this study was that SPU would receive information that would be useful in increasing support for students regarding the use of technology in their education. The data could also support SPU in administering or developing more professional development for instructors along with the understanding that students could need more support with technology, including using the school's LMS.

Research Questions

Question 1. Are SPU undergraduates' perceptions of instructors' use of technology during a class comparable to similar, small, private, liberal arts institutions?

Null Hypothesis: There is no statistically significant difference between SPU undergraduate students' perceptions of the instructors' use of technology during a class compared to similar, small, private, liberal arts institutions.

Alternative Hypothesis: There is a statistically significant difference between SPU undergraduate students' perceptions of instructors' use of technology during a class comparable to similar, small, private, liberal arts institutions.

Question 2. How do undergraduate perceptions of SPU's learning management system compare to similar, small, private, liberal arts institutions?

Null Hypothesis: There is no statistically significant difference between SPU undergraduate students' perceptions of the SPU's learning management system compared to similar, small, private, liberal arts institutions.

Alternative Hypothesis: There is a statistically significant difference between SPU undergraduate students' perceptions of the SPU's learning management system compared to similar, small, private, liberal arts institutions.

Question 3. How does SPU compare to similar, small, private, liberal arts institutions regarding students' preferred learning environment?

Null Hypothesis: There is no statistically significant difference between SPU undergraduate students' perceptions of preferred learning environment when compared to similar, small, private, liberal arts institutions.

Alternative Hypothesis: There is a statistically significant difference between SPU undergraduate students' perceptions of preferred learning environment when compared to similar, small, private, liberal arts institutions.

Chapter Two

Review of Literature

Introduction

Integrating digital devices into a classroom is a complicated process with a wide range of variables to consider. Instructors and administrators need to be cognizant of the differing skill levels that students bring with them into the classroom (Buzzard, Crittenden, Crittenden, & McCarthy, 2011; Jones & Shao, 2011; Kennedy, Judd, Dalgarnot, & Waycott, 2010). Buzetto-More (2012) and Henderson, Finger and Selwyn (2016) claimed that students come to higher education comfortable using digital devices to communicate via social media and are adept at finding information that fits their needs. However, these students may lack the skills to use specific programs or applications that their instructors require (Buzzard et al., 2011; Gebre, Saroyan & Aulls, 2015; Kassens, 2014; Kennedy et al., 2010; West et al., 2015). Students are interested in using mobile devices in their education but request more support or guidance within their learning process (Buzzard et al., 2011; Gebre et al., 2015; Halverson & Smith, 2009; Sykes, 2014). Although Brooks (2016) reported that most students own two to three different mobile devices, he found that not all students who attend college own mobile devices. In these cases, administrators have to find ways to supply students with the applicable technology, for example, clickers, mobile devices that allow students to interact electronically (Morse, Ruggieri, & Whelan-Berry, 2010; Vaterlaus, Beckert, Fauth, & Teemant, 2012).

A vital step in integrating mobile devices into the classroom is to ensure the instructors have the skills and confidence for using such devices. Research has suggested that one of the larger hurdles to overcome when integrating mobile devices is the instructor's pedagogical beliefs (Chen, 2015; Tapscott & Williams, 2010; Tucker, 2014). Higher education tends to utilize teacher-centered or direct learning pedagogies. However, research has suggested that in teacher-centered classrooms mobile devices are perceived as distractions (Coffin et al., 2015; Dahlstrom et al., 2015). Supporting instructors through developing technology policies and instituting basic programs or applications to be used in the class, for example, Quizlet, Kahoot or Twitter, may help guide instructors toward increasing their confidence with integrating technology and evolve their pedagogical beliefs and acceptance of technology's role.

One scenario for instructors who implement a teacher-centered pedagogical style would be using a live Twitter feed during lectures (Tyma, 2011). This application allows students to ask questions via the class Twitter feed, prompting the conversation in other directions or giving clarity to what the instructor may be discussing (Blessing et al., 2012; MacArthur & Bodesto-Conway, 2012; Tyma, 2011). A social media application like Twitter could be useful in a larger lecture hall, giving voice for reticent students and allowing all students to easily ask questions.

Then, there are modern 21^{st} century classrooms where instructors are transitioning to student-centered classes and striving for "developing learning independence and self-reliance" (Gebre et al., 2015, p. 213). These types of classrooms are called "blended" (Hudson et al., 2015; Porter & Graham, 2016), "flipped" (McLaughlin et al., 2016), or "active learning classrooms" (Gebre et al., 2015). A variety of approaches exist within each of these pedagogical styles. Hudson et al. (2015) and McLaughlin et al. (2016) noted that some instructors requested or required that "pre-class materials" be accomplished before the next class. Pre-class materials allowed for smaller group projects within a class, deeper conversations on topics, or time to work on real-world problems (Hudson et al., 2015; McLaughlin et al., 2016). Instructors that utilized one of these approaches in class did not require that digital devices be used at every moment. Instead they used digital devices for a variety of reasons. The most prominent use was digital presentations for both instructor and student (Gebre et al., 2015; Porter & Graham, 2016). Communication, feedback, group projects via a Google Doc, for example, research and data analysis, were other common uses of digital devices within student-centered classes (Gebre et al., 2015; Hudson et al., 2015; McLaughlin et al., 2016; Porter & Graham, 2016).

Incorporating 21st century skills and adjusting the style of the classroom can seem beneficial. Yet it is important to keep in mind student perception of their instructor's use of mobile devices and the institution's infrastructure for student support with mobile devices. For example, students need training on how to use the learning management system, the online library and other accessible digital resources. It could be hypothesized that student perception of technology usage within a classroom could help guide administrator and instructor actions toward successfully meeting the needs of the current generation and future generations of technology savvy students.

Integrating mobile devices into a higher education classroom is not simple. There are various aspects, both negative and positive, that need to be addressed. There are challenges to integrating mobile devices that need to be addressed by administrators, instructors and students. There are benefits with using mobile devices that administrators, instructors and students need to be made aware of. The following pages of this literature review will address the challenges and benefits of mobile device usage within higher education classrooms.

Challenges with Mobile Devices

Mobile devices have become a norm in the daily lives of students. The average college student has two or three mobile devices with them at all times (Brooks, 2016). Recent reports also suggest that 92% to 95% of all college students have smartphones (Brooks, 2016; Dahlstrom, Brooks, Grajek & Reeves, 2015; West et al., 2015)**.** With such a high prevalence of mobile devices on hand, students can easily become distracted during a lecture, potentially missing important information being discussed. As mobile devices continue to emerge in higher education classrooms, empirical research has begun to highlight the challenges this presents. Students are able to disconnect from a class lecture and dive into the digital world in a variety of ways not related to the course content. Instructors may be unable to determine if a student is on task or distracted by a mobile device (Finn & Ledbetter, 2015; McCoy, 2013; Ragan et al., 2014).

Mobile device distractions. With the use of mobile devices in higher education, four types of distractions were consistently addressed: social media, checking email, instant messaging or texting with peers, and surfing the internet (Coffin et al., 2015; Dahlstrom et al., 2015; Kraushaar & Novak, 2010; Kuzenkoff et al., 2015; Lepp et al., 2015; McCoy, 2013; Nguyen et al., 2015; Tindell & Bohlander, 2012; Wood et al., 2012). Some researchers enlisted student volunteers to engage in these distractions during class time (Lepp et al., 2015; Sana et al., 2013). One researcher directed participants to engage in these distractions as often as they wanted during a class to gauge their level of attentiveness and distraction (Wood et al., 2012). At the end of some studies, participants were assessed to measure what they missed from the class lecture or discussion (Sana et al., 2013; Wood et al., 2012). Researchers have suggested that students who engaged in using mobile devices during class scored lower on assessments than students who did not use mobile devices during the class (Sana et al., 2013; Wood et al., 2012).

McCoy (2013) and Sana et al. (2012) surveyed students to better understand how they used mobile devices during class time. The four main forms of distractions identified were using social media, checking and responding to email, instant messenger or texts, and surfing the internet. Students self-reported the frequency with which they engaged in each of these distractions. Surveys were given to instructors to gauge how often they felt their students were distracted from the class lecture due to mobile device distractions (Coffin et al., 2015; Dahlstrom et al., 2015; Nguyen et al., 2015). The two groups varied greatly on their responses. Instructors reported a higher percentage of students using mobile devices as a distraction tool during class time (Coffin et al., 2015; Dahlstrom et al., 2015). The students agreed that these distractions took place during class time, but not at the frequency the instructors indicated (Coffin et al., 2015; Dahlstrom et al., 2015).

In 2011, McCoy (2013) surveyed six Midwestern universities regarding student usage of mobile devices during class for non-class related activities. In particular, he was looking at how non-academic usage of digital devices during class impacted student learning, the nature of students' perceived advantages and disadvantages to using digital devices for non-class related activities, and whether policies should be implemented that would effectively limit distractions caused by digital devices. A total of 741 undergraduate students and 25 graduate students completed the 15-question survey.

McCoy (2013) did not present a breakdown of the different types of courses or majors' students were enrolled in when they completed the survey.

Data indicated that undergraduates used a digital device for a non-class related activity 11.16 times per academic day, whereas graduate students reported using a digital device 3.90 times per typical school day for non-class related purposes. The overall average usage of a digital device for non-class related purposes was 10.93 times per typical school day. Unfortunately, McCoy (2013) did not specify what a typical school day entailed, nor did he differentiate between daytime or evening classes. Graduate programs can tend to have longer evening courses, whereas undergraduates can have two to three 50-minute classes a day. The responses for using a digital device during class for non-academic purposes included: entertaining themselves (49.1%), fighting boredom (55%) and staying connected to the outside world (through social media) (69.8%). Texting received the largest response (85.9%) for non-academic use of digital devices during class, with checking the time (79%), email (67.9%) and social media (66%) following as the top distractors during class.

Students acknowledged that using a digital device during class was a large disadvantage to them academically. The biggest disadvantages of using a digital device for non-academic purposes included: not paying attention to the lecture (89.8%), missing instructions for an assignment or project (80.4%), and distracting others (39.4%). Just over 52% of respondents stated that they were a little distracted by watching others around them using digital devices for non-academic purposes.

McCoy (2013) stated that 70% of respondents indicated their instructors had a technology use policy, with just over half of the respondents (53.7%) believing there should be a mobile device policy within a class. Yet, 91.2% of participants stated that mobile devices should not be banned in classes. When asked about upholding a policy when a student is distracting peers with a digital device, 71.8% of respondents stated the instructor should talk to the student. Sixty-five percent of respondents stated the student should get a warning for first offense followed by penalties. Finally, 3.5% believed the student should receive a penalty for each time they were caught using digital devices to distract themselves or others. Unfortunately, no concept was presented regarding what a penalty might entail, nor any clarification on how a student might be deemed to be distracting to others.

The analysis presented by McCoy (2013) aligns with what other instructors believe they see in the classroom (Finn & Ledbetter, 2015; McLaughlin et al., 2016). Yet at the same time, when one considers that fighting boredom, entertaining oneself and staying connected to the outside world were identified as the biggest advantages of having mobile devices within a class, an instructor should be asking how to better engage their students during class. These “advantages” of having mobile devices within a class give strong reason to implement a technology integrated approach to teaching, for example, using a flipped classroom format to engage students more during the class.

Sana, Weston and Cepeda (2013) examined the effects of in-class laptop use on student learning in a simulated classroom using two different experiments. Sana et al. (2013) hypothesized that a student would be distracted by whatever was on the screen of the device of the student in front of them. Besides the four most common forms of technology usage (using social media, checking and responding to email, texting, and surfing the internet) (Coffin et al., 2015; Dahlstrom et al., 2015; Kraushaar & Novak, 2010; Kuzenkoff et al., 2015; Lepp et al., 2015; McCoy, 2013; Nguyen et al., 2015; Tindell & Bohlander, 2012; Wood et al., 2012), the researchers added a Word document on which to take notes during the class discussion as another form of distraction. Sana et al. (2013) noted that the intriguing finding from this research was that even if a student was paying attention in class, participating in class discussions and taking notes on their own mobile device, they still had the potential to distract anyone sitting behind them through the use of their mobile device.

The first experiment had the control group (n = 20) take notes on their laptops while the experimental group (n = 20) had a list of 12 random tasks to accomplish on their laptop during their lecture. The authors looked at prior studies by Kraushaar and Novak (2010) and Wood et al. (2012) to replicate the time that multitasking took place in an average class and the tasks that could simulate multitasking within a class.

The second experiment used the same lecture format as the first experiment, yet explored whether or not someone within view of a student who was multitasking on a mobile device would be distracting, potentially bringing down the observer's post-lecture comprehension score. This second experiment had 16 participants placed in view of others who were multitasking on a laptop and 19 participants who were seated in a way that they would not be able to view a peer's laptop. At the end of each experiment, students were given 30 minutes to answer a short quiz with a combination of simple and complex questions based on the lecture material presented.

Experiment one resulted in multitasking students scoring 11% lower on the post quiz than the non-multitaskers confirming prior research that multitasking on a digital device has the potential to lower a student's overall grade. Experiment two showed that participants in view of a multitasker scored 17% lower on the post quiz than students who did not have a multitasker in their view. The second experiment brought to light the concept that mobile devices, when used purposefully, can still distract nearby peers, potentially inhibiting their learning as well.

In the survey completed at the end of the lecture, students in the second experiment commented that being in the view of a multitasker was either “somewhat” distracting or “barely” distracting (Sana et al., 2013, p. 30). This suggested that students are unaware of the direct impact that the actions of their peers have on their overall retention of information given during a lecture.

Sana et al. (2013) attempted to keep a level of fidelity in both experiments by placing a monitor at the back of the class, reminding participants about their specific directions. If a participant was reminded more than twice to stay on task with their specific directions, then that participant’s data were discarded. Overall, only one participant’s data from the first experiment was excluded. The authors did not state how many students had to be reminded at least once to stay on task with their specific directions. This aspect mirrors the challenges that Wood et al. (2012) experienced with participants not being able to follow their specific directions when asked to use a mobile device with a particular application by using a variety of applications.

Concerns with this study include the small number of participants for each experiment, using a simulated classroom and having a monitor in each experiment. All of these concerns call into question the generalizability of the experiment. One could argue that most undergraduate classes are not typically under 20 students. McCoy et al. (2013) chose a simulated classroom setup to have more control over the overall experiment, yet more control equates to a less generalizable outcome. Having a monitor in the class to remind students to stay on task greatly calls into question the overall reliability and validity of this research. Perhaps students with mobile devices could be asked to sit in the back of the class or on the edges of the classroom so that they might not distract those nearby.

Sana et al. (2013) made four suggestions in their research to help instructors and students understand the potential challenges of laptops or other digital devices in class. They stated that developing technology policies with students could be useful (Finn & Ledbetter, 2015; McLaughlin et al., 2015). Instructors need to explain the benefits and detriments of digital devices within a classroom (Gebre et al., 2015; Kraushaar & Novak, 2010; Sana et al., 2013). Instructors should discourage laptop usage for classes that did not require technology, suggesting that students take notes with pencil or paper (Sana et al., 2013). Finally, institutions need to empower and support instructors to make classes more engaging with technology usage to capture their students' attention.

Multitasking. Knowing that students have numerous mobile devices with them during class (Brooks, 2016), and how distractions, connected with mobile devices, can potentially lower a student's GPA (Sane et al., 2013; Woods et al., 2012), one might wonder how technology-related multitasking contributes to a student's success or failure within a class. Multitasking, with digital devices, would be defined as listening to a lecture and texting friends or searching the internet for something not related to a class while taking notes. The more a person tries to accomplish multiple tasks simultaneously, the longer it actually takes them to accomplish all the tasks at hand (Posner, 1982). Task-switching, a term similar to multitasking, refers to switching between tasks instead of focusing on just one task at a time (Lepp et al., 2015; Posner, 1982). Whether it is multitasking or task-switching, neither approach seems to benefit a person when trying to successfully accomplish multiple tasks at the same time rather than focusing on one task at a time (Posner, 1982). Though it seems to be most beneficial for a person to focus on one task at a time, the accessibility of mobile devices encourages people to do multiple tasks at once. For example, students have acknowledged that they check email, surf the internet, and text during class (Coffin et al., 2015; Dahlstrom et al., 2015; Kraushaar & Novak, 2010; Kuzenkoff et al., 2015; Lepp et al., 2015; McCoy, 2013; Nguyen et al., 2015; Tindell & Bohlander, 2012; Wood et al., 2012). Additionally, these actions have been shown to lower a student's GPA (Sana et al., 2013; Woods et al., 2012). Since mobile devices have emerged, schools and educators continue to work toward learning how to connect with 21st century learners on using mobile devices effectively in the classroom.

The concept of using mobile devices for multitasking seamlessly is evident in the college classroom as students can be observed using a variety of devices during a lecture. Typically students can be observed with a laptop in front of them, with their cell phone on the table or desk, while listening to a lecture. Instructors tend to assume that students are not taking notes on their computers and instead are on social media, checking email, texting or surfing the internet (Coffin et al., 2015; Dahlstrom et al., 2015; Kraushaar & Novak, 2010; Lepp et al., 2015; Sana et al., 2013; Tindell & Bohlander, 2012; Wood et al., 2012). Inversely, students report that they do not use mobile devices for non-educational purposes as much during a lecture as their instructors believe (Coffin et al., 2015; Dahlstrom et al., 2015; McCoy, 2013).

Woods et al. (2012) studied the impact of multitasking with digital devices while attending to a real-time lecture in a college classroom. The authors explored how multitasking with a mobile device, for example reading and responding to emails, would affect a student's focus on the class lecture. The researchers hypothesized that participants would not be able to stick to their one assigned task, so they included a fidelity measure to assess what exactly participants were doing during the class. The experimental group had four tasks consisting of: sending text messages during the lecture; sending and responding to emails; using MSN messenger; or interacting on Facebook. The control group's tasks consisted of three categories: taking notes with a pencil and paper, taking notes with a laptop or using their laptops as they do naturally within a class. Participants completed a survey at the end of class indicating how much they used other programs or applications instead of the one they were asked to use. This fidelity measure allowed the researchers to further assess the challenge of multitasking with digital devices during class.

All groups had at least three members that were non-compliant in one way or another during each class session. Participants in the MSN messenger and Facebook groups tended to be the most non-compliant. The only group that could not be labeled as "non-compliant" was the "natural use of technology" group as they were using technology as they regularly would within a classroom. Overall, 30-40% of participants were non-compliant during each session. Knowing that around one-third of all participants were not able to focus on their one assigned task and had to participate in other forms of multitasking leads one to contemplate how easy it is to multitask with digital devices at any given moment. This drive to multitask within a classroom when digital devices are so prevalent should lead instructors to ask what they need to do to help engage students during lectures. Wood et al., (2012) reported that only 57% of the participants followed directions completely during this study. One could wonder how this percentage would change if the tasks presented during the class were relevant to the overall class discussion and to the students' lives; or does it highlight the challenge instructors and students face with the ease and accessibility of digital devices.

Wood et al. (2012) conducted their research over three class sessions with the end result being consistent with prior research indicating a drop in scores on quizzes, tests or group projects as multitasking increased (Sana et al., 2013). Unfortunately, the high level of non-compliant participants negated most of what the researchers were hoping to uncover. They were not able to assess if using only one program or application as a form of multitasking would allow the participant to become more comfortable with that program or application, allowing them to focus more on the class lecture and potentially resulting in a rise in student scores.

Wood et al. (2012) did not intend to present data that digital devices can promote multitasking due to the ease and accessibility to the internet. Yet it became evident through the percentage of participants who were non-compliant that students have low willpower to not multitask when a digital device is nearby. The challenge then becomes for instructors to find engaging ways to capture students' attention within a class in order to lessen the amount of multitasking during a lecture.

In 2010, Kraushaar and Novak examined the effects of students' multitasking with laptops during class lectures. Kraushaar and Novak separated their research into three aspects of multitasking: productive, distractive, and duration. The researchers were able to examine the accuracy of self-reporting by comparing what students self-reported to Activity Monitor, a form of spyware used in the study. The study consisted of 97 participants, of whom 41 agreed to have the spyware installed on their laptops. Two important aspects of this study are that all students in the class were required to have a laptop and that the study consisted of two different instructors for three sections. The duration of this study was one of its greatest benefits, consisting of meeting for 75 minutes twice a week for 15 weeks.

This was an exploratory research project intended to uncover actual student usage of laptops in a typical college classroom. The research included examining the duration a student would multitask during a class and whether the multitasking was productive or distractive. Productive multitasking was defined as looking up information that would further their understanding of the topic being discussed, filling in gaps in their own knowledge or working on graphs or tables that would coincide with the discussion topic. Distractive multitasking was defined as anything that a student was doing on a laptop that was not parts of the class discussion, for example, sending emails or being on social media sites. A confusing aspect of the spyware was that students were not required to keep the spyware active during all lectures. Students who did not have the spyware activated for a minimum of one-third of a lecture were excluded.

Kraushaar and Novak (2010) also explored the duration that a participant engaged in a multitasking activity, what they called “duration.” The duration of productive multitasking was more than twice as long as distractive multitasking, 120.7 seconds compared to 52.5 seconds (Kraushaar & Novak, 2010). The authors stated that these were only estimated times as they were not able to truly know how long a participant looked at the screen and rather based these numbers on how long a screen was active on a laptop before the next active screen.

This research produced minimal support for their second hypothesis that "students spending a long time viewing active windows will exhibit lower academic performance than students with a short duration time" (Kraushaar & Novak, 2010, p. 247). Students who conducted productive multitasking presented a statistically significant increase in scores on five of the seven graded items. The authors pointed out that prior research suggested the opposite, that is, longer durations of distraction tend to be associated with lower scores.

Considering the possible benefits of productive multitasking within smaller class sizes, Ragan et al., (2014) examined whether self-driven learning (productive multitasking) would take place within a larger classroom format. This study took place during a weekly 165-minute evening class that had a total enrollment of 2724 students. The class was an introduction to geography where attendance was not required, and where it was estimated that between 70-80% of the students attended class regularly (Ragan et al., 2014). It was reported that this was an active class where student participation was encouraged, including having microphones placed around the lecture hall, allowing everyone to hear a question or comment from a student. Laptops were not required for this class.

The authors were interested in how students used technology during class. Knowing that this was a large format class, the authors were interested in whether students took it upon themselves to answer their own questions instead of speaking up. A total of 212 participants responded to the survey with 114 of the participants reporting that they had a laptop during class. The remaining participants stated that they did not have laptops in class for varying reasons, including no outlet to plug into, finding laptops distracting during class, and note taking by pencil and paper format. Observations were conducted without students knowing they were being observed. Observers sat in an area where they were able to record student usage of technology over a 50 minute period before moving to another area to observe more students. The outcome of the research suggested that students who used laptops in class did so in waves of multitasking and actively taking notes. Observed students tended to be on task at the beginning of the class, dipping toward off task activities during the middle of class and then re-engaging with on task actions toward the end of class.

In conclusion, multitasking is a regular challenge for all within a higher education classroom. With a plethora of mobile devices on hand and the ease of access to the internet, students have the chance to get off-task during a lecture and multitask, for example, surf the internet, email friends or connect to social media sites. Though Kraushaar and Novak (2010) differentiated between productive and distractive multitasking, it would seem that higher education instructors would need to train their students how to utilize productive multitasking to benefit their own education. Unfortunately, disruptive multitasking is not only limited to the person doing the multitasking, but can also affect the students sitting in view of a peer’s laptop screen. Finally, it continues to be confirmed that multitasking on a mobile device has a great potential to lower a student’s GPA, both on quizzes, projects and final exams.

Pedagogy. Adjusting an instructor’s pedagogy to meet the needs of the students continues to be an obstacle toward fully embracing and integrating mobile devices into the class (Greener & Wakefield, 2015; McCoy, 2013). Greener and Wakefield (2015), Halverson and Smith (2009), and Sykes (2014) recommended more consistent training or professional development for instructors on how to implement mobile devices into the classroom. Another challenge with adjusting an instructor's pedagogical approach is that instructors tend to assume that students are using mobile devices to distract themselves instead of focusing on the class. To potentially help alter these beliefs, Sane et al. (2013) suggested that instructors help students fully comprehend how distracting mobile devices can be in the classroom, for example, spending part of a class discussing the expectations for using mobile devices in a class. MacArthur and Bostedo-Conway (2012) and Sana et al. (2013) encouraged instructors to make the course content relevant and related to the students' lived experiences, for example, using a blended or flipped format within the course. Such strategies allow for engagement and thus, potentially, encourage productive multitasking to take place (Kraushaar & Novak, 2010).

In 2015, Greener and Wakefield conducted a case study at a small English university. Their hypothesis was that if staff were provided with new mobile devices that it would increase their professional desire to adopt mobile devices into their classrooms. Participants were required to use SharePoint, which was fairly new to the institution, and Visual Learning Equipment (VLE). The study consisted of three stages: obtain student feedback and present that information to the faculty; obtain instructor opinions on the use of mobile devices; and conduct interviews with faculty participants at end of the study. Initially the study consisted of 20 instructors and concluded with seven instructors being interviewed. This study was based off a paper presented at the European Conference on E-Learning in 2012 which stated that multiple steps or phases must be accomplished while transitioning to a mobile device institution (Greener & Wakefield, 2015, p. 261). The authors chose to just focus on the local environment as their first step toward becoming a mobile device institution. For no particular reason, they chose to use a disruptive technology, a new device that would be challenging to use and had greater potential to disrupt the current environment at the institution. The device introduced was the Google Nexus tablet, a device with which few staff had experience (Greener & Wakefield, 2015).

An all-around excitement over mobile devices was reported among the faculty, yet there was a concern around confidently using digital devices with students and questions about the pedagogical reasoning for integrating mobile devices into the classroom. The authors believed that given the necessary investment and staff training, mobile device integration would be possible. Training sessions were offered to faculty prior to the project, but the authors provided no details about the type of training. It is not clear if the training was mandatory, how many participants attended the training, if there were multiple or follow-up trainings, if the training was only on using the Google Nexus, or if it was on using SharePoint or VLE through the tablet.

Stage One, a focus group, was comprised of current and former students. The authors wanted to find out what devices students were aware of that existed within the institution and what the students thought about the integration of mobile devices into classes, both what was already taking place and what they wanted to have implemented into their classes. Overall, the students wanted more consistency between the classes with mobile devices, both in physical devices within the class and with programs and software that could be used outside of classes. Yet it was concluded that students had a limited understanding of how to employ digital technologies to further their own learning.

Stage Two consisted of two questionnaires. The authors did not state when the first questionnaire was administered but 85% of the participants (17 out of 20) completed the survey. A majority of participants reported being online regularly and described information communication technologies (ICT) with enthusiasm. About 60% of the instructors owned smartphones and 70% owned tablets. The instructors used VLE mainly for uploading lectures and posting YouTube videos, along with some use of marketing tools and creating online reading lists. The second questionnaire only got a 45% response rate (9 out of 20). The authors assumed the low results were due to the questionnaire being released mid-term and that participants could have been frustrated with the Google Nexus.

Only seven participants were a part of Stage Three, an interview that focused on their overall thoughts about mobile devices in the classroom, attitudes about compulsory and non-compulsory technologies within the institution, barriers they experienced while learning to use new technologies and their preferred method for learning to use new technologies. An excitement for learning to use new digital devices or programs was still evident, yet the underlying fear of making mistakes in front of students or not using a mobile device fluidly persisted. Not one participant used the Google Nexus tablet in their classrooms "for teaching or learning activities" (Greener & Wakefield, 2015, p. 265).

Greener and Wakefield (2015) concluded that more training and guidance should be implemented to model for instructors how to integrate technology into their lessons. The instructors presented the challenges of lack of confidence and self-efficacy when learning to use new digital devices. Engaging staff with specific applications, for example, SharePoint, was difficult due to lack of sufficient training and support.

> This suggests that rather than trying to tackle confidence improvement directly, for example through workshops and technical support, the objective should be to engage with teaching staff on the pedagogical issues they face and the potential opportunities for solving learning problems and improving learning opportunities for students through experimenting with proven learning technology applications. (Greener & Wakefield, 2015, p. 265)

Though the authors were able to interview seven instructors, it should still be asked why there was a consistent decline in participants from Stage 1 to Stage 3. It also brings into question the training instructors received to make them successful in this transition to changing their pedagogical approach to incorporating mobile devices into a course.

Kumar and Vigil (2011) hypothesized that digital natives enrolled in a teacher education program would have higher levels of technology skills and that if they were taught to make the connection between technology, subject matter and pedagogy, they would quickly become adept at implementing educational technologies into the classroom. The authors believed there would be a connection between the students' use of technology in their personal lives and their use of technology within a classroom. Initially, 320 education undergraduates at a large private university received an email inviting them to participate in a survey looking into their use of Web 2.0 tools, creation of online content and their perception of new technologies being beneficial to teaching and learning. Fifty-four students participated in the survey.

The authors investigated the formal and informal uses of Web 2.0 technologies, including online videos, photo sharing apps, online forums, blogs, wikis, podcasts, Google Docs and Second Life. They predicted that students would naturally transfer knowledge and abilities between formal and informal uses. Looking at the specialized disciplines within the school of education, one could wonder how or why these Web 2.0 technologies would be implemented. For example, 25% of participants were majoring in elementary education, 16% were studying special education, and about 9% were early childhood educators. The specialized disciplines that might actually use the Web 2.0 technologies that this study focused on included mathematics education, at 12% and science education at just under 3%.

The top uses of Web 2.0 technologies, informally, were watching online videos (98%), photo sharing (68%) and online forums (52%). In contrast, educational uses of Web 2.0 technologies consisted of 58% of professors using online videos as a resource and 45% of students using online videos as a resource, as the main Web 2.0 technology. Approximately 8% of instructors used blogs or wikis as a resource compared to 19% of students. Under 2% of instructors used Google Docs in a class compared to 19% of students using Google Docs with peers. Ninety-three percent of the students had created a website for a class compared to only 4% doing this on their own, informally.

The results of the study did not coincide with existing research that suggested digital natives would naturally transfer knowledge from informal uses of digital devices to formal uses within their education. When applications, for example social media or Google Docs, were not required or encouraged to be used by instructors, the researchers acknowledged that students implemented informal uses of collaboration and communication to work on group projects. In contrast, students needed to be instructed and continually guided toward using digital devices in a formal educational manner. The generalizability of the study needs to be reviewed when a strong contingent of the participants would unlikely use digital devices in their future classrooms, for example, special education or early childhood teachers.

Ten years after Prensky (2001) defined digital natives and digital immigrants, Margaryan, Littlejohn and Vojt (2011) wanted to define patterns of technology adoption by university students and to explore the motivations driving technology adoption between digital natives and digital immigrants. The authors chose to look at two specific majors, social work and engineering at two British universities. Unfortunately, the authors presented no explanation for choosing these two polar opposite majors.

The total enrollment between the two institutions was over 20,000 students, yet the total number of participants was only 160 students. To further complicate this research project, Phase 1, a survey, was only administered during one class and only to the students that happened to be attending class on that particular day. Margaryan et al. (2011) stated that this snapshot of student views was time and cost effective, yet it severely limited the overall representation of the student population. The sample consisted of 130 students majoring in engineering and 30 students majoring in social work. Only 39 of the participants were female and most majoring in social work. The authors stated that this imbalance of genders was representative of the overall population of both institutions (Margaryan et al., 2011). The survey focused on four areas: student demographics; student technology use in the course; student technology usage for learning; and technology usage for socializing and entertainment.

Phase 2 consisted of semi-structured, in-depth interviews. At the time of the survey, students were asked to provide contact information if they were interested in participating in an interview. Twenty-eight students offered to be interviewed, yet only four students from each major were interviewed. The authors also interviewed eight faculty members.

A multiple regression was conducted to explore student usage of technology in their formal learning environment. Some of the predictor variables included the amount of digital devices used in informal learning, number of digital devices used for social media, the student’s major and their age. The findings suggested that the use of digital devices in a student’s formal learning increases in parallel with an increase in use of technology for their informal learning. The data supported commonly held beliefs that technology driven disciplines will have a higher usage of technology use for both formal and informal learning, whereas, disciplines that do not rely on digital devices will have students that do not have high levels of technology usage in their formal or informal learning. The survey might be the strongest piece to this research as it at least has a higher number of participants, though it has a disproportionately higher number of engineering majors, males and digital natives.

Neither the survey nor the interviews provided sufficient evidence to support prior claims that digital natives required radically altered approaches to instruction. Regardless of student age or major, their attitude toward using mobile devices in their learning appeared to be influenced by their instructors’ approach to teaching. Students still expected to be taught in a traditional manner, predominantly through lectures, along with being guided toward how to use digital devices in their learning. The instructors’ interviews presented data that showed instructors have a minimal understanding of ways in which digital devices could support effective teaching and learning. Overall, integrating digital devices into a higher education classroom is a complex process that requires support for both students and instructors.

Margaryan et al. (2011) confirmed aspects of existing research that students in higher education continue to not fully understand how to utilize digital devices in their formal learning and require support and guidance with the use of these devices. They also highlight how Prensky’s predictions in 2001 are not supported by subsequent research. Instead, digital natives have not been found to be fluid with a wide range of digital devices and programs. Margaryan et al. (2011) reaffirmed that students prefer a lecture-based classroom and model their use of digital devices on their instructors’ use. Though these aspects are important, there are serious concerns with this study. The authors’ choice of using extremely diverse majors, engineering and social work, is confusing and this author is unsure how that supports their overall goal. The fact that there was a severe imbalance of participants between the two majors, and the two genders and the imbalance between the number of survey participants and interviewees calls into question the overall results and generalizability. Though the instructors’ interviews can be questioned due to the lack of random selection, it was noted that instructors continue to need guidance and support when adjusting their use of digital devices within the classroom. This change in their pedagogical approach mirrors other current research articles that continue to call for consistent guidance for instructors to integrate digital devices into their classrooms.

In conclusion, if higher education administrators truly want classrooms that integrate digital devices, then instructors need consistent support and guidance to adjust their pedagogical approach to the classroom. Instructors are excited and interested in engaging their students in meaningful ways with digital devices and 21st century skills. These changes take time and do not happen quickly. Furthermore, instructors' excitement is tempered by the possibility of making embarrassing mistakes in front of their students.

Student Abilities and Expectations. Since the publication of Prensky's *Digital Natives, Digital Immigrants* (2001), administrators and higher education instructors have been pushed to change their approaches to teaching to meet the technological demands of the students. Parts of Prensky's rallying cry stated, "Our students have changed radically. *Today's students are no longer the people our educational system was designed to teach*," (p. 1, emphasis in original). Yet, since that publication, researchers have been working toward confirming or denying Prensky's claims (Buzzard et al., 2011; Buzetto-More, 2012; Kennedy et al., 2010; Jones & Shao, 2011). Research consistently presents data that current students are highly skilled in social media and using technology to communicate. Contrary to Prensky's beliefs, a majority of students do not want a heavy integration of technology into their courses and actually prefer a limited amount of information and communication technologies (ICT) (Buzetto-More, 2012; Finn & Ledbetter, 2013; Jackson et al., 2011; Jones & Shao, 2011). In spite of Prensky's claims that all digital natives would be exceptional users of digital devices, research has demonstrated the opposite, as students have a wide range of experiences and abilities when using digital devices, both in and outside of the classroom (Greener & Wakefield, 2015; Kennedy et al., 2010; Prestridge, 2014).

Kennedy et al. (2010) reviewed data collected from 2,096 students from three different Australian universities. Their focus was to define the different types of technology users that existed at each university along with exploring the degree to which technology users differed according to seven demographic variables. The three universities were the University of Melbourne, a very large, well-established research institution; the University of Wollongong, a large regional institution that offered a number of prestigious disciplines; and Charles Stuarts University, a multi-campus regional institution consisting mainly of part-time students, distance learners and students from lower socio-economic backgrounds.

A cluster analysis was used to categorize the different types of technology users. Kennedy et al. (2010) used a three-, four- and five-cluster approach before settling on a four-cluster approach to differentiate the types of technology users. Through this analysis the authors identified four distinct types of technology users: power users, ordinary users, irregular users and basic users. Power users were defined as having a wide range of technology skills who embraced new and emerging technologies; ordinary users were regular users of the internet and mobile devices; irregular users were similar to ordinary users but used mobile devices less frequently; and basic users infrequently used new or emerging applications or mobile devices. A MANOVA was used to differentiate the users by seven demographic variables. Results showed that the University of Melbourne had an overrepresentation of power users and an underrepresentation of basic users. The other two institutions showed an underrepresentation of power users. This was intriguing as the researchers predicted the University of Wollongong to be more similar to the University of Melbourne based on basic demographics, such as types of disciplines offered and similar socio-economic backgrounds. Males were overrepresented as power users and ordinary users, yet females were overrepresented as irregular users, an outcome that confused the researchers as current research shows that females are more likely to use technology in their educational endeavors compared to males. Finally, local students were overrepresented as basic users compared to 20 year-old international students being overrepresented as power users.

Kennedy et al. (2010) concluded that digital natives are a heterogeneous group of individuals with a wide range of technological abilities. The use of digital devices and experience with different devices varied in individuals from all socio-economic backgrounds. Kennedy et al. (2010) concluded that a student’s skill level with mobile devices could not be predicted by any one variable. Instructors and higher education administrators need to consider the wide range of skills and abilities found in digital natives.

In 2011, Buzzard et al. wanted to add to the plethora of research focused on instructional technologies. They chose to use different research surveys to compile their data. Phase 1 was a national survey that was administered to faculty in a wide range of disciplines in higher education. This national survey resulted in 1,717 usable responses that focused on how instructors used technology for teaching and learning. Phase 2 focused on both students’ and instructors’ perceptions of digital technologies in the classroom. There were 765 students and 308 instructor participants who completed the survey. Unfortunately, the authors did not present any demographic information on the types of institutions from which participants were drawn nor the response rate from either survey. This lack of detail limits the generalizability of the data set.

Phase 1 examined differences among academic disciplines with regard to instructional technology usage. The results presented no major differences between the traditional disciplines, yet there was an overall increased desire to integrate more technology into classrooms. The instructors were asked to rate the role instructional technology took in their teaching practice. This included seven specific areas: course planning, course management, teaching, assignments, assessment, grading and overall needs. The results indicated that it was most challenging to integrate technology in course planning and course management. It is not clear whether instructors received any support or guidance to integrate instructional technology into established courses. Though instructors seemed to be frustrated with integrating technology into their established courses, they did envision technology as a useful tool for developing interactive course materials. The authors did not focus on support or guidance for instructors but multiple studies do highlight the importance of continual support of instructors to encourage integration of technology into their classroom (Chen, 2015; Cotner et al., 2013; Gebre et al., 2015; Greener & Wakefield, 2015; Kumar & Vigil, 2011).

Phase 2 consisted of a survey administered to students and instructors, focusing on their preference for instructional technologies within the classroom and whether instructional technologies positively contributed to student learning. Overall, 58% of students preferred a “great deal” of technology within their courses, while 48% of instructors had a similar view (Buzzard et al., 2011). There were statistically significant differences in preference for mobile device usage between genders and in the usage of mobile devices between the different disciplines, both consistent with existing research (Margaryan et al., 2011). As research suggests, engineering, business or marketing classes tend to integrate instructional technology at a higher rate than the fine arts. This was also evident in Buzzard et al.’s (2011) results. Yet the belief that digital natives want more technology integrated into their courses became evident by looking at the instructors’ preference for instructional technology compared to students’ in the fine arts, mathematics, life sciences and physical sciences. There was an average difference of 20% between instructors’ and students’ preference in these disciplines. An interesting twist to this survey showed that though digital natives were technology savvy, there was a large gap between the student preferences for instructional technologies and their instructors support (Buzzard et al., 2011). Students were excited and willing to learn new educational or instructional technologies but required support and guidance from their instructors which instructors were hesitant or unable to provide. The authors reported a strong difference between student and instructor perception of digital tools within a course. Traditional tools consisted of Microsoft Office applications, for example, with 52% of instructors finding these important compared to 73% of students. Additionally, 55% of instructors and 30% of students believed learning management systems were important to the course. These large discrepancies between two important instructional technologies could be concerning for higher education administrators and instructors as they try to connect with the current student population.

Buzzard et al. (2011) called for student support with instructional technologies. It is evident that students are savvy with technology (Buzetto-More, 2012; Henderson et al., 2016; Jones & Shao, 2011; Kennedy et al., 2010) but lack the required skills to successfully utilize instructional or educational technologies to further their own education (Gebre et al., 2015; Kassens, 2014; Kennedy et al., 2010; West et al., 2015). It is important students understand how digital devices can enhance their learning. Instructors could achieve this by presenting learning goals or objectives for students to focus on (Buzzard et al. 2011). Both students and instructors are excited to use digital devices within the classroom, but both groups need support and guidance through this process.

There has been a significant amount of research testing Prensky's claims. Jones and Shao (2011) set out to review research articles from around the world focusing on evidence that contradicted Prensky's findings. They reviewed over 50 journal articles published from 2001 to 2010. These articles were from more than 15 countries, including the United States, and the first five ECAR Student Technology Surveys, 2004 to 2009. Unfortunately the authors did not present any data analysis, but instead presented an Executive Summary of their findings. Jones and Shao (2011) concluded that there was no evidence that digital natives completely comprehend the technological changes taking place in education nor how to integrate them into their education. There was minimal evidence that suggested students enter higher education with technological demands that instructors cannot meet. There was not a permanent gap between instructors' technology usage in the classroom and students' abilities that could not be overcome. As much as Prensky claimed that students would want heavy technology usage in their education, research suggests the opposite, that students want a moderate amount of technology usage in the classroom. The challenge with the term "moderate" is that as technology has rapidly evolved, "moderate" can vary from year to year and by instructor. Students appreciate the infrastructure developed by institutions, including learning management systems, online libraries and technology support. Finally, no consistent demand was discovered where students wanted instructors to change their pedagogy within the classroom. Other researchers presented data that students continue to prefer lecture-based lessons while blending in technology and 21st century skills (Buzetto-More, 2012; Finn & Ledbetter, 2013; Jackson et al., 2011; Jones & Shao, 2011).

Though no data analysis was presented within this research, the research articles from around the world continue to support current beliefs and practices in higher education in regard to digital devices within the classroom. It is evident that some students come to higher education institutions with strong technology skills but that they may lack understanding of how digital devices can support them. There are numerous benefits to using digital devices within the classroom, but first administrators and instructors need to be aware of the gaps students bring to school in the use of educational programs or applications. Though instructors may want to focus on the content of the class it would be beneficial if they took time to train students on how to use educational technologies along with the learning objectives in using these programs and devices.

Benefits of Mobile Devices

The negative aspects of mobile devices are apparent, however, researchers have also presented various benefits to the use of mobile devices within a college classroom. Mobile devices in the classroom allow for the versatility that students are requesting (Alden, 2013; Kuzenkoff et al., 2015; Martin et al., 2011; MacArthur & Bostedo-Conway, 2012; Yang, 2012). Students can easily communicate with an instructor or peer, in or out of the classroom. Assignments can be submitted during class without disrupting the flow of the lecture or conversation and students have more autonomy and accountability over their own learning (Yang, 2012). The personalization of mobile devices and the fluid flow between applications and programs allows students and instructors to take notes in real-time using digital applications such as Evernote, Dropbox, or Google Docs which can be easily shared with peers during or after a lecture. Consequently, collaboration can become more effective and efficient. For example, instructors can use clickers or Twitter to get instantaneous feedback during lectures to check for understanding or to contribute to ongoing conversations (Blessing et al., 2012; Kuzenkoff et al., 2015; Martin et al., 2011; MacArthur & Bostedo-Conway, 2012; Tyma, 2011).

As mentioned earlier, the average college undergraduate possesses multiple mobile devices (Alden, 2013; Brooks, 2016; Coffin et al., 2015; Dahlstrom et al., 2015; Martin et al., 2011). These devices generally consist of smartphones, tablets and/or laptops. Many students have these devices at all times, both in and out of the classroom. This convenience allows students the ability to work on class projects whenever or wherever they are. This mobility is the foundation of ubiquitous learning; an anytime, anywhere mentality for learning (Lee, 2013; Yang, 2012). For example, students can be revising notes from a prior class while waiting for the next class to begin. Students are highly interested in using technology more in their education (Brooks, 2016; Dahlstrom et al., 2015; Greener & Wakefield, 2015). This notion brings up the concept of meeting students where they are in utilizing mobile devices in their academic lives. Halverson and Smith (2009) and Sykes (2014) found that students still need to be trained on how to use their devices with respect to learning. Greener and Wakefield (2015) and Dahlstrom et al. (2015) observed that college students prefer a blended approach to learning. This approach allows students to participate in a course that offers both face-to-face and online instruction. Some studies found that if instructors incorporated mobile devices into their class, students were more engaged in discussions, lectures or online discussions (MacArthur & Bostedo-Conway, 2012: Sana et al., 2013).

Before computers became a common tool in education, a student would have to carry multiple notebooks and textbooks from class to class. In the current realm of mobile devices and cloud services, students have the ability to use one device to help with note taking along with having the opportunity to download digital copies of textbooks. The fluidity that college students are afforded in the current realm of digital devices is wide ranging. With mobile devices, students have the ability to keep all their class notes in a digital platform like Evernote, Dropbox or Google Docs. This ability allows students to access, add to or adjust their notes and collaborate at any time. Mobile devices also allow for immediate communication, including email, texting, and social media platforms like Twitter or Facebook.

Twitter. With social media being cited as one of the biggest distractors in the classroom (Kraushaar & Novak, 2010; Ragan et al., 2014), it would be worthwhile for instructors to find ways to utilize this distractor to their advantage. Researchers continue to state that instructors need to make classes more engaging while incorporating 21st century learning skills (Barnes & Jacobson, 2015; Chen, 2015; Cotner, Loper, Walker & Brooks, 2013; Henderson, Finger & Selwyn, 2016; Kop & Hill, 2008; La Roche & Flanigan, 2013; Park & Choi, 2014). With data showing that between 90% and 98% of students carry smartphones and laptops (Alden, 2013; Brooks, 2016; Coffin et al. 2015; Dahlstrom et al., 2015; Martin et al., 2015), instructors have numerous ways to connect with and engage their students during a lecture. Creativity and risk taking may be the first step for all parties involved (Al-Bahrani & Patel, 2015; Kassens, 2014; Prestridge, 2014; Tyma, 2011). One way that instructors can utilize social media is through Twitter. This application can allow students to ask questions during a lecture, for example in a large class format, where they could get instantaneous feedback and potentially help guide the lecture. Instructors can use Twitter to encourage collaboration by continuing conversations outside of the class by sending in-depth questions or vocabulary words to students when class is not in session (Blessing et al., 2012; MacArthur & Bodesto-Conway, 2012; Tyma, 2011). One benefit of Twitter is that "tweets" can be no larger than 140 characters, forcing people to be brief and concise in their statements (Kassens, 2014). Twitter has the potential to force students to be reflective and refined in their writing, (Al-Bahrani & Patel, 2015; Kassens, 2014) along with potentially allowing for community enrichment and connectedness (West, Moore & Barry, 2015). It should be noted that Twitter increased the amount of characters to 280 in 2017.

Twitter is emerging as a versatile collaborative tool (Blessing et al., 2012; MacArthur & Bodesto-Conway, 2012; Tyma, 2011). With large class sizes, students may not have the ability to ask questions or receive individual support from the instructor during class. Twitter is a tool that students can use to instantly communicate with an instructor during a lecture (Blessing et al., 2012; MacArthur & Bodesto-Conway, 2012). Some university policies empower instructors to implement Twitter into their regular classes. For example, an instructor may have two different projectors and screens during a lecture. One screen would be used for the presentation and the other screen would be used for the class Twitter feed (Tyma, 2011). Students would be able to ask questions, give feedback or make comments via Twitter during the lecture, another opportunity to engage in the learning process. This application provides instantaneous feedback and allows the instructor to check for understanding by asking questions that could require a tweet from students.

Integrating 21st century skills and mobile digital devices into some areas of academics can be challenging. Kassens (2014) felt that economics courses were lagging behind other disciplines, for example, engineering courses, in technology use. Kassens (2014) chose to implement Twitter into two semesters of macro-economic courses. At the end of two semesters she had 25 students complete an online survey stating whether Twitter had helped clarify class material. Kassens' (2014) focus for implementing Twitter was to help her students become more reflective on the lectures, to improve and refine their writing skills and to expand the class community.

Initially, Kassens dedicated one class to the establishment and usage of Twitter, mainly because Twitter was a mandatory part of the course. The class took place in a computer lab that supplied a digital device to each student during class, but outside of class the students had to find a digital device if, by chance, they did not own a smartphone or other digital device. The students had 10 Twitter assignments for the semester. Students were required to post a minimum of two tweets per assignment. During the introductory lecture on Twitter, students helped create a scoring rubric for their tweets, allowing for more buy-in into the use of Twitter. Taking time to walk through the process of using an application or program is supported by research as students, though "digital natives," are not proficient in use of every digital device, application or program (Buzzard, Crittenden, Crittenden & McCarthy, 2011; Gebre, Saroyan & Aulls, 2015; Kassens, 2014; Kennedy, Judd, Dalgarnot & Waycott, 2010; Halverson & Smith, 2009; Sykes, 2014).

Within the two classes, Twitter allowed students to participate in conversations with experts in the field of economics, US Senators and college students from other universities in the United States (Kassens, 2014). One assignment was to comment on the 2013 State of the Union address within 24 hours of the speech being delivered. Through the process, the class hashtag was picked up by other users, quickly connecting the class to tweets from 637 members of Congress “creating an unintended class over a million strong” (Kassens, 2014, p. 104). Experts in the field of economics were invited to ask questions or provide comments during the viewing of a video that students watched outside of the class. Tweets were reviewed at the beginning of each class session, scoring them randomly, allowing students the opportunity to understand how to reflect and refine one’s comments or questions. This aspect potentially encouraged student growth in writing about economics.

Kassens (2014) did not supply any data to show that the use of Twitter increased student understanding about economics or any increase in a student’s grade. Her research process was based on prior research articles that supported the use of Twitter in higher education classrooms. She did have a 50% response rate to an online poll, but she did not supply any data other than that 76% of the respondents agreed that Twitter helped clarify course material. Kassens guided her students through the initial process of setting up a Twitter account and allowing for practice before being graded (Al-Bahrani & Patel, 2015; West et al., 2015). Kassens did comment about the size of a class being a potential limitation to using Twitter as she believed that having 10 assignments for a large class could become time-cost prohibitive.

While Kassens was concerned about using Twitter in a large class format, West, Moore, and Barry (2015) took on that challenge working with two large format classes at a Canadian university with a total of 411 participants. One class was a first-year marketing course with 231 participants, equally split between males (46%), and females (54%). The other class was a first-year fashion course with 180 participants, predominantly female, at 95%, the norm for that course. Twitter was mandatory in both courses. Students were required to post tweets at least 10 times during the semester. The authors agreed with research that Twitter was a tool that could enhance learning, engagement and success among students using 21st century skills (Blessing et al., 2012; MacArthur & Bodesto-Conway, 2012; Tyma, 2011). The authors focused on five research questions ranging from defining a baseline level of experience with Twitter, to how mandatory use of Twitter would affect student evaluations of their learning to their perceptions of tweeting during a lecture. The researchers wanted to provide an open forum to encourage student participation throughout the semester, both in and outside of the class.

Similar to Kassens (2014), West et al. (2015) set aside one class to teach how to use Twitter “in a course learning context” (p. 163). Additionally, they provided tutoring outside of the class upon request, which about 5% of the participants attended. A complete analysis of the data showed 5,012 tweets were sent within the marketing class and 3,006 tweets sent within the fashion course, both over a three month period. The authors did not indicate how many of these tweets were original tweets compared to retweets. With such a high number of tweets sent during the semester, West et al. wanted to compare the top 10% of users (n = 39) to the rest of the participants, comparing end of course grade point averages. The average number of tweets sent by the top 10% was 31, compared to the rest of the participants at 15 tweets sent, with an average final grade of 75.6% and 70.5%, respectively (West et al., 2015). West et al. found no evidence that being a new Twitter user would lower a student's grade. Participants did not view Twitter as a distraction during class and strongly reported that it was a useful learning tool. Participants strongly agreed that they would use it again in their educational journey.

In 2012, Blessing, Blessing, and Fleck set out to "provide empirical data supporting the use of social networking in an educational setting," (p. 268). The authors noted that prior research had been predominantly anecdotal in nature. The focus of the study was to send near daily tweets to students throughout the semester. The study consisted of two instructors, in two separate classes, teaching the same subject, introduction to psychology. Each class was split into two random groups. The control group received a humorous tweet, for example on a near daily basis. The experimental group also received a tweet on a near daily basis that contained humorous tones based around important aspects of the chapter they were required to be reading for class. Two sets of 84 tweets were written before the experiment took place. Students received six tweets per chapter.

On the first day of class students received a piece of paper informing them how to use Twitter, unlike the prior two studies that utilized the first class to walk students through how to use Twitter. This approach was implemented based on a prior study by the authors that concluded that less than 20% of the students had experience with Twitter, yet all students were familiar with how to use Facebook (Blessing et al., 2010). The authors also created two Facebook pages in case students did not want to use Twitter but still wanted to have access to the tweets released. The authors stated that 63% of the participants subscribed to the Facebook page, but did not provide any numbers for how many participants subscribed to the course Twitter feed.

Similar to Kassens (2014), Blessing et al. (2012) had a relatively small number of participants (n = 63). At the end of the study five participants were dropped from the data due to either dropping the course or incomplete data. The participants consisted of 42 females and 21 males, mainly Caucasian and from middle to upper socioeconomic backgrounds. This low number of participants from a homogeneous background calls into question the generalizability of this study and the reliability of the empirical data set acquired. The authors did not present data on whether males or females posted the most on Twitter.

To acquire empirical data, the authors had students take four "cued recall tasks based on the previous three to four chapters of material" (Blessing et al., 2012, p 270). These cued recall tasks were given to the class before an exam on the same chapters. The authors also gave four regularly scheduled exams that contained multiple-choice items that matched particular tweeted content that the experimental group received. Between the two different sources of potential data, the authors believed that they would have enough information to present empirical evidence about Twitter and student success. There was not a statistically significant difference between the control and experimental groups. The experimental group listed remembering a tweet 33% (*S*D = 0.10) of the time while the control group listed remembering a tweet 29% (*SD* = 0.08) of the time.

Though the cued recall tasks did not present statistically significant data supporting the authors' hypotheses, the data acquired from the four regular scheduled exams did present some statistically significant data to support their hypotheses. Embedded within each exam were 6 to 8 multiple choice questions specifically related to the tweets sent to students. All of the remaining multiple choice questions were related to material from the textbook or discussed in class. When looking at the Twitter based questions only, the control group did significantly worse than the experimental group, (*M* = 0.74, *SD* = 0.12), *t*(61) - 2.02, *p* = .048, *d* = 0.52. This may support that Twitter did in fact provide an effective mechanism for presenting data to students. Yet when analyzing the complete exam and comparing the two groups, there was no difference between them; control group (*M* = 0.78, *SD* = 0.10) and the experimental group (*M* = 0.78, *SD* = 0.12).

In conclusion, social media apps like Twitter have the potential to benefit students in a variety of educational ways. This is one way that instructors can engage students both in and out of the classroom. The challenge of motivating instructors to integrate Twitter or other social media apps within their classrooms still remains. If instructors are not interested in engaging students through social media, perhaps the next step is guiding instructors towards enhancing the classroom environment.

Preferred Learning Environments. Historically, education within the United States has been teacher-centered with students sitting in desks and rows facing the teacher while answering teacher-directed questions. This initial approach to education can be traced back to the Puritans in the Massachusetts Bay Colony (Fraser, 2014). The Puritans did not initially have physical schools, but the teachers, usually the father of the household, decided what was to be taught and how (Fraser, 2014). As the nation was preparing to separate from England in the 1700s, Benjamin Franklin was one of the first to publicly speak out against the traditional education that existed at that time, encouraging an experiential approach to learning (Urban & Wagoner, 2014). Through all of these years, teachers led the class, making all the decisions on what and how students should learn. Fortunately, in the 1900s people started to challenge this traditional approach to learning. Some of these were John Dewey, Jean Piaget, Lev Vygotsky, Carl Rogers and Maria Montessori. The concept of a student-centered or learner-centered approach to education began to emerge. One could say that this was the genesis of instructors starting to think about the type of learning environment in which their students might prosper. This concept of considering what the learner might prefer has been slowly trickling into higher education.

Since the introduction of mobile devices into higher education classrooms, student preferences for differentiating the learning environment has evolved at a quicker pace. The concept of an "anywhere and anytime" approach to learning has become more prominent (Lee, 2013; Yang, 2012). The EDUCAUSE ECAR 2016 Student Technology Survey presented data that 10% of college students preferred live-only courses, with no digital devices, and about seven percent of college students preferred online-only courses (Brooks, 2016). The rest of the students surveyed preferred a blended learning approach. Brooks stated that these numbers have been stable for the past several years as indicated through the annual ECAR Student Technology Survey. A blended learning classroom can look very different from instructor to instructor, but the most basic description is a class that has varying aspects of technology blended throughout the lecture or class experience.

In 2015, Barnes and Jacobsen set out to explore how millennials felt about the traditional lecture approach and their perceptions of various learning styles, including how students felt about digital technology within a class. They conducted two studies in business courses at a small private university and a medium sized state university. The first study consisted of 83 participants. One aspect the authors were looking for within the first study was preferred delivery style in a classroom, focusing on lectures, class discussions, group projects or use of visual media. Students filled out a Likert scale survey consisting of questions about their preference for lecture-based classes, if they saw lectures as educational, if they felt that visual media courses were educational and what resources could help improve their classroom experience. This study presented data that half of the participants preferred lectures and that they enjoyed the incorporation of technology into a class, “but they strongly question its educational value” (Barnes & Jacobsen, 2015, p. 26). The study also presented data that males strongly preferred lectures and females strongly preferred group work. Their results contradicted current research and opinions on what millennials wanted in the classroom, thus confusing the researchers.

Outcomes from the first study guided the questions for the second study that focused only on lectures and visual media. This study consisted of two groups, one (n = 64) contained a visual media condition and the other (n = 57) contained a lecture condition. Each group took their primary focus and blended it with another form of instruction, for example, lecture and group project, or visual media and group project. Each focus area was blended with a total of four other forms of instruction. The lecture-based group rated the lecture and video combination as best, receiving a 93% in “educational” and 84% in “enjoyable”. The visual media group rated the visual media and discussion as the best combination, receiving 84% in “educational” and 80% in “enjoyable”.

The authors did not give any specifics on the length of each class, when the surveys were administered and what statistical procedure was used to process the raw data. They also did not present any data on how the classes were conducted and how they tried to control any variables or manipulate the classes toward lecture heavy or visual media heavy. Two takeaways from this study are that students continue to enjoy lectures, though they do not find them completely engaging, and that students within this study questioned the educational value of technology usage in the classroom. This study reaffirms that professors need to have a combination of approaches within a classroom, and that college students are not exactly sure what they want in a classroom.

Jackson, Helms, and Gum (2011) replicated a study that was originally conducted in 1996 at a small southeastern private college, focusing on student expectations of technology-enhanced classrooms. This initial study was replicated ten years later in 2006 at the same private college along with two public institutions in the same area. The authors used the same survey administered ten years prior to compare student preferences. The survey consisted of a 5-point Likert scale progressing from “Extensively” (5), to “Occasionally” (3), to “Never” (1). The researchers focused on two research questions; the first asking about students’ expectations for technology-enhanced pedagogical practices within the classroom and if those expectations had changed, the second asking what students’ expectations were for technology-enhanced pedagogical practices within the classroom and how those had changed over 10 years.

Knowing that the current participants were classified as digital natives, the authors expected a change in their preference for technology-enhanced approaches in the classroom. To help define these potential changes, the authors divided their analysis into three categories: “use of technology” (within the last year of classes), “anticipated learning environments” and “ideal learning environment”. With regard to the use of technology within the classroom, the 1996 respondents reported that 53% of the time instructors used technology to present information, whereas the 2006 respondents indicated that 79% of the time instructors used technology to present class information.

The second category, “anticipated learning environments,” did ask about lectures and digital presentations. For the 1996 respondents, 99% anticipated lectures to take place extensively (almost every class) to occasionally (6-7 times per semester) and for digital presentations to take place 50% of the time. In comparison, the 2006 respondents reported 83% and 81%, respectively. It is not surprising that 99% of the respondents expected lectures to be the predominant form of delivery of information in 1996. Yet is it intriguing that the 2006 respondents had both lecture and digital presentations so close in scores. These numbers could lead one to wonder if digital presentations were being blended with lectures in university classrooms and that students saw them as one and the same.

The third part, “ideal learning environment,” 95% of the 1996 respondents preferred lectures. In comparison, 88% of the 2006 respondents preferred lecture based classes and 81% of the participants preferred digital presentations. Again, the 2006 respondents were fairly similar between the two forms of delivering information. The 1996 respondents anticipated lectures 99% of the time, their ideal class consisted of lectures 95% of the time. In comparison, the 2006 respondents anticipated lectures 83% of the time but wanted, ideally, to have lectures 88% of the time. These numbers lead one to contemplate why students would prefer lectures more than other approaches to technologically enhanced pedagogical approaches to their classroom.

Though Jackson et al. (2011) released their findings five years after the research was conducted, it led this author to look at the ECAR Student Technology Survey that was conducted in 2006 to see if there was a comparison between the two different studies. Since students in 2006 reported wanting lectures to be such a big component of the college experience, this author questions if there is a convergence of lecture and digital presentations beginning to take place where students think they are one and the same.

In 2006 ECAR released their third Student Technology Survey at 96 different two-year and four-year institutions with a total of 28,724 participants (Katz, 2006). This survey focused on student ownership of mobile devices, student use and skills with mobile devices, and information technology in their college courses. They did not specifically look at student anticipation or ideal situation with technology within the classroom as did Jackson et al. (2011), yet together they fill in more pieces of the puzzle of digital devices in education. When asked about student preference for technology in the classroom, 80% of respondents preferred moderate to exclusive use (Katz, 2006). This was similar to Jackson et al. (2011) who reported that 81% of students preferred digital presentations in 2006. Unfortunately neither study specifically stated who was using the digital presentation software, nor differentiated whether these digital presentations were connected with the lectures being presented.

One useful puzzle piece the 2006 ECAR survey provided was student suggestions on what they would do with extra funding for IT. Two responses strongly stood out; training for students to use IT more effectively in the classroom and training for instructors to begin using IT in more ways within the classroom (Katz, 2006). Students commented how instructors rarely gave directions on how to use different forms of IT, and yet they expected students to know how to use IT properly for a course. More teacher training was also a hot topic as students commented on how digital devices sat on the shelf and were never used or instructors would use IT incorrectly, confusing students in the end. Current research has demonstrated how both of these concerns are vital and that they both still need to be addressed (Dahlstrom et al., 2015; Hawkes & Hategekimana, 2009; Kassens, 2014; West et al., 2015).

Since Jackson et al. (2011) conducted a longitudinal study and Katz (2006) supported some of their findings, it seemed appropriate to look at the 2016 ECAR Student Technology Survey (Brooks, 2016) for any other potential connections. Jackson et al. (2011) reported that in 1996, 62% of respondents wanted digital presentations in their ideal classroom. In 2006, both Jackson et al. (2011) and Katz (2006) reported that approximately 82% of respondents preferred digital presentations or IT in their classroom. How would this trend continue in 2016?

In 2016, ECAR worked with 183 institutions in 37 states and 12 countries for a total of 71,641 respondents. The number of institutions doubled and the respondents tripled within a decade. Ninety-three percent of the respondents in 2016 reported owning a laptop, compared to 69.8% in 2006 (Brooks, 2016; Katz, 2006). Furthermore, in 2006, 97.8% of the participants owned a desktop computer, with 38% of those participants owning both a desktop and a laptop. However in 2016, the only devices ECAR was interested in were laptops, tablets and smartphones. In 2016, only 1% of the respondents reported owning no digital devices at all (Brooks, 2016).

Like Jackson et al. (2011) and Katz (2006), the 2016 ECAR survey inquired about students preferred learning environments. Though Jackson et al. (2011) differentiated explicitly between lecture and digital presentations, Katz (2006) and Brooks (2016) seemed to have blended the two and were focusing on students' preferred learning environment. If lecture and digital presentations were combined, then 78.5% of the 1996 respondents (Jackson et al., 2011) would have preferred a blended learning environment. In 2006, Jackson et al., (2011) reported that about 85% of participants preferred a blended learning environment and Katz (2006) reported that 80% of participants preferred blended learning. Brooks (2016) reported that 83% of the respondents preferred a blended learning environment. Over the course of three decades an average of approximately 80% of college students appreciate digital devices being a part of their education. The challenging part with these data is in the details: do students want instructors to use digital devices during class? Do students want to use digital devices during class? Or both?

In 2006, Katz asked for respondents' suggestions about what to do with extra funding for IT. As already reported, student training and instructor professional development were the two biggest factors mentioned by the respondents. Brooks gave more specific information in 2016. Thirty-nine percent wished they had been better prepared for an institutions' specific technology programs, for example, the school's learning management system, or the online library and its resources. Twenty-seven percent of the participants reported that they needed to be better prepared with basic software, for example, Word or Excel (Brooks, 2016). Students who were trained on devices and programs prior to classes were significantly less likely to get distracted (Brooks, 2016). This seemed to be a common theme throughout institutions, considering the responses to these questions in 2016 and seeing the continuity from 2006. It would be informative to explore whether institutions are integrating introductory classes on technology usage for their incoming classes, and what type of training they are supplying for the instructors. It also seemed evident from Kassens (2014) and West et al. (2015) that using one class meeting to explain digital devices better supported student success in the long run.

With the continual possibility of combining lectures and digital presentations and the desire for a blended learning environment, this researcher asks what are some common approaches used in higher education classrooms to meet the needs of the students. Three equivalent terms that appear in the current literature include "blended classrooms," "flipped classrooms" and "active learning classrooms" (ALCs). All are considered approaches to 21st century classrooms, an environment that blends digital devices with an assortment of traditional approaches within a classroom, for example, large or small group conversations, group projects or traditional lecture.

The 21st Century Classroom. The idea of a blended classroom consists of a wide range of variables one must take into account. One iteration is the instructor who uses technology only to transmit knowledge to the students through a lecture based approach (Gebre et al., 2015). A shift to the other end of the pendulum would consist of a student-centered environment where the instructor presents a problem to the class, and in small groups, the students solve the problem using digital devices. This technique develops learning independence and self-reliance (Gebre et al., 2015). Regardless of which approach is implemented, developing a blended classroom requires a variety of steps. Consistent themes across the literature include the amount of time required for set up in the first year (Hudson et al., 2015; McLaughlin et al., 2016; Porter & Graham, 2016), consistent support and training for instructors and students (Cotner et al., 2013; Henderson et al., 2016; Hudson et al., 2015; McLaughlin et al., 2016; Porter & Graham, 2016), the importance of a blended classroom being data driven (Hudson et al., 2015; McLaughlin et al., 2016; Porter & Graham, 2016), the value of using student feedback requiring flexibility from instructors to make quick adjustments to the curriculum (Hudson et al., 2015; McLaughlin et al., 2016) and confirming that out-of-class materials align with in-class activities (Hudson et al., 2015; McLaughlin et al., 2016). There may be multiple variables for instructors and administrators to consider but current research presents positive outcomes within blended classrooms.

Research suggests that instructors need guidance and support with integrating technology into their classrooms (Katz, 2006; Brooks, 2016). Porter and Graham (2016) explored “the degree to which institutional strategy, structure and support decisions facilitate or impede blended learning adoption among higher education faculty” (p. 1) at a four-year private institution. The study consisted of 214 instructors that were transitioning their classrooms toward “hybrid teaching,” the school’s term for a blended learning environment. Hybrid teaching constituted less physical class time and more time outside of the classroom for “pre-class learning” (McLaughlin et al., 2016, p. 28). Students were expected to watch videos and read materials in preparation for the next class. Class time was then intended for in-class group projects, whole group conversations and potential focus on real-world problems.

In the years prior to the study, the institution had been transitioning its classrooms to a blended format in their introductory and evening courses (Porter & Graham, 2016). They had been providing training for new faculty and had provided instructional developers and academic technical representatives to help instructors re-design courses (Porter & Graham, 2016). The goal of this study was to examine whether the use of blended learning was being achieved within classrooms. Survey questions were designed to explore the appropriate innovation adoption category for each faculty member and the factors that impacted faculty decision to adopt a blended learning approach. Faculty were then assigned to an innovation adoption category through each faculty member's self-categorization and their blended learning adoption score.

Some of the influencing factors to emerge from the data were the need for funding, more professional development to support current faculty, and technical support. Fifty-three percent of the instructors stated the availability of sufficient infrastructure to upload and download media and materials on campus was important to implementing a blended learning environment. Thirty-two percent specified the availability of technical support and 28% requested that pedagogical support would be significantly useful (Porter & Graham, 2016). Initially the authors believed that instructors' self-categorization would match up with their blended learning adoption score, allowing for triangulation of their data. Instead, instructors tended to overrate themselves on their actual use of technology both inside and out of the classroom by one standard deviation. The authors questioned if this difference in scores was due to the faculty that participated in the study, who might be eager to implement blended learning, but had not fully grasped the concept.

One challenge with this study was that in a blended format, instructors were encouraged to reduce the amount of physical class time as students were having to do more pre-class learning on their own. This is a difficulty with a blended class as students tend to hold the view that they are teaching themselves (Chen, 2015; Hudson et al., 2015; McLaughlin et al., 2015). Also, with a reduction of class time, it is not clear when instructors found the time to teach students how to use the different aspects of technology needed for the class (Kassens, 2014; West et al., 2015). The authors' research aligned with other studies indicating the need for sufficient infrastructure, consistent technological support, pedagogical support, consistent blended learning evaluations from faculty and students, and an alignment between the faculty and the administration on the purpose of a blended learning environment (Cotner et al., 2013; Gebre et al., 2015; Henderson et al., 2016; Hudson et al., 2015; McLaughlin et al., 2016).

Creating a blended class requires some revisions as Hudson et al. (2015) clearly stated in their longitudinal study over the course of six consecutive semesters using the same introductory to psychology course at Missouri State University. A total of 4,750 students participated in the study. The initiative to change the classroom to a flipped format was to improve student academic performance, increase the rate of course completion and to change student perception of the course. To achieve this, Hudson et al. (2015) had to quickly revise their syllabus and their approach toward meeting student needs between each semester. There was one pilot class in the spring of 2012, the baseline group, and only students enrolled in the course by the fourth week were included in the data. All classes following the spring of 2012 semester were transitioned to flipped classrooms. To confirm that each class was similar, student ACT scores were analyzed, and found to have no statistically significant differences across all semesters ($p > .05$) (Hudson et al., 2015).

In the flipped classroom developed by Hudson et al. (2015) students were required to watch videos, read materials and take a quiz outside of class all before the next class. Data received from each quiz dictated the type of real-world problems students would be exploring during the next class. Students were given a pretest on the first day of class and an end-of-course exam that included questions for the post-test. These scores were used to analyze student progress within the flipped classroom. These same pre- and post-tests had been given to students for an extended period of time prior to the study, allowing the authors to look back on how scores were before the institution started flipping its classrooms.

As hypothesized by the authors, there was resistance from the students during the piloting of the flipped classroom with an increase in the dropout and fail rate (DFW), rising from 24.6% in the fall of 2011 to 34.0% in the spring of 2012. This frustration quickly dissipated in the fall of 2012 with the DFW rate at 24.3%. After six semesters, the DFW rate was at 19.3%. There was an average of a 75% increase in scores on the pre- and post-tests over the six semesters. Students receiving an A in the course increased from 8.9% in the fall of 2011 to 26.2% in the spring of 2014, with students receiving a C or D declining over the course of the study. The authors concluded that improving academic performance and course completion were achieved through a flipped learning environment.

Changing student perception was not an easy feat for instructors to accomplish. During the pilot course, the authors hypothesized that student evaluations would drop compared to prior years. To counteract this hypothesis, the institution provided support and guidance for the instructors in interpreting student feedback. Through this feedback, instructors were able to adjust the course between each semester to meet student needs. The authors were also able to access all course evaluations ever completed for the introductory psychology course over 30 years to further explore student perception of a flipped classroom. The same end of course evaluation was used for all courses taught. The authors only used course evaluations from one instructor, who taught every semester, to “eliminate individual instructor variability in course delivery from different instructors” (Hudson et al., 2015).

Hudson et al. (2015) presented a variety of suggestions from their research. Similar to Katz (2006) and Brooks (2016), continual support and guidance for instructors was vital. Hudson et al. (2015) continued their research for six consecutive semesters, collecting as much data as possible during the process, including student feedback and quizzes. The findings suggested that “the ultimate success of a redesigned course depends not only on a careful honing of pedagogical practices, but also on a process of culture change” (Hudson et al., 2015, p. 263).

McLaughlin et al. (2016) published a case report on the implementation of flipped classrooms at two different institutions, one in the USA and another in Australia. Both institutions were pharmacy schools that were in the process of transitioning to flipped classrooms. Design considerations during the classroom transition included instructor skill development, student buy-in, institutional support and technology support

(McLaughlin et al., 2016). Common themes that emerged between the two institutions involved pre-class learning, in-class active learning and assessment. The authors reported on each of the common themes and what their experiences were while flipping their classrooms.

As in current research, pre-class learning can be viewed by the students as self-taught material before getting to class (Chen, 2015; Hudson, 2015; McLaughlin et al., 2016). McLaughlin et al. (2016) confirmed that outside of class material must be aligned with in class activities. While Hudson et al. (2015) stated that class projects were determined by the pre-class exam, McLaughlin et al. (2016) did not specify if a quiz was required but simply stated that if a student could attend to the class conversations without doing pre-class materials, then students were unlikely to complete the pre-class materials. McLaughlin et al. (2016) stated that completion of pre-class materials meant a more engaged student in the class, but did not supply any data to support that claim. The authors stated that pre-class assignments needed to be organized and aligned with learning objectives. Instructors needed to be aware of the amount of student time required for completion of tasks. Instructors also needed to consider student access to devices to complete pre-class materials, and competing interests, for example, other classes, exams or job responsibilities. One point McLaughlin et al. (2016) made was that all faculty participants needed to be aware of the amount of time required for preparing out of class materials along with completion of those materials and the time needed to evaluate and return assignments to students in a timely manner.

Moving foundational information to be learned before class freed up time for active learning during class (McLaughlin et al., 2016). Year two of implementation at the

Australian university showed that 79% of respondents believed that solving problems and applying knowledge during class activities would increase their ability to perform those skills. The United States students indicated an increase in participation and engagement during class. These students also stated that there was an increased belief that active learning enhanced their learning along with an acknowledgment that discussions with peers greatly enhanced their learning (McLaughlin et al., 2016). Suggestions from the case report included expanding opportunities for student engagement, providing students with the opportunity to practice and assess their own mastery, providing scaffolding or support for students when transitioning from foundational material to complex concepts and avoiding double lecturing, meaning re-teaching what was already in the pre-class material or lecturing on a different topic that could confuse the students (McLaughlin et al., 2016).

Assessment was the final common theme between the two institutions. As McLaughlin et al. (2016) confirmed, “embedded self-assessments in pre-class materials, audience response systems, wikis, and discussion forums, for example, can provide critical insight to instructors and students about the extent to which students are mastering concepts and meeting desired course outcomes” (McLaughlin et al., 2016, p. 31). Other similarities between the two institutions included making sure that assessments were aligned with the desired outcomes, allowing for a diverse set of assessments, including formal and informal, and making sure that instructors “close the loop” (McLaughlin et al., 2016, p. 32), meaning that any open-ended questions presented to the students should be answered before moving onto something else. The authors voiced concerns about students who might be confused by not receiving a correct, final answer to a problem or situation.

Initially, transitioning to a blended, flipped or active learning classroom requires continuous support from all parties involved; administrators, instructors, support staff and the students (McLaughlin et al., 2016). Instructors need on-going support through professional development and technology personnel after an initial class has been set up (McLaughlin et al., 2016). The authors did not indicate how often technology personnel met with instructors once the classes were established but they did indicate that the workload increased threefold the first year, but went back to normal after the first year (McLaughlin et al., 2016). It was vital to both institutions that instructors had a protected time to plan and share their experiences with their peers.

An active learning classroom (ALC) is similar to a blended or flipped classroom. In 2009, a large research institution in Canada installed two active learning classrooms. One classroom was comprised of eight large round tables, each consisting of two computers, screen sharing abilities, and outlets for laptops and a microphone. Each table held nine students and the instructor's podium was in the middle of the room. The second classroom consisted of six long tables and 38 computers, one for every student. The instructor's podium was off to the side of the classroom. Two years after these classrooms were established, Gebre et al. (2015) was interested in the concepts of effective teaching from instructors using the active learning classrooms and what their perceived use of technology was within those particular rooms. Thirteen professors, 68% of the instructors using the active learning classrooms, agreed to take part in the study, along with their students (n = 232). Interviews were semi-structured and based on seven questions focusing on the instructor’s views of effective teaching in their area of content during that term in the active learning classroom, their specific instructional strategies, their expected student outcomes and their perception of the role of technology in achieving their instructional goals (Gebre et al., 2015). Three questions were added to the institution’s student technology survey for this study. The students were asked if “their learning would have been better, the same or less if the course had been taught in a traditional room, about their professor’s use of computers in teaching, and their own use of computers for learning in that specific course” (Gebre et al., 2015, p. 207).

The interviews were analyzed using a holistic inductive and constant comparison approach, resulting in three facets of effective teaching: teacher-centered, student engagement, and developing learning independence. The authors specified three divisions of learning outcomes: subject matter understanding and application, skills development and strategies, and learning independence. The instructional strategies presented included transmitting knowledge, engaging students, and developing learning independence and self-reliance. There was almost an even split of instructors among the instructional strategies with three instructors in the transmitting knowledge category and five instructors in each of the remaining two categories. The authors presented information that connected instructors who thought that effective teaching was teacher-centered, had expected learning outcomes that included subject matter understanding and application, and whose instructional strategy was to transmit knowledge, predominantly through lectures. Similar connections were presented for the two remaining effective teaching approaches.

Within the middle group, student engagement, there was a split among the instructors on the level of technology needed within the active learning classroom. Some instructors felt that the computers were cumbersome and simply got in the way (Gebre et al., 2015). These instructors wanted more conversations taking place within the classroom. They wanted students to develop higher level thinking through group projects and problem solving. The other half of the instructors within this category saw technology as not just a presentation tool but also as a device for data analysis and modeling real world problems. Within this category, all instructors stated the importance of student presentations, but did not indicate if this included digital presentation software.

Research suggests that student use of technology within a classroom matches the level of technology usage by the instructor (Buzzard et al., 2011). The student survey seemed to align with Gebre et al.'s (2015) research on the instructor's effective teaching strategies and perceived use of technology within an active learning classroom. Forty-three percent of students in the teacher-centered, knowledge transmission group stated that their learning would have been the same or better if they were *not* in an active learning classroom (Gebre et al., 2015). This aligns with teacher-centered instructors predominantly using technology for digital presentations. The student engagement group had 27% of students agreeing with the same statement and only 8% from the developing learning independence group agreed. The learning and development centered instructors regularly encouraged students to use technology within class to further their higher order thinking and problem solving skills (Gebre et al., 2015). The authors presented a list of all subjects taught among the 13 instructors, but did not specify what the breakdown was between the effective teaching strategies.

The authors' final comment on technology usage within a classroom was that instructors who engage or encourage student independence tend to have a higher usage of technology within the classroom. Administrators need to keep in mind that professors have a variety of approaches to effective teaching strategies and pedagogical beliefs that might not easily blend with an active learning environment. The researchers followed current research (Brooks, 2016; Hudson et al., 2015; Kassens, 2014; West et al., 2015) and called for more guidance and support for instructors to reflect upon effective teaching strategies and pedagogical practices that would help embrace the idea of developing student learning independence and self-regulation (Gebre et al., 2015).

Whether it is a blended, flipped or active learning classroom, numerous variables need to come into alignment for all parties to achieve the goal of a 21st century approach to learning. Training for instructors and students was encouraged in all articles reviewed (Gebre et al., 2015; Hudson et al., 2015; McLaughlin et al., 2016; Porter & Graham, 2016). Instructors require continuous guidance and support from IT professionals, educational technology professionals, curriculum designers and administrators. Students require guidance and training from their instructors regarding an institution's learning management systems, Twitter (Kassens, 2014, West et al., 2015) or other programs being used for a course (Gebre et al., 2015). Instructors and administrators need to be aware of the increased faculty workload for the first year during implementation (Hudson et al., 2015; McLaughlin et al., 2016). The importance of gathering and analyzing data is also a vital piece to establishing an active learning environment. Student feedback is a major part of data collection as it can help guide the course to meet student needs and help change the culture (Hudson et al., 2015). Assessment is also an important piece of data collection, in the form of pre-class assessments to help guide the next day's lesson, or informal assessments on student's misconceptions during small group activities. Formal and informal assessments need to be consistently utilized in the classroom (Hudson et al., 2015; McLaughlin et al., 2016). Pre-class learning (Hudson et al.,. 2015) supports an active learning classroom environment as students explore foundational material before class, thus allowing students and instructors to solve real-world problems together or break into small groups and have deeper conversations about class material. Finally, there must be alignment between pre-class materials and in-class activities, with the goal of keeping students engaged and not confusing them during class activities (Hudson et al., 2015; McLaughlin et al., 2016).

One interesting aspect to blended, flipped or active learning classrooms is the role that technology takes within each environment. Not one of the articles reviewed strongly pushed for the implementation of technology within the classroom. Most articles called for support or guidance for instructors to learn how to utilize technology within that environment. McLaughlin et al. (2016) and Hudson et al. (2015) insisted on pre-class learning that was technology based, but they did not specify how technology should be used within the classroom. It seemed that the intention for technology within these types of classrooms would be to use it for research, data analysis, communication and presentations. The programs and applications that students used seemed to be up to the instructor, but none of these articles clearly specified what instructors used and why within these environments.

Rationale. Seattle Pacific University has never administered a survey to the undergraduate students focusing on technology usage within its classrooms. As a graduate student and an adjunct professor, this researcher was interested in how SPU compares to other institutions in regard to the use of mobile devices within the classrooms from the students' perspective. The findings from the proposed study can provide some valuable insights into how well SPU as an institution is integrating 21st century skills and mobile devices within the classroom.

Conclusion

There are both abundant benefits and numerous challenges when looking at embracing mobile devices in higher education classrooms. Some of the more dominant and concerning challenges involve students multitasking during class lectures, thus missing information being presented or discussed, along with the distraction that can occur from nearby peers using a mobile device. While there are some hurdles that universities, instructors and students must overcome, there is also a wealth of potential benefit as students and instructors customize their experiences, empowering them to learn as much as possible from a course. Mobile devices give instructors the opportunity to enhance or change the flow of the lecture by using a variety of interactive applications or programs. These devices allow faculty to adjust their curriculum in real-time based on the level of understanding of their students.

Mobile devices are still a very young technology in the realm of education (Nguyen, Barton, & Nguyen, 2015). For example, the iPad was released in 2010, giving higher education only eight years to facilitate its integration and implementation into the college classroom. Current research shows that between 92% and 95% of college students own a smartphone (Brooks, 2016; Dahlstrom et al., 2015; Tindell & Bohlander, 2012; West et al., 2015). Though not quite 100% of college students own smartphones or mobile devices, the number is consistently increasing, driving universities to find alternative ways to support student learning and development through use of mobile devices.

There is an incongruity between instructors' pedagogical approach and integration of mobile devices into regular college level courses. This is a challenging, yet exciting, situation for universities as they need to provide consistent professional development and support for instructors to develop confidence using mobile devices. Once this is achieved, instructors will develop the ability to empower their students to help problem solve as they introduce other aspects of using mobile devices.

Chapter Three

Methodology

The intent of this study was to present data that outlines SPU undergraduate students' perceptions of technology usage within their classrooms when compared to similar, small, private, liberal arts institutions. This chapter describes the methodology used for the research study. Participants reported their perceptions of how instructors use digital devices to support student learning, how students perceive SPU's learning management system and what their preferred learning environment is during a class, for example, lecture only, blended learning or online only.

Research Design

This research was a non-experimental, causal comparative study using a convenience sample in which participants provided survey data at one point in time regarding their perception of their instructors' use of digital devices within a classroom, their perception of SPU's learning management system and their preferred learning environment. A causal comparative design was chosen to compare Seattle Pacific University undergraduates to undergraduates at similar, small, private, liberal arts institutions based on responses to the 2017 ECAR Student Technology Survey. The purpose for using a causal comparative design was to assess how SPU compared to similar, small, private, liberal arts institutions in regard to mobile device usage in the classroom. Utilizing the 2017 ECAR Student Technology Survey was beneficial in that it is a well-established instrument and it was an efficient and cost effective way to gather student generated data focusing on technology usage within classrooms at SPU. ECAR acquired data from 124 participating institutions, from ten different countries, in April of

2017. A causal comparative design allowed the researcher to compare SPU to other participating institutions that are similar small, private, liberal arts institutions.

Sampling Procedure

The 2017 ECAR Student Technology Survey was administered to the undergraduates of SPU, a private Christian university in the heart of Seattle, Washington, in April of 2017. As of the fall quarter of 2017, SPU had 2,911 undergraduates enrolled. Student body was 33% male and 67% female with an ethnic diversity of 40%. SPU has a retention rate of 79%, based on first year persistence.

On Tuesday, April 18th, 2017, undergraduate students at SPU received a request to participate in a survey designed to obtain their perspective on the usage of digital devices within their classrooms and their own education. Within that email, EDUCAUSE offered an incentive in the form of the potential for participants to win an Amazon gift card once they completed the survey. On Wednesday, April 26th, a reminder email was sent to undergraduates about the survey closing on Friday, April 28th.

The total number of potential participants was 2,911. As of Saturday, April 29th, 347 students had completed the 2017 ECAR Student Technology Survey, achieving a response rate of 8.4%.

Instrumentation

The survey instrument used for this study was the EDUCAUSE 2017 ECAR Student Technology Survey. This survey has been in existence since 2004, the first year EDUCAUSE released the instrument. Since its inception, the Student Technology Survey has been revised each year to meet the trends taking place in higher education and technology development and usage (D. Brooks, personal communication, December, 5, 2016). Some examples of changes to the survey include: in 2005 participants were asked about their most frequently used method to access the internet, with two possible responses being "commercial dial-up modem service" or "school dial-up modem service;" the last time the survey mentioned dial-up modem service was in 2008 as wireless technology was becoming more prevalent; 2011 was the first time the term "cloud computing" was used; 2013 was the last time participants were asked if they owned a printer; and 2015 was the first time participants were asked if they used "wearable technology."

Reliability and Validity

Upon extensive research of the EDUCAUSE website, no research articles were found that focused on the reliability and validity of the survey instrument. On the 28th of November, 2016, an email was sent to D. Christopher Brooks, PhD, Senior Research Fellow for ECAR, requesting information about the reliability and validity of the survey instrument. According to Dr. Brooks, ECAR "did not formally engage in reliability and validity testing for the student survey development" (D. Brooks, personal communication, December 5, 2016), nor do they publish any articles on the validity and reliability of the survey "given that the nature of our publications and our audiences are not the same as those of/for a peer reviewed article" (D. Brooks, personal communication, December 5, 2016). The reason for this decision is multifold. It is a recursive, annual survey that has been taking place for over fourteen years. Each year the content of the survey is adjusted slightly "based on what the literature suggests as behavioral or perceptual shifts in the IT market" (D. Brooks, personal communication, December 5, 2016). ECAR also expects changes in the availability of technological products consumers can acquire, along with cultural shifts in technology usage, and innovation in technology and higher education. Brooks noted that the results have been similar year to year, continually aligning with cultural and industry trends (D. Brooks, personal communication, December 5, 2016).

With regard to the validity of the instrument, a team of EDUCAUSE researchers, IT experts and "higher education institution-based subject matter experts" (D. Brooks, personal communication, December 5, 2016) review and revise the wording of the questions for the best possible understanding by the students. According to Brooks (D. Brooks, personal communication, December 5, 2016), this ensures the face validity of the instrument.

Research Questions

Question 1. Are SPU undergraduates' perceptions of instructors' use of technology during a class comparable to similar, small, private, liberal arts institutions?

Null Hypothesis: There is no statistically significant difference between SPU undergraduate students' perceptions of instructors' use of technology during a class compared to those of students from similar, small, private, liberal arts institutions.

Alternative Hypothesis: There is a statistically significant difference between SPU undergraduate students' perceptions of instructors' use of technology during a class comparable to similar, small, private, liberal arts institutions.

Question 2. How do undergraduate perceptions of SPU's learning management system compare to similar, small, private, liberal arts institutions?

Null Hypothesis: There is no statistically significant difference between SPU undergraduate students' perceptions of the SPU's learning management system compared to similar, small, private, liberal arts institutions.

Alternative Hypothesis: There is a statistically significant difference between SPU undergraduate students' perceptions of the SPU's learning management system compared to similar, small, private, liberal arts institutions.

Question 3. How does SPU compare to similar, small, private, liberal arts institutions regarding students' preferred learning environment?

Null Hypothesis: There is no statistically significant difference between SPU undergraduate students' perceptions of preferred learning environment when compared to similar, small, private, liberal arts institutions.

Alternative Hypothesis: There is a statistically significant difference between SPU undergraduate students' perceptions of preferred learning environment when compared to similar, small, private, liberal arts institutions.

Data Analysis

Initially, a factor analysis (FA) was conducted to verify three hypothetical factors within the 2017 ECAR Student Technology Survey. These hypothetical factors in the FA include student perception of instructor's use of technology during class, student perception of their institution's learning management system and the student's preferred learning environment. Despite extensive research, no research articles were discovered that reported on an exploratory factor analysis, a confirmatory factor analysis or any psychometric analysis on the ECAR Student Technology Survey. Per email communication with Dr. D. Christopher Brooks, reliability and validity tests are conducted in house, but nothing is released to the public due to their expected audience (D. Brooks, personal communication, December 5, 2016). In the absence of psychometric information of any kind, this researcher chose three specific factors that were based on questions that have appeared in the ECAR Student Technology Survey over the last eight years. These factors were also based on consistent topics within the broader spectrum of research in technology and higher education. The ECAR Student Technology Survey is traditionally comprised of six sections, though the format has evolved over the past 14 years. For this study, the researcher conducted a factor analysis on Section 2: Device Use and Ownership, Section 3: Technology and the College/University Experience, and Section 4: Learning Environment.

Though the researcher predicted three factors to appear within the factor analysis, an initial FA was conducted to ascertain the actual number of factors within the questions being assessed. Using a FA provided the researcher with an opportunity to test hypotheses about the potential relationships between observable variables and latent variables. Based on the results of this initial FA, the researcher decided if it was appropriate to use the originally predicted three factors or to adjust the number of factors to be assessed. The researcher thoroughly explored the scree plot and total variance accounted for before choosing the number of factors to proceed with.

Once the factors were confirmed a one-way multivariate analysis of variance (MANOVA) was run to determine the effect of students' institution on their perception of digital technology usage in higher education classrooms and their preferred learning environment. Assumptions of normality were met before running a MANOVA. Descriptive statistics were calculated to confirm that skewness and kurtosis were between

– 1 and + 1 and that there was normal distribution. Assumption of independence was met as data was collected independently. Outliers were assessed, along with multivariate normality. Multicollinearity was assessed along with confirming linear relationships. Box's M test confirmed the homogeneity of variance-covariance matrices. The homogeneity of variance was verified using Levene's Test. Though there were unequal group sizes, there were enough participants in total to proceed with a MANOVA.

Chapter Four

Results

The purpose of this study was to compare undergraduates of Seattle Pacific University to undergraduates of other similar, small, liberal arts institutions regarding digital technology in higher education classrooms. To accomplish this task a factor analysis was required prior to conducting a MANOVA for the research questions. Upon initiation of this study, the researcher predicted three factors within the survey; students' perceptions of instructors' use of technology during a course, students' perceptions of the institution's learning management system (LMS) and students' preferred learning environment. These hypothesized factors were developed through careful examination of past ECAR Student Technology Surveys and current trends in higher education research pertaining to the use of digital devices in higher education classrooms. Upon completion of a factor analysis, five factors were chosen: Access to Administrative Activities by Handheld Mobile Devices, Technology Usage in Class, Learning Management Systems, Perception of Instructors' Technology Usage and Online Student Success Tools.

Factor 2, *Technology Usage in Class,* was the only factor to present no statistically significant difference between any of the institutions. This factor contained 16 "wish list" questions where students indicated if they wanted their professor to use a digital device, program or application more or less often during a course. Seven of the 16 questions presented data that indicated an average of 50% of students across all four institutions wanted their instructors to use a digital device, program or application more often during a course. Some of these increased expectations involved using the learning management system more often, providing free, web-based content to supplement course-related materials, using an early-alert system to catch potential academic trouble and using search tools more often to find references or other information online for class work. These results could indicate that instructors need support and guidance in implementing these various digital devices, programs or applications. Not aligning with current research, only around 20% of students from all four institutions indicated that they wanted their instructors to use social media more often during classes. Table 1 presents each institution's combined percentage from the top two responses, agreed and strongly agreed, for nine of the questions from Factor 2.

The final question in Factor 2 asked students to rank how they agreed with the statement, "I get more actively involved in courses that use technology." An average of 36% of all participants agreed or strongly agreed with this statement and 41 % of all participants responded as neutral to the statement. The higher percentage of neutral responses could align with the desire for instructors to use student laptops as learning tools.

Table 1

Factor 2 Comparisons between Institutions

	SPU	South	Northeast	Southeast
Learning management system	58.6%	53%	42.7%	57.6%
Free, web-based content to supplement course-related materials	58.7%	48.2%	57.9%	50.5%
Simulations of educational games	43.1%	39.8%	40.3%	46%
Lecture capture	63.9%	44.9%	64.1%	58.5%

Student laptops as learning tool for course-related activities	42.2%	51.1%	47.2%	46%
Early-alert systems designed to catch potential academic trouble as soon as possible	45.3%	47.8%	46.5%	48.4%
Search tools to find references or other information online for class work	49.5%	40.8%	44.7%	41.1%
Publisher electronic resources	50.9%	49.8%	49.1%	42.4%
Social media as a teaching and learning tool	22%	21.9%	22.6%	16.9%

Descriptive statistics

For the purpose of this study, student data were gathered from three small, private, liberal arts institutions similar to Seattle Pacific University as well as from SPU. These institutions are located in Southern United States, Southeastern United States and Northeastern United States. The combined data from these institutions plus SPU resulted in a total of 1,366 participants.

Gender. A summary of the frequencies and percentages of subgroups determined by Gender is completed in Table 2. The subgroup Male accounted for 29.4% of the respondents (n = 401). Females accounted for 68.9% of the respondents (n = 929). Ten respondents chose “Other” for their gender (0.7%) and 1.9% of the respondents (n = 26) did not provide a response.

Table 2

Frequency distribution of participants by gender

		Frequency	Percent
Valid	Male	401	29.4
	Female	929	68.0
	Other	10	.7
	Prefer not to answer	14	1.0
	Total	1354	99.1
Missing	System	12	.9
Total		1366	100.0

Age. A summary of the frequencies and percentages of subgroups determined by Age is presented in Table 3. The subgroup 18-24 accounted for 94.9% of the respondents (n = 1297). The subgroup 25 or more accounted for 5.1% of the respondents (n = 69).

Table 3

Frequency distribution of participants by Age

		Frequency	Percent
Valid	18-24	1297	94.9
	25 or more	69	5.1
	Total	1366	100.0

Race. A summary of the frequencies and percentages of subgroups determined by Race is presented in Table 4. The largest subgroup, White accounted for 68.2% of the respondents (*n* = 932), Black/African American accounted for 2.9% of the respondents (*n* = 40), Hispanic accounted for 7.2% of the respondents (*n* = 98), Asian/Pacific Islander accounted for 7.4% of the respondents (*n* = 101) and “Other” or “multiple” accounted for 10.9% of the respondents (*n* = 149). Forty-six respondents had missing data, accounting for 3.4%. It needs to be noted that the 2017 ECAR Student Technology survey provided American Indian/Native American/Alaskan native as an option for respondents, yet this variable value was not presented in the Variables Labels Excel Spreadsheet provided to SPU. This value and label was also not present in any of the data acquired from the three other institutions. This could mean that not one participant from the 1,366 surveys submitted for this study marked this category, or it could mean that there was an error in the survey instrument.

Table 4

Frequency distribution of participants by Race

		Frequency	Percent
Valid	White	932	68.2
	Black/African American	40	2.9
	Hispanic	98	7.2
	Asian/Pacific Islander	101	7.4
	Other or multiple	149	10.9
	Unknown	46	3.4
	Total	1366	100.0

Class standing. A summary of the frequencies and percentages of subgroups determined by Class standing is presented in Table 5. The largest subgroup Freshman or first-year student accounted for 27.7% of the respondents (n = 378). The subgroup Sophomore or second-year student accounted for 22.4% of the respondents (n = 306). Junior or third-year students accounted for 24.7% of the respondents (n = 337). Senior or fourth-year students accounted for 22.8% of the respondents (n = 311). Twenty-two respondents (1.6%) were recorded as Fifth-year students or beyond. Twelve respondents (0.9%) were recorded as "Other" type of undergraduate student.

Table 5

Frequency distribution of participants by Class Standing

		Frequency	Percent
Valid	Freshman or first-year student	378	27.7
	Sophomore or second-year student	306	22.4
	Junior or third-year student	337	24.7
	Senior or fourth-year student	311	22.8
	Fifth-year student or beyond	22	1.6
	Other type of undergraduate student	12	.9
	Total	1366	100.0

Data Analysis

This section presents the results of the data analysis for each of the research questions. A factor analysis had to be conducted prior to the MANOVA. The researcher conducted a factor analysis to confirm the five factors chosen and to assess the reliability of the survey instrument. Reliability of the final 69 items from the 2017 ECAR Student Technology Survey were explored using Cronbach's Alpha, which is a common measure of internal reliability (Gall, Gall, & Borg, 2007), receiving $\alpha = .96$ (Table 8).

Pre-Analysis Data Screening. The 2017 ECAR Student Technology Survey consists of six sections covering a range of topics from the number of digital devices a student owns to how a student may use digital devices in their education. For this study, the researcher only focused on sections of the survey that were judged to pertain to the research questions. The pre-analysis data screening consisted of the determination of cases with missing values, and an examination of univariate normality. Some of the questions used from the survey utilized a 7-point Likert scale in which two of the possible responses included 99 and 999 representing responses of N/A, Not Provided, Don't know, and Haven't used service in the past year. These values were consistent outliers within the data set as all other scores ranged from 0 to 6. These outliers heavily altered the means, skewness and kurtosis within the data sets due to the large discrepancy between single digit values and double or triple digit values. These outliers were excluded from the data analysis.

Factor Analysis. A factor analysis was conducted only on the items in the 2017 Student Technology Survey that the researcher determined were relevant to the overall research questions. Initially, 91 questions were included in the factor analysis. These questions came from within four sections of the survey: Section 2: Device Use and Ownership, Section 3: Technology and the College/University Experience, Section 4: Learning Environments, and Section 5: Your Personal Computing Environment. The selection of the specific questions was intended to focus only on identifying factors that would inform the research questions.

A factor analysis using principal axis factoring (PAF) procedures and orthogonal Varimax rotation of factors was conducted with SPSS 25 to determine the factor structure of the identified items. The 2017 ECAR Student Technology Survey has been in use for over 14 years and is an established instrument. Yet no publications were discovered that established factors nor factor loadings of the survey. Through email correspondence, Dr. Brooks (personal communication, December 5, 2016) stated that ECAR does an internal assessment of the instrument, but does not publish the results because their intended audience is more interested in the results of the study instead of the inner workings of the survey instrument itself. For this reason PAF was initiated, looking for latent variables within the survey questions being used for this study.

With no prior information on which to base assumptions, the researcher confirmed the choice of using PAF with Varimax rotation by conducting a principal component analysis (PAC) with Varimax and Direct Oblimin rotations along with a PAF using Direct Oblimin rotation. The KMO statistics and variance accounted for are presented in Table 6. The PAC implementing Varimax rotation contained eight items that cross loaded. The PAC using Direct Oblimin presented Factors 4 and 5 containing only negative loadings. The PAF using Direct Oblimin presented Factor 4 with negative loadings and Factor 5 with negative loadings and cross loading all items with Factor 3. The PAF using Varimax rotation presented three items cross loading between Factor 1 and Factor 5. These outcomes confirmed that a PAF with Varimax rotation was the best scenario to assess the factor loadings of the survey questions being used.

Table 6

Exploratory Factorial Rotations

Method/Rotation	KMO	Variance explained
PAF/Varimax	.94	50.04%
PAF/Oblimin	.94	41.77%
PAC/Varimax	.93	45.29%
PAC/Oblimin	.93	45.29%

The sampling adequacy of the ECAR Student Technology Survey using PAF and Varimax rotation produced a Kaiser-Meyer-Olkin measure of sampling adequacy, which displayed "marvellous" values of .94 (Field, 2013, p. 685). Sampling adequacy with a value close to 1 indicates correlational patterns which are relatively compact. Consequently, conducting a factor analysis should yield reliable factors (Fields, 2013). Bartlett's test of sphericity, (2346) = 12,564.57, $p < .005$, indicated that correlations between items were sufficiently large for the principal axis factoring (Appendix A).

Initial examination of the PAF results yielded 12 factors with eigenvalues greater than 1. The 12 factors accounted for 50.04% of the total variance. Of the 72 items, 66 loaded on the first five factors, two of which cross loaded with one of the first five factors and 11 that cross loaded with the remaining factors. Factors 6 through 12 retained 20 out of the 72 items, 11 of which cross loaded with one of the first five factors. A 12 factor solution was deemed too complex. To reduce the number of factors the scree plot provided guidance toward using various solutions ranging from 3 factors to 7 (Appendix A). The objective was to find a factor solution that provided the greatest total variance explained with the strongest possible factor loadings and minimal cross loadings. A three factor rotation resulted in 32.7% total variance, with 10 items cross loading and a seven factor rotation resulted in 44.4% total variance with only two items loading on Factor 7 and Factor 6 possessing a negative loading. A five factor solution presented the strongest results with a KMO measure of .937, Bartlett's test of sphericity of (2346) = 12,564.57, *p* < .005 (Appendix A), with 41.77% of the total variance explained (Table 7).

Table 7

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	16.13	23.38	23.38	15.60	22.61	22.61	9.84	14.26	14.26
2	6.12	8.86	32.26	5.48	7.94	30.55	5.81	8.42	22.68
3	3.43	4.97	37.21	2.87	4.16	34.71	4.81	6.96	29.65
4	3.31	4.79	42.00	2.77	4.02	38.73	4.56	6.60	36.25
5	2.63	3.82	45.82	2.10	3.04	41.77	3.81	5.52	41.77

Extraction Method: Principal Axis Factoring.

Factor Loadings. Each combination of factor extraction and rotation resulted in a possible solution that was compared to all others to ascertain the best fit model. The strength and direction (positive or negative) of the factor loadings were evaluated. Due to the large dataset (*N* = 1,366), items with factor loadings of .300 were considered acceptable (Field, 2013). Strong loadings on each component were considered as well as the content of the item (content validity) and its contribution to the component. Four items that did not load on any factor were removed from the initial five factor solution.

The final five factor solution consisted of 69 items of which three items cross loaded on Factors 1 and 5. Item 3.4 (b) loaded on Factor 1 (.305) and Factor 5 (.633), item 3.4 (c) loaded on Factor 1 (.334) and Factor 5 (.519), and 3.4 (d) loaded on Factor 1 (.346) and Factor 5 (.543). These cross-loading factors were retained on Factor 5 (Appendix D).

Factor Naming. The researcher looked at the body of research regarding students' perceptions of mobile device usage in higher education classrooms when considering the naming of the factors. This included student perception of technology usage by an instructor during class, student perception of learning management systems and students' preferred learning environment. The magnitude of the individual factor loadings were also considered. High item loadings were given more consideration in the labeling of the factors. The content of the corresponding questions also informed the labeling of the factors. Factor 1 corresponded with question 2.6 involving student perception of their institutions support with using handheld mobile devices to conduct administrative activities. For this study this factor was labeled *Access to Administrative Activities by Handheld Mobile Devices.* Factor 2 consisted of question 3.6 regarding the resources or tools students wished their professors used less or more of and question 4.4 regarding how actively involved a student gets in class that uses technology. For this study this factor was labeled *Technology Usage in Class*. Factor 3 corresponded with question 3.7 regarding student satisfaction with their institutions learning management system and question 4.4 regarding whether or not their institution sufficiently prepared them to use institution specific technology. For this study, this factor was labeled *Learning Management Systems*. Factor 4 corresponded with question 3.5 regarding student experience with instructors using technology during class within the past year.

For this study, this factor was labeled *Perception of Instructors Technology Usage*. Factor 5 corresponded with question 3.4 involving student perception of the usefulness of online student-success tools at their institution and three parts of question 4.4 regarding student perception of the use of mobile devices in a class. For this study, this factor was labeled *Online Student Success Tools.* The label assigned to each factor, the survey items associated with each factor and the factor loading for each item are listed in Appendix C.

Reliability. Reliability encompasses two constructs: consistency between multiple measures of a variable, and the internal consistency among the variables ascribed to a scale. Internal consistency signifies that variables are measuring the same construct with the assumption that the variables should be highly correlated. An estimate of internal consistency is considered necessary in the determination of the validity of the composition of factors derived from a factor analysis (Field, 2013). Cronbach's alpha coefficient is a diagnostic measure that provides a reliability coefficient. The commonly agreed upon minimum specification for the Cronbach's alpha measure is $\alpha > .70$ (Field, 2013).

For this study, the Cronbach's alpha coefficient was computed for all the items and also for each individual factor. The computed values were within the acceptable parameters indicated. The Cronbach's alpha for all 69 items was $\alpha = .96$. Factor 1, *Access to Administrative Activities by Handheld Mobile Devices*, comprised of 21 items, had a computed alpha of $\alpha = .95$. Factor 2, *Technology Usage in Class*, comprised of 17 items, had a computed alpha of $\alpha = .90$. Factor 3, *Learning Management Systems*, comprised of 11 items, had a computed alpha of $\alpha = .90$. Factor 4, *Perception of Instructors Technology Usage*, comprised of 9 items, had a computed alpha of $\alpha = .89$. Factor 5, *Online Student Success Tools*, comprised of 11 items, had a computed alpha of α = .87 (Table 8).

Table 8

Cronbach's α for all Factors

Factor	Description	Total Items	Cronbach's α
Factor 1	*Access to Administrative Activities by Handheld Mobile Devices*	21	.95
Factor 2	*Technology Usage in Class*	17	.90
Factor 3	*Learning Management Systems*	11	.90
Factor 4	*Perception of Instructors Technology Usage*	9	.89
Factor 5	*Online Student Success Tools*	11	.87
Totals		69	.96

MANOVA. A one-way multivariate analysis of variance (MANOVA) was run to determine the effect of students' institution on their perception of digital technology usage in higher education classrooms and their preferred learning environment. Specific questions from the ECAR Student Technology survey were assessed comparing four different private, liberal arts institutions within the United States. Preliminary assumptions were assessed earlier.

Additional underlying assumptions for MANOVA include the absence of outliers, linear relationships, absence of multicollinearity and homogeneity of variance. There were univariate and multivariate outliers as assessed by boxplots (Figure 1-5), there were linear relationships, as assessed by scatterplot (Figure 6).

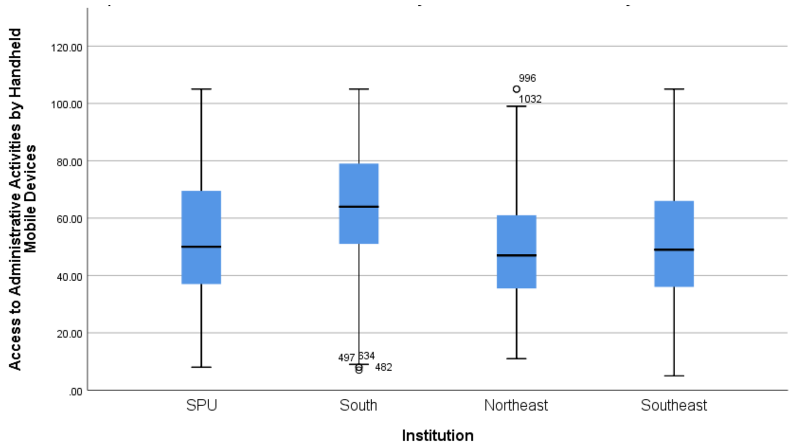

Figure 1. Boxplot of Access to Administrative Activities by Handheld Mobile Devices

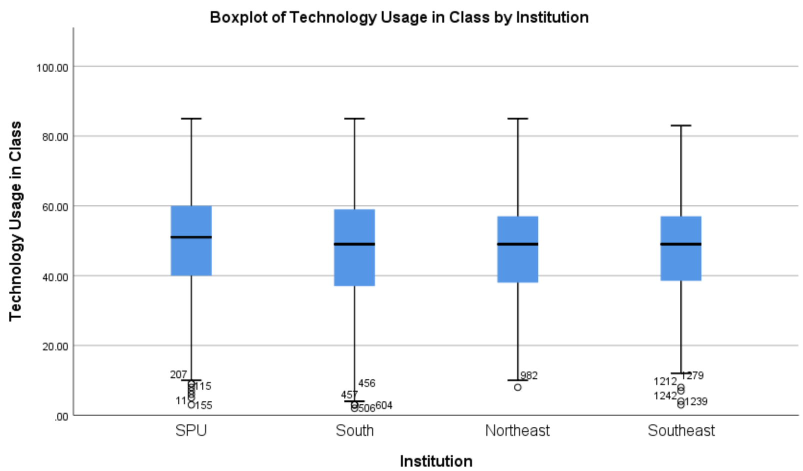

Figure 2. Boxplot of Technology Usage in Class

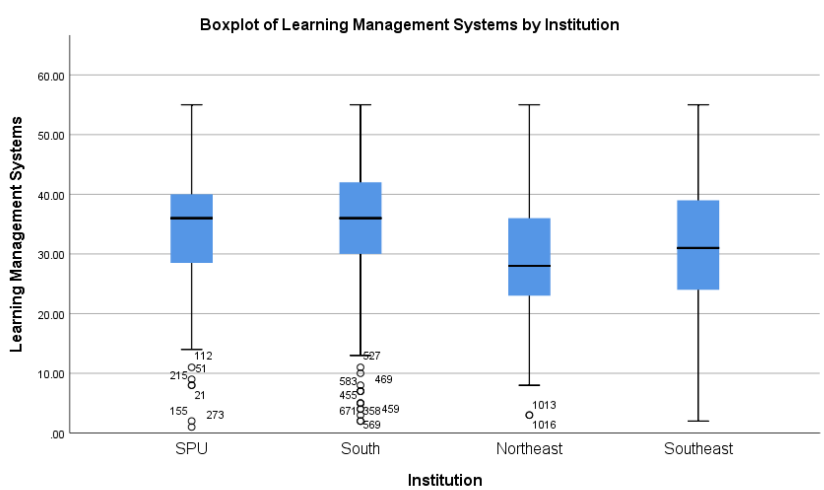

Figure 3. Boxplot of Learning Management System

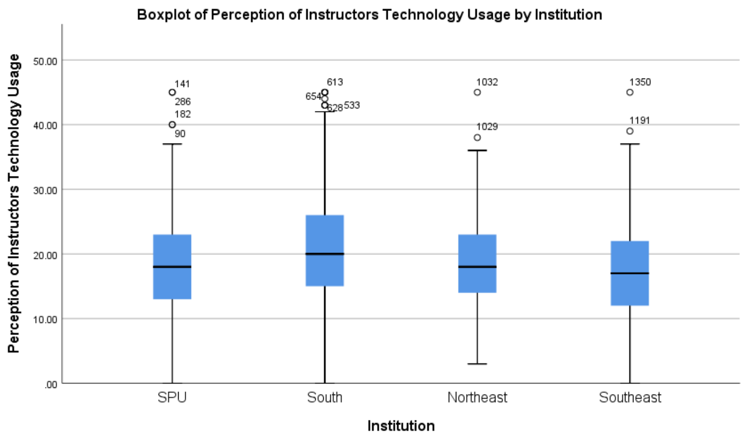

Figure 4. Boxplot of Perception of Instructors Technology Usage

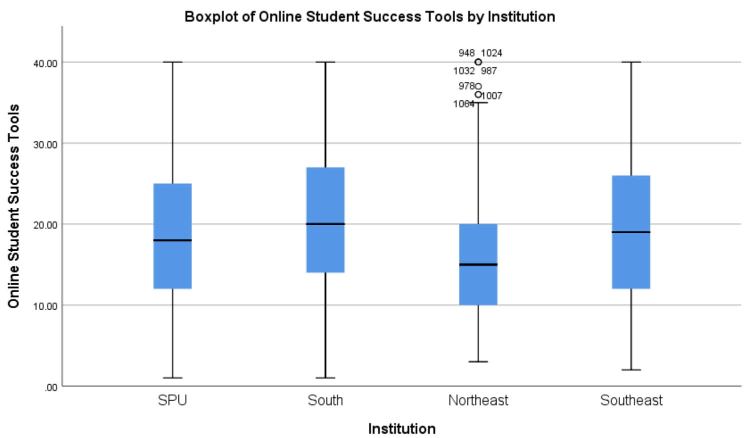

Figure 5. Boxplot of Online Student Success Tools

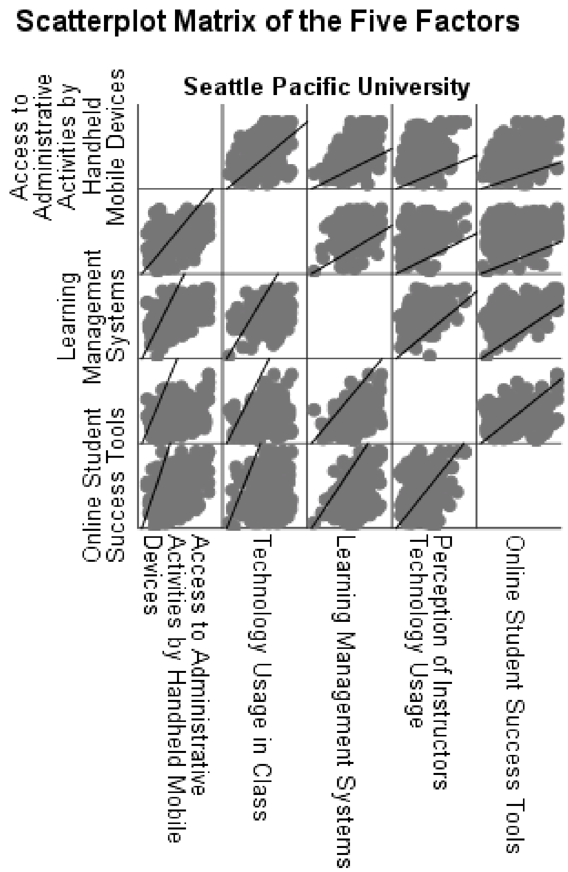

Figure 6. Scatterplot Matrix of the Five Factors

There was no multicollinearity with small correlations and moderate correlations between dependent variables (Table 9) and there was homogeneity of variance-covariance matrices, as assessed by Box's M test (p = .19). The Multivariate Tests presented differences between the institutions on the combined dependent variable. Based on the results of the Pillai trace test, there was an overall statistically significant difference among the institutions, (F(15, 3474) = 13.72, p < .0005; Pillia's Trace = .17, partial η^2 = .05) (Appendix D).

Table 9

Correlations among the five factors

		1	2	3	4
1. Access to Administrative Activities by Handheld Mobile Devices	Pearson Correlation				
	N				
2. Technology Usage in Class	Pearson Correlation	.22**			
	N	1207			
3. Learning Management System	Pearson Correlation	.47**	.27**		
	N	1207	1347		
4. Perception of Instructors Technology Usage	Pearson Correlation	.45**	.22**	.42**	
	N	1210	1344	1344	
5. Online Student Success Tools	Pearson Correlation	.48**	.21**	.48**	.41**
	N	1175	1309	1310	1309

** $p < .01$

Research Question 1. Are SPU undergraduates' perceptions of instructors' use of technology during a class comparable to other religious institutions or institutions of similar size?

To address this question a MANOVA was conducted with institution as the independent variable and the scores on Factor 2, *Technology Usage in Class* and Factor 4, *Perception of Instructors Technology Usage* as the dependent variables. There was not a statistically significant difference among the four institutions in regard to technology usage in the class, Factor 2, (F = 96.78, p = .73, η^2 = .001). There was a statistically significant difference among the four institutions in regard to student perception of instructor's technology usage, Factor 4, (F = 980.16, p < .005, η^2 = .04) (Appendix E). About 4% of the variance in student perceptions was accounted for by institution. A post hoc test using Tukey's HSD procedure was conducted to determine which institutions differed. Table 10 presents the homogeneous subsets for Factor 4. The students from the Southern institution perceived their instructors as using significantly more technology than students from the other three institutions (Table 10).

Table 10

Perception of Instructors Technology Usage

	Institution	*n*	Subset	
			1	2
Tukey HSD	Southeast	236	17.87	
	Northwest	299	18.56	
	Northeast	136	18.57	
	South	493		21.49

Research Question 2. How do undergraduate perceptions of SPU's learning management system compare to other religious institutions or institutions of similar size?

Factor 3, *Learning Management Systems***,** was used to assess this research question. There was a statistically significant difference among the four institutions, (F = 2958.45, p < .005, η^2 = .08) (Appendix E). About 8% of the variance in student perceptions of the learning management systems was accounted for by institution. A post hoc test using Tukey's HSD procedure was conducted to determine which institutions differed. Table 11 presents the homogeneous subsets for Factor 3. The students from the Southeast and Northeast institutions perceived they were using their learning management systems significantly less than students from the other two institutions (Table 11).

Table 11

Learning Management Systems

	Institution	*n*	Subset	
			1	2
Tukey HSD	Northeast	136	28.90	
	Southeast	236	30.75	
	Northwest	299		34.95
	South	493		36.29

Research Question 3. How does SPU compare to similar institutions regarding students' preferred learning environment?

The remaining two factors, Factor 1, *Access to Administrative Activities by Handheld Mobile Devices* and Factor 5, *Online Student Success Tools*, were used to assess the final research question. These factors do not specifically address the research question but instead are proxies that could lead to insight into the overall question. With the addition of mobile devices in a student's education, these devices have the potential to change a student's learning environment to include a variety of applications, programs and resources that can be accessed through a mobile device. For this reason, these two factors were assessed to provide insight into student's preferred learning environment. Both Factor 1 and Factor 5 showed statistically significant difference, (F = 36.01, p < .005, η^2 = .085), and (F = 980.98, p < .005, η^2 = .030), respectively (Appendix E). Table 12 presents the homogeneous subsets for Factor 1. Factor 1 presented about 8% of the variance in student perceptions was accounted for by institution. A post hoc test using Tukey's HSD procedure was conducted to determine which institutions differed. The students from the South institution perceived they were accessing administrative activities significantly more than students from the other three institutions and students from SPU perceived accessing administrative activities more often than the Northeast institution (Table 12). Factor 5 presented about 3% of the variance in student perceptions was accounted for by institution. The students from the Northeast institution reported using online student success tools significantly less than students from the other three institutions (Table 13).

Table 12

Access to Administrative Activities by Handheld Devices

	Institution	*n*	Subset		
			1	2	3
Tukey HSD	Northeast	136	49.04		
	Southeast	236	50.85	50.85	
	Northwest	299		54.02	
	South	493			64.40

Table 13

Online Student Success Tools

	Institution	*n*	Subset	
			1	2
Tukey HSD	Northeast	136	15.82	
	Northwest	299		19.24
	Southeast	236		19.70
	South	493		21.00

Summary. Using a one-way MANOVA with post-hoc Tukey HSD testing, a statically significant difference was found in Research Question 2 and Research Question 3; the students of the Southern institution perceived that they are using technology more within the classroom than students at SPU and the students from the Southern institution and the Southeastern institution perceived that they used online student success tools more often than students at SPU, respectively. Based on the results of the MANOVA with the post-hoc, the null hypotheses for these two research questions were rejected.

Research Question 1 presented one factor with a statically significant difference and another factor that did not present statically significant difference between any of the institutions. The students of the Southern institution perceived that their instructors are using technology more than instructors at SPU. Whereas, there was not statically significant difference between any of the institutions in regard to technology usage in class. Based on the results of the MANOVA with the post-hoc, there is partial support to reject the null hypothesis for the first research question.

Conclusion

This study set out to compare SPU to similar, small, private liberal arts institutions using the 2017 ECAR Student Technology Survey. This process was accomplished in two steps: first a factor analysis was conducted on specific questions pulled from the 2017 ECAR Student Technology Survey, and second, conducting a one-way MANOVA on the five factors established by the factor analysis. Tukey's HSD confirmed differences across four of the five were statistically significant. The results of the MANOVA supported the rejection of the null hypotheses for Research Questions 2 and 3 and provided partial support for the rejection of the null hypothesis for Research Question 1. These findings will be further discussed in Chapter Five, along with recommendations for SPU and the limitations of this study.

Chapter Five

Discussion

This study explored data sets from four small, private, liberal arts institutions around the nation, comparing one of the schools, Seattle Pacific University, to three other institutions referred to as South, Southeast and Northeast. Initially the researcher requested data sets from six small, private, liberal arts institutions around the nation that were comparable to SPU. Each institution had undergraduate classes within a thousand students of SPU's enrollment. Three of the six institutions agreed to share their 2017 ECAR Student Technology Survey data. Between all four institutions the researcher had a total of 1,366 participants.

The researcher wanted to look at three carefully crafted questions developed after reviewing the past eight ECAR Student Technology Surveys, including the most recent, and research articles on the use of mobile devices in education. Digital devices are prevalent in almost all college classrooms (Alden, 2013; Brooks, 2016; Coffin et al., 2015; Dahlstrom et al., 2015; Martin et al., 2011) and the researcher was interested in exploring how SPU compared in their access and use of such devices to similar institutions. The researcher was also interested in seeing how SPU compared to current research focusing on technology usage in the classroom.

Answering the research questions was a two-step process. First, a factor analysis was conducted on the items chosen from the survey. The factor analysis was required as no evidence of a previous factor analysis on the ECAR Student Technology Survey was found in the literature. Two emails were sent to Dr. Brooks, Director of Research for the EDUCAUSE Center for Analysis and Research, in August, 2017 and January, 2018, requesting any information about factors established by ECAR pertaining to the Student Technology Survey. His responses did not provide any information about factors. Once the factor analysis was completed, five factors were retained from the initial questions. Initially, the researcher predicted only three factors to arise from the survey items chosen. Second, a MANOVA was conducted on the five factors retained from the factor analysis to provide possible answers to the research questions. One concern with running a MANOVA was the variance in sample sizes from the four institutions. With an overall sample size, N = 1,366, the researcher chose to continue with a MANOVA.

Research Questions

Question 1. Are SPU undergraduates' perceptions of instructors' use of technology during a class comparable to similar, small, private, liberal art institutions?

Factor 2, *Technology Usage in the Class*, presented no statistically significant differences across the institutions. This factor comprised of a "wish list" for digital devices, programs or applications participants wanted their instructors to use more or less often in the class. Closer examination of SPU results highlighted some interesting data to consider in regards to the use of mobile devices within the classroom. Almost 60% of the participants wanted their instructors to use the institutions learning management system more often with only 25% of the participants satisfied with their instructors' current use of LMS. In comparison, 43% of the Northeastern institution students requested more use of the learning management system by their instructors with 38% of the participants satisfied with their instructors' current use of LMS. Over half of SPU participants (54%) wanted instructors to provide free, web-based content to supplement course-related materials. This response rate is consistent with the three other institutions. An average of

53% of respondents between all institutions are requesting instructors to provide free, web-based content. Sixty-four percent of the students want instructors to use lecture capture more often. SPU students want instructors to use an early-alert system to catch potential academic trouble (45%), comparable to the three other institutions. Yet, 18% of SPU students do not know if an early-alert system exists. This percentage is comparable with the other institutions that range from 15% to 20% of respondents unaware of an early-alert system at their institution. Half of all participants want instructors to provide search tools to find references or other information for online class work (Appendix F). This could lead to the conclusion that mobile device use in the classroom allows for the versatility that students are requesting (Alden, 2013; Kuzenkoff et al., 2015; Martin et al., 2011; McArthur & Bostedo-Conway, 2012; Yang, 2012).

When all four schools were compared, the most common response was the call for instructors to use social media less often in class, in contrast to what current research is advocating (Al-Bahrani & Patel, 2015; Kassens, 2014; Kassens-Noor, 2012; McArthur & Bostedo-Conway, 2012; Tyma, 2011; West et al., 2015). The three institutions being compared to SPU were calling for less social media to be used in the classroom. This ranged from 26% to 30% of students requesting less use of social media compared to 21% of SPU students. Only 21% of participants at SPU preferred more social media usage within a course and 36% preferred less usage of social media during a course (Appendix F).

Other aspects of digital devices and programs that participants wished their instructors used more often included simulations or educational games (43%), laptops as learning tools for course related activities (42%), electronically published resources, for example, quizzes, assignments, tutorials, homework or practice problems (50%), and in-class polling tools, for example, clickers (40%) (Appendix F). Though SPU had 42% of respondents request for laptops to be used more often as a learning tool, it was the lowest request rate compared to the other institutions which ranged from 46% to 51% of respondents.

Factor 2 included a question regarding students' perceptions of how actively involved they are in a class that uses technology. Forty-three percent were "neutral" in regards to their level of active involvement in courses that use technology, comparable to the other institutions. Only 35% of the respondents reported being more actively involved in technology oriented classes. One-fifth of the participants (20%) strongly disagreed or disagreed with this statement, comparable with the other institutions. (Appendix F). With two-thirds of the participants stating they do not get actively involved with technology in class, this prompts the question of how well trained are the students to use mobile devices to support their learning?

Factor 4, *Perception of Instructors Technology Usage*, presented statistically significant results indicating that the students at the Southern institution believe their instructors use mobile devices more often in class than student perceptions at SPU. There was no statistically significant difference in students' perceptions of technology usage by the instructor between each of the two other institutions when compared to SPU.

Instructors who use technology in face-to-face settings to engage students in the learning process varied across SPU. Though only 23% of SPU participants reported that most of their instructors use technology in face-to-face classes to engage them in the learning process, this was a larger percentage than the other institutions. Yet, 17% of

SPU students responded that almost all to all instructors use technology in face-to-face settings compared to 21% of student responses from Southern and Northeastern institutions. Eleven percent of SPU students responded that none of their instructors used technology in face-to-face settings compared to only 4.5% of respondents from the Southern institution. Overall, 28% of SPU students stated that none to very few of their instructors use technology whereas 21% of the Southern students agreed with these statements.

Forty-four percent of SPU participants reported that none to very few of their instructors encouraged the use of digital devices during class to deepen their learning. In comparison, 31% of the Southern students reported the same. Just over a third (34%) of participants indicated that some of their instructors encourage the use of digital devices during class to deepen their learning, comparable to the Southern institution with 32%. Only 8% of respondents indicated that almost all to all of their instructors encouraged the use of digital devices during class to deepen their learning in contrast to 15% of students from the Southern institution stating this (Appendix F).

In regard to instructors having students use a laptop as a learning tool during class, SPU presented the lowest percentage indicating almost all to all instructors doing this with 13% of students responses. The Southern institution reported 24%, the highest response, and the Northeastern institution reporting 17% of its students agreeing, the closest percentage to SPU. Seven percent of SPU students reported that none of their instructors had students use laptops as learning tools during class compared to 4% from the Southern institution and 12% from the Northeastern institution. A majority of SPU student responses, 34%, indicated that some instructors used laptops as learning tools during class. The Southern institution had 29% of students agreeing with this and 31% of the Northeastern institution. These data from these two factors indicate that administrators at SPU would be well-served by exploring how instructors are using technology within a class to enhance and support student learning.

Question 1 gives support to current research that instructors require constant support and guidance to engage students in the learning process with the use of technology (Greener & Wakefield, 2015; Ertmer, 2012; Kumar & Vigil, 2011; McCoy, 2013; Halverson & Smith, 2009; Sykes, 2014; Tindell & Bohlander, 2012). The data from Question 1 indicates that students want their instructors to use technology more often within a course. For example, about 40% of SPU participants want their instructors to use laptops as learning tools for course related activities, to implement simulations or educational games, and to use mobile devices for in-class polling. Additionally, less than a quarter of participants indicated that their instructors use technology to engage them in the learning process (Appendix F). If the goal is to engage students in the classroom with the use of technology, then it would be important to make sure that instructors have received training on how to implement technology into their courses. In turn, instructors need to then guide students with how to use technology successfully in their education.

Question 2. How do undergraduate perceptions of SPU's learning management system compare to similar, small, private, liberal art institutions?

The MANOVA results for Factor 3, *Learning Management System*, indicated a statistically significant difference in scores between SPU and the Northeast and Southeast institutions. That is, students from the Northeastern and Southeastern institutions indicated that they use their institutions' LMS less frequently than SPU students. There was no statistical difference in reported LMS use between SPU and the Southern students.

SPU participants reported satisfaction with their institution's LMS system. Yet when it comes to satisfaction with regards to engaging their peers or instructors through the learning management system, they were predominantly neutral. Though 36% reported being satisfied or very satisfied when engaging with peers through LMS, 33% were neutral and 19% "don't use this feature at all", comparable to the Southern institution. Over a quarter of respondents (29%) reported being satisfied or very satisfied when collaborating on projects, 30% were neutral and 21% "don't use this feature at all", compared to 33% of the Southern students being satisfied or very satisfied when collaborating on projects, 34% being neutral and 17% not using the feature. Only 26% reported being satisfied or very satisfied with using LMS for study groups with peers, 30% reported being content and 28% of the participants "don't use this feature at all". A third of the respondents (33%) were content when asked about their satisfaction with engaging their instructors through the institutions LMS, comparable to the Southern students, and 39% were satisfied or very satisfied with their engagement with instructors through LMS, compared to 43% of the Southern students. The response of "don't use this feature at all" was a common response for all institutions, ranging from 15% from the Southern institution regarding engagement with instructors to 47% from the Northeastern institution regarding study groups conducted through LMS. This response is one that needs to be kept in mind when thinking about supporting student growth, yet 43% of the SPU participants indicated that SPU had sufficiently prepared them to use institution-specific technology when entering the institution, comparable to the Southern institution with 45% of students agreeing (Appendix G). The opposite side of the spectrum was not comparable between SPU and the Southern institution with almost a quarter of SPU students (24%) disagreeing or strongly disagreeing that their institution had prepared them compared to on 18% of the Southern students. It would be beneficial for SPU administrators to evaluate how students are being guided toward using the institution's learning management system to further enhance their learning.

Question 3. How does SPU compare to similar, small, private, liberal art institutions regarding students' preferred learning environment?

Though the initial goal was to explore student preferred learning environments, the two factors used for this research question are considered proxies of learning environment. This means that the two factors presented touch upon programs or applications that could support student learning both in and out of the classroom. Items initially predicted to support this question were not retained in the factor analysis.

The MANOVA results for Factor 1, *Access to Administrative Activities by Handheld Mobile Devices,* indicated a statistically significant difference in scores between SPU and the Southern institution indicating the Southern students use handheld devices more often when conducting administrative activities. There was no statistically significant difference in the use of a handheld device to conduct administrative activities with SPU and the Southeastern institution. SPU students perceived they used handheld devices more often than students at the Northeastern institution. The items used in this factor pertained to the exclusive use of handheld devices, for example, tablets or smartphones, to access administrative activities. A few examples of conducting administrative activities with a handheld device include accessing library resources, taking notes, recording a lecture, communicating with instructors, reviewing grades, and registering for classes.

Overall, SPU participants were content with accessing administrative services through handheld devices. Yet, upon closer examination of the results, missing data was prevalent in Factor 1. Thirteen out of 21 questions had 38% or more missing responses, with five out of these thirteen questions missing over 50% of the responses. Two responses were initially deleted from the data, “Service not offered/does not function on my mobile device” and “Haven’t used service in the past year,” because they were outliers and skewed the data. Once these responses were added, to hopefully provide more insight into student use of handheld devices to access administrative services, 24-48% of the respondents simply have not used these services in the past year, depending on the specific question. For comparison, 26% of SPU students have not accessed library resources in the past year compared to 17% of Southern students, 27% of SPU students have not used handheld devices in the past year to answer questions posed in class, compared to 15% of Southern students, and 26% of SPU students have not participated in interactive class activities using handheld devices in the past year compared to 10% of Southern students. Some of the other administrative services included accessing, registering for classes, taking notes during class or recording lectures (Appendix H). This presents the question about training instructors and students how to use handheld mobile devices to enhance the learning process.

The MANOVA results for Factor 5, *Online Student Success Tools*, indicated a statistically significant difference in scores between SPU and the Northeast institution. That is, students from the Northeastern institution indicated that they use their institutions' LMS less frequently than SPU students. There was no statistically significant difference in reported use of online student success tools between SPU and the Southern and Southeastern students.

Unfortunately missing data rates were prevalent in Factor 5. Five out of 11 questions had 37% or more missing responses, with two out of those five questions missing over 50% of the responses. The two outliers deleted from the data set consisted of "Service not offered" or "Don't use service" responses. Upon closer examination, when the outliers were included, the data did not provide any more guidance to how SPU students perceive the online student success tools. For example, "Guidance about courses you might consider taking in the future" had a 30% response rate of "Service not provided" and a 21% response rate to "Don't use service" for a total of 51% of the respondents. In comparison, the Southern and Southeastern institutions had a combined totals of 41% and 44%, respectively, to the same question. Whereas for "Early-alert systems designed to catch potential academic trouble as soon as possible," 20% of the respondents believe the service is not provided and 29% do not use the service, just under half of all respondents (Appendix H). In comparison, the Southern and Southeastern institutions had combined totals of 47% and 49%, respectively, to the same question. In contrast, all three institutions being compared presented an average of 25% of student responses indicating a very useful or extremely useful response to both questions presented. There is a large difference between half of all participants not being aware of a service or using a service compared to a quarter of all participants finding a service very useful. This calls into question if participants truly understand all aspects of SPU's services provided regarding online student success tools and if students require more training.

Responses to questions regarding the distraction caused by mobile devices within a class was consistent with current research (Coffin et al., 2015; Dahlstrom et al., 2015; Kraushaar & Novak, 2010; Kuzenkoff et al., 2015; Lepp et al., 2015; McCoy, 2013; Nguyen et al., 2015; Tindell & Bohlander, 2012; Wood et al., 2012). Forty-six percent of SPU participants agreed or strongly agreed that mobile devices are distracting for themselves in face-to-face classes, compared to 36% of Southern students and 37% of Southeastern students. Fifty percent of SPU students believe that mobile devices are distracting for others during a class compared to 38% of Southern students and 40% of Southeastern students and 58% of SPU students believe mobile devices are distracting to the instructors compared to 36% of Southern students and 37% of Southeastern students (Appendix H). These results continue to raise the question of whether SPU students are being successfully trained on how to use mobile devices in their education to enhance the learning process.

Factor 5, *Online Student Success Tools*, presents data that questions how well trained students are to use student success tools, and if instructors give guidance to using these tools within their class, or if students are expected to learn them on their own. Current research shows that students require guidance and support when using programs or applications within a course (Buzzard et al., 2011; Greener & Wakefield, 2015; Jones & Cross, 2009; Kennedy et al., 2010; Margaryun et al., 2011; Rossing et al., 2012; Tyma, 2011).

Implications

When looking at completely integrating mobile devices and 21st century skills into higher education classrooms, there are numerous steps to accomplish (Cotner et al., 2013; Gebre et al., 2015; Henderson et al., 2016; Hudson et al., 2015; McLaughlin et al., 2016; Porter & Graham, 2016). Vital steps to keep in mind when approaching this process include teacher and student training, access to programs and applications for both groups, a learning environments that allows for student success and how to use technology to engage students in the learning process. The 2017 ECAR Student Technology Survey helped to highlight some of these areas.

Research Question 1 addressed instructor use of technology, utilizing two factors, the first being a “wish list” from students indicating what they would like their instructors to use, and the second focusing on student perception of instructors’ use of technology within the classroom. Fortunately, over 60% of SPU students felt that most to all of their instructors use technology adequately, the highest response from all four institutions, yet this response does not specify how instructors use technology. Using digital devices in class to further student learning, had only 13% of SPU students agree or strongly agree, and engaging students in the learning process, had only 17% of SPU students agree or strongly agree, were not strongly supported by student responses. In contrast, 24% of the Southern students believe their instructors use digital devices in class to further student learning and 21% of the Southern students believe instructors use technology to engage students in class. Students at SPU are requesting that instructors use technology in more effective ways. For example the learning management system, 50% of SPU students, free, web-based content, 58% of SPU students, and simulations or educational games, 43% of SPU students. Although 43% of SPU students believe that the institution has sufficiently prepared them to use institution specific technology, over half of the respondents do not agree with this statement, leading one to believe that SPU can do more to support students with enhancing their learning through the use of mobile devices.

An initial step would be to ask why instructors at SPU are not doing this consistently within their classrooms. In reality, the question to be asked is what type of professional development and support are instructor's receiving from SPU to help integrate technology into their curriculum? This is not an easy process because it involves taking into account the instructor's pedagogical beliefs (Ertmer et al., 2012; Greener & Wakefield, 2015; McCoy, 2013; Tapscott & Williams, 2010; Ting, 2012; Wood et al., 2012), instructor's level of confidence with technology (Ertmer et al., 2012; Greener & Wakefield, 2015) and the discipline being taught, along with what support and professional guidance instructors are receiving (Ertmer et al., 2012; Greener & Wakefield, 2015; Halverson & Smith, 2009; Sykes, 2014). These are four vital factors administrators need to keep in mind when considering how to support the integration of technology within a classroom at SPU.

Unfortunately there does not seem to be an easy way to take on any of these at once, as an instructor's pedagogical beliefs could be connected to their level of confidence with using technology in front of students (Ertmer et al., 2012; Greener & Wakefield, 2015). An instructor's confidence level with using technology in a class could be connected to their perception of available support or guidance with technology integration. Pedagogical beliefs could also be connected with the discipline being taught. Science and engineering courses, for example, have high levels of technology usage but what about a professor whose discipline is in social work or art (Buzzard et al., 2011; Cotner et al., 2013; Kennedy et al., 2010; Littlejohn & Vojt, 2011)? Research shows that students use technology in a class the way it is modeled for them (Buzzard et al., 2011; Gebre et al., 2015; Kumar & Vigil, 2011), in other words, if an instructor does not use technology effectively, neither will the students.

Research Question 2 addressed student perceptions of SPU's learning management system, Canvas. One vital piece of information to consider when reviewing SPU responses regarding LMS is that the 2016-2017 school year was the first year Canvas was introduced to the instructors and students. Prior to this school year, SPU had been using Blackboard. A third of SPU students were "neutral" in response to the statement about using LMS to engage with peers, collaborate on projects or engage with instructors and only another third of the students were satisfied or very satisfied with the LMS. A fifth of all SPU students stated that they do not use LMS to engage with peers, collaborate on projects of engage with instructors. Upon closer examination of the other institutions, the Southern and Southeastern institutions had similar ratings with the Northeastern institution presenting higher percentages of students not using LMS at all and lower percentages of satisfaction with LMS. The specific LMS systems being used at the other institutions is not known nor how long those systems have been in place. Yet, knowing that Canvas was in its first year of use at SPU, it would be helpful to know what type of training instructors have received and if there is ongoing support for instructors. It would also be helpful to know how much training students have received on using Canvas and where that training came from, for example, by instructors, SPU specific trainings or from peers. If SPU continues to participate in the ECAR Student Technology

Survey, these results could change as both instructors and students become more accustomed to using Canvas.

Research Question 3 assessed the learning environment and how the perceptions of SPU students compared to those of students from other institutions. The factors used for this question are proxies of the learning environment; for example, the use of programs or applications in and out of the class that would benefit the students. The first factor focused specifically on handheld devices being used to access administrative activities and the second factor focused on online student success tools. Both of these aspects seem to take place outside of the classroom. These factors could be an indication of a change in the current learning environment evident from that ECAR research. Research findings suggest that institutions need to adjust their classrooms to meet 21st century learning needs (Cotner et al., 2013; Hudson et al., 2015; McLaughlin et al., 2016) and institutions are attempting to achieve this by transitioning classrooms to a blended, flipped or active learning classroom format.

With regards to handheld devices, particularly cellphones and tablets, research has shown a steady decline of tablet usage among college students (Brooks, 2016), thus begging the question as to why tablets are a part of the ECAR survey. Cellphones, on the other hand, are prevalent on college campuses (Brooks, 2016; Coffin et al., 2015; Dahlstrom et al., 2015). Research shows that cellphones are useful when a class has a live Twitter feed (Tyma, 2011; Kassens, 2014) or when used as a clicker to poll students during a class (Morse et al., 2010; Vaterlaus et al., 2012). About a quarter of the respondents stated that they have not used handheld devices in the past year to participate in a polling of student responses during a class, have not participated in interactive class activities, and have not produced content during class with the sole use of a handheld device. In comparison, students from the Southern institution reported that 16% had not used handheld devices in the past year to participate in a polling of student responses during a class, 10% have not participated in interactive class activities, and 11% have not produced content during class with the sole use of a handheld device. Though student training has been questioned, this finding also raises the question of the SPU instructors' confidence in using handheld devices to support student learning. Research suggests that the laptop continues to be the workhorse in a class (Brooks, 2016; Henderson et al., 2016). Therefore, including laptops in this question could add more clarity to how students are using technology to create their preferred learning environment.

About a quarter of all SPU participants reported that they do not use online student-success tools, access administrative activities or use LMS to engage peers or instructors. Though 43% of respondents believe SPU has sufficiently prepared them to properly use institution-specific technology, this indicates more specific training would be useful. In comparison, 20% to 30% of students at the other institutions do not use online student success tools or use LMS. SPU had higher percentages of students not conducting administrative activities through handheld devices compared to the other institutions and 30% of respondents were content on this aspect of technology use for their education, which might also indicate that more training is required for the students. Based on research results, researchers encourage instructors to train students on programs or applications that pertain to their course (Cotner et al., 2013; Henderson et al., 2016; Hudson et al., 2015; Kassens, 2014; McLaughlin et al., 2016; Porter & Graham, 2016; West et al., 2015). If each instructor at SPU took one of the first classes of a course to educate students on these various services, would the students become more proficient at using them and thus potentially help to increase their learning? For example, 35% of participants stated that they became more actively involved in a course that used technology, yet 43% were neutral to this concept. Both the Southern institution and the Southeastern institution were similar to SPU in both regards. With 43% of SPU students being neutral to technology being used in class, do both instructors and students need to be shown how to use technology to engage everyone in the learning process? Current research shows that students and instructors are eager to use technology within the classroom (Brooks, 2016; Chen, 2012; Greener & Wakefield, 2015; Jones & Shao, 2011; Rossing et al., 2012), yet one could speculate that a greater use of technology in a class is not taking place because instructors do not know how to implement these programs or lack the confidence to do so (Hudson et al., 2015; Porter & Graham, 2016).

Based on the data, students at SPU are indicating that they want their instructors to use technology more within their courses. This is consistent with all institutions within this study. Particularly, all students are interested in instructors using LMS more within the classroom. They want more web-based, free content to supplement course-related materials, lecture capture to be implemented, and search tools to be presented by their instructors. Students are interested in early-alert systems to warn about possible academic concerns. The interesting point about all of these aspects is that they mostly take place outside of the classroom and thus point toward transitioning classrooms to a blended, flipped or an active learning classroom environment (Hudson et al., 2015; McLaughlin et al., 2016). Current research suggests that this transitioning of the classroom is consistent with 21st century learning concepts (Hudson et al., 2015; McLaughlin et al., 2016; Porter

& Graham, 2016). Are instructors at SPU fully aware of these requests from the students and are instructors being supported to implement these requests?

Though SPU students indicated they want more technology to be used in the classroom, there is cause to question how beneficial mobile devices are within a class, given that such devices potentially cause students to become distracted during a class. The concept of distraction has been shown to be a significant concern when mobile devices are used in the classroom (Kraushaar & Novak, 2010; Lepp et al., 2015; McCoy, 2013; Sana et al., 2013; Wood et al., 2012). Embracing 21st century learning concepts within a class could be a challenge at SPU since around 50% of the respondents believe that mobile devices are distracting to all, mirroring current research (Coffin et al., 2015; Dahlstrom et al., 2015; Kraushaar & Novak, 2010; Kuzenkoff et al., 2015; Lepp et al., 2015; McCoy, 2013; Nguyen et al., 2015; Tindell & Bohlander, 2012; Wood et al., 2012). Yet when comparing SPU to the Southern and Southeastern institutions, both institutions had an average of 40% of its respondents stating that mobile devices are distracting to all. How are instructors at SPU training students to use mobile devices in a manner that will enhance their education and yet not distract people during the process?

Barnes and Jacobsen (2015) reported that students strongly question the educational value of technology in a class. Responses on the SPU 2017 ECAR Student Technology Survey indicated that students perceive that only 8% of instructors encourage students to use technology to deepen their learning and only 13% of instructors encourage the use of a laptop as a learning tool during class, compared to the Southern institution reporting 15% and 24%, respectively. Sixty-six percent of the participants stated that most to all of their instructors use technology adequately during a course, yet again, this question does not differentiate how instructors are using technology or if they are encouraging students to use technology during class. Only 17% of SPU participants, compared to 21% of Southern and Northeastern institutions participants, stated that almost all to all instructors use technology to engage students in the learning process, 23% stated that most of their instructors did this, which was comparable to all institutions and 27% reported that some of their instructors do this currently. This data highlights the need for consistent and constant training for instructors on how to integrate technology into their courses, a constant need mirroring current research (Greener & Wakefield, 2015; Ertmer, 2012; Kumar & Vigil, 2011; McCoy, 2013; Halverson & Smith, 2009; Sykes, 2014; Tindell & Bohlander, 2012).

Changing student perception of the distraction caused by mobile devices is a challenge that the administrators of SPU could address through changing the learning environment. Though 46% of respondents stated that their instructors encourage the use of online collaboration tools to communicate in and out of classes, only 20% stated that their instructors encourage the use of devices during class to deepen their learning. This is comparable to the Northeastern and Southeastern institutions. Only the Southern institution presented a higher percentage of instructors encouraging the use of devices during class. Research indicates that training students to use technology appropriately while transitioning the class to a 21st century learning environment is time intensive and can increase the workload for instructors three-fold the first year, yet the benefits outweigh the initial process (Hudson et al., 2015; McLaughlin et al., 2016; Porter & Graham, 2016). With support and guidance from the administration, students and teachers would benefit from implementing mobile devices into the curriculum (Cotner et al., 2013; Henderson et al., 2016; Hudson et al., 2015; McLaughlin et al., 2016; Porter & Graham, 2016). Mobile devices are just another tool to use in the classroom that requires time and training for all.

Recommendations

Several recommendations can be made from this study. The most prevalent recommendation is consistent training and support for all parties involved. Instructors need to be aware of the wide range of skills undergraduates possess in technology usage when they enter higher education (Buzzard et al., 2011; Jones, 2011; Kennedy et al., 2010; Rossing et al, 2012). Students would benefit from regular training by the instructors at the beginning of each course in the use of programs or applications that pertain to the course. Instructors could also assign the exploration of these programs or applications prior to the first class of the course and then provide support within the class. With around 25% of students not using online student success tools or administrative tools, the instructors could benefit from quarterly training to support students in these areas during their first year.

Research has shown that students and instructors are excited to use technology more in the classroom (Brooks, 2016; Chen, 2012; Greener & Wakefield, 2015; Jones & Shao, 2011; Rossing et al., 2012), but frustration is a leading cause for instructors to stop using technology (Hudson et al., 2015; Porter & Graham, 2016), thus leading to less technology use in the classroom. The students of SPU are requesting that their instructors provide more access to programs, simulations, lecture capture software and search tools, all of which can engage students in the learning process. SPU could benefit from helping their instructors find and implement these resources thereby allowing the integration of 21st century skills into the classroom.

The next recommendation would be that SPU look towards adjusting the learning environment within classrooms. Students are requesting that they be encouraged to use technology to deepen their learning during class. Though research has shown that students still prefer lecture based courses (Barnes & Jacobsen, 2015; Buzzard et al., 2011; Buzetto-More, 2012; Finn & Ledbetter, 2013; Jackson et al., 2011; Jones, 2011; Kennedy et al., 2010; La Roche & Flanigan, 2013), there is a push to encourage students' to use class time to deepen their understanding of concepts through 21st century classrooms (Chen, 2015; Cotner et al., 2013; Gebre et al., 2015; Park & Choi, 2014; Rossing et al., 2012), for example, implementing a flipped, blended or active learning classroom. These classrooms consist of students doing work outside of class to prepare for deeper exploration of concepts during class. For example, some instructors are presenting real-world problems to be explored or solved during a class, using information presented outside of the class as the foundation of the process (Hudson et al., 2015; McLaughlin et al., 2016; Porter & Graham, 2016). This concept encourages students to use technology to help solve these problems in small groups while working beside the instructor, who can guide the students instead of only lecturing (Chen, 2015; Cotner et al., 2013; Gebre et al., 2015; Park & Choi, 2014; Rossing et al., 2012).

Limitations

Limitations are present in all studies and need to be kept in mind when reading the research. There are a variety of limitations to keep in mind when reviewing this study. The most prominent limitation is that no prior factor analyses were discovered to help guide this study from the beginning. This researcher had to conduct a factor analysis on carefully selected items focusing on the intended research questions. This researcher did not conduct a factor analysis on the complete survey which may have excluded some items that might have been useful in the study.

Another larger limitation to this study was the amount of time students had to participate in the survey. Students only had two weeks to participate in the 2017 ECAR Student Technology Survey at SPU. Though 347 students did participate in the study, achieving a response rate of 11.9%, the response rate could have been greater if students would have had a month to respond to the survey.

The unequal sample sizes between the institutions was another limitation to the study. The Southern institution had the largest number of participants at 439, whereas the Southwestern institution only had 136 participants. This disparity in group sizes had the potential to distort the results. The variance in sample sizes had the potential to be inflated when the outliers, responses that used a value of 99 or 999, were removed from the data when pairwise comparisons were used in the data analysis. Though the overall goal was to compare SPU to similar small, private, liberal art institutions, varying sample sizes were a concern.

Finally, SPU used a third party survey from ECAR. The ECAR Student Technology Survey has been in use since 2004, yet this still calls into question the use of a survey that might not fully address all the concerns of SPU. Only three out of six sections of the survey were used in this study, and only a handful of those questions were used in the final data analysis. It is recommended that a survey be developed by SPU that focuses on more specific details pertaining to technology usage by their instructors and students.

Conclusion

The question needs to be asked, what can SPU do to further student learning and engagement with mobile devices within the classroom? This is not a simple question as research has shown there are numerous aspects to consider (Cotner et al., 2013; Gebre et al., 2015; Henderson et al., 2016; Hudson et al., 2015; McLaughlin et al., 2016; Porter & Grahman, 2016) when integrating technology into the classroom. This study presents data that SPU can use to guide further technology usage in the classroom. Students are asking for their instructors to use LMS more often, provide more engaging activities with the use of technology and to encourage the use of laptops as a learning device within classes.

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Appendix A

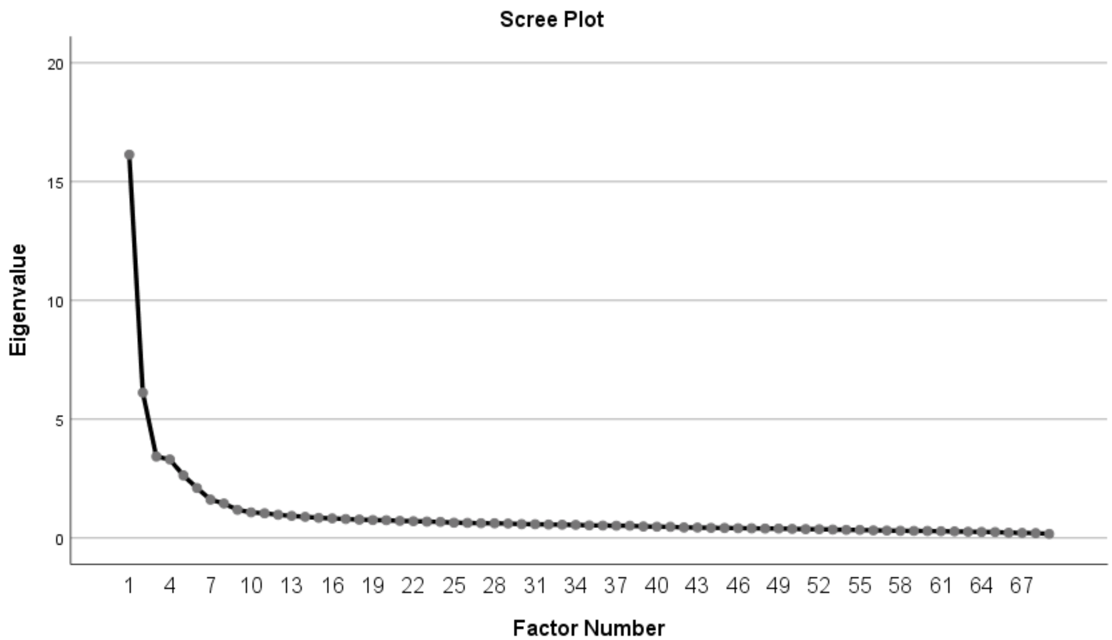
KMO and Bartlett's Test of Sphericity for Factor Analysis

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.94
Bartlett's Test of Sphericity	Approx. Chi-Square	12564.586
	df	2346
	Sig.	.000

Appendix B

Spree Plot



Appendix C

Factor Rotation

Rotated Factor Matrix[a]

	Factor				
	Access to Administrative Activities by Handheld Mobile Devices 1	Technology Usage in the Class 2	Learning Management System 3	Perception of Instructors Technology Usage 4	Online Student Success Tools 5
2.6 Handheld support: Access library resources	.681				
2.6 Handheld support: Check grades	.602				
2.6 Handheld support: Access course content	.683				
2.6 Handheld support: Use the LMS	.580				
2.6 Handheld support: Register for courses	.697				
2.6 Handheld support: Review transcript	.705				
2.6 Handheld support: Make tuition/fee payments	.712				
2.6 Handheld support: Track financial aid	.689				
2.6 Handheld support: Access information about events, activities, and clubs/organizations	.621				

2.6 Handheld support: Use the mobile device as identification	.624
2.6 Handheld support: Use the mobile device to verify/record attendance	.645
2.6 Handheld support: Use e-texts	.608
2.6 Handheld support: Communicate with other students about class-related matters outside class	.480
2.6 Handheld support: Communicate with instructors about class-related matters outside class	.607
2.6 Handheld support: Take notes in class	.578
2.6 Handheld support: Look up course-related information while in class	.606
2.6 Handheld support: Take pictures of in-class activities or resources	.427
2.6 Handheld support: Record your instructor's lecture or in-class activities	.501
2.6 Handheld support: Answer questions posed in class to generate/tally automatic responses	.601

2.6 Handheld support: Participate in interactive class activities	.644			
2.6 Handheld support: Produce content	.696			
3.4 Student-success tools: Guidance about courses you might consider taking				.589
3.4 Student-success tools: Early-alert systems designed to catch potential academic trouble ASAP	.305			.633
3.4 Student-success tools: Suggestions for how to improve performance in a course	.334			.519
3.4 Student-success tools: Suggestions about new or different academic resources	.346			.543
3.4 Student-success tools: Degree planning or mapping tools that identify courses needed				.605
3.4 Student-success tools: Degree audit tools that show the degree requirements completed				.626
3.4 Student-success tools: Online self-service tools for conducting student-related business				.573

3.4 Student-success tools: Digital tools that keep a record of services used, advice given, or decisions made		.572
3.5 How many instructors: …use technology adequately for course instruction	.543	
3.5 How many instructors: …use technology in face-to-face settings to engage you in the learning process	.594	
3.5 How many instructors: …use technology during class to make connections to the learning material	.566	
3.5 How many instructors: …encourage you to use your own technology devices during class to deepen learning	.746	
3.5 How many instructors: …encourage you to use online collaboration tools to communicate/collaborate	.555	
3.5 How many instructors: …encourage you to use technology for creative or critical-thinking tasks	.733	

3.5 How many instructors: …have you use your tablet as a learning tool in class		.526
3.5 How many instructors: …have you use your smartphone as a learning tool in class		.607
3.5 How many instructors: …have you use your laptop as a learning tool in class		.690
3.6 Wish instructors used: LMS	.334	
3.6 Wish instructors used: Online collaboration tools	.603	
3.6 Wish instructors used: E-portfolios	.625	
3.6 Wish instructors used: E-books or e-textbooks	.461	
3.6 Wish instructors used: Free, web-based content to supplement course-related materials	.579	
3.6 Wish instructors used: Simulations or educational games	.594	
3.6 Wish instructors used: Lecture capture	.519	
3.6 Wish instructors used: Student laptops as learning tools	.574	
3.6 Wish instructors used: Student tablets as learning tools	.581	

3.6 Wish instructors used: Student smartphones as learning tools	.628	
3.6 Wish instructors used: Social media as a learning tool	.556	
3.6 Wish instructors used: Software to create videos or multimedia resources	.660	
3.6 Wish instructors used: Early-alert systems designed to catch potential academic trouble ASAP	.617	
3.6 Wish instructors used: Search tools to find references or other information online for class work	.602	
3.6 Wish instructors used: Publisher electronic resources	.540	
3.6 Wish instructors used: In-class polling tools	.590	
3.7 LMS satisfaction: Accessing course content		.571
3.7 LMS satisfaction: Managing your assignments		.671
3.7 LMS satisfaction: Checking course progress		.663

3.7 LMS satisfaction: Accessing information about your institution's news, events, or activities		.560		
3.7 LMS satisfaction: Submitting course assigments		.634		
3.7 LMS satisfaction: Engaging with other students		.563		
3.7 LMS satisfaction: Collaborating on projects		.611		
3.7 LMS satisfaction: Study groups with other students		.579		
3.7 LMS satisfaction: Engaging with your instructors		.589		
3.7 LMS satisfaction: Receiving feedback on course assignments		.629		
4.4: I get more actively involved in courses that use technology.	.422			
4.4: My institution sufficiently prepared me to use institution-specific technology.		.307		
4.4: Use of mobile devices in face-to-face classes is distracting for me.				.313
4.4: Use of mobile devices in face-to-face classes is distracting for other students.				.327

4.4: Use of mobile devices in face-to-face classes is distracting for instructors.	.321

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.[a]
a.

Appendix D

Multivariate Test

Multivariate Test

Effect		Value	*F*	Hypothesis *df*	Error *df*	Sig.	Partial Eta Squared
InstitutionName	Pillai's Trace	.17	13.72	15	3474	.00	.06

Appendix E

Tests of Between-Subjects Effects for five factors

Factor	*F*	*p*
Access to Administrative Activities by Handheld Mobile Devices	36.01	.00
Technology Usage in Class	96.78	.73
Learning Management Systems	2958.5	.00
Perception of Instructors Technology Usage	980.16	.00
Online Student Success Tools	980.08	.00

Appendix F

Percentage of Student Responses for Research Question 1 (Factor 2 and Factor 4)

Boldfaced phrases are referenced within the study.

Factor 2 – *Technology Usage in Class*

Which resources/tools do you wish your instructors used less… or more?

	Missing	Don't know	(Less) 1	2	3	4	(More) 5
Learning management system	2.0	5.5	2.3	5.8	**25.1**	**30.6**	**28.6**
Online collaboration tools to communicate/collaborate	2.3	9.5	6.1	10.4	32.1	25.7	13.9
E-portfolios	2.9	35.3	12.1	10.7	22.0	10.7	6.4
E-books or e-textbooks	2.3	7.8	18.5	10.1	24.0	14.2	23.1
Free, web-based content to supplement course-related materials	2.0	7.2	6.9	6.4	18.8	**24.3**	**34.4**
Simulations or educational games	2.0	9.5	12.4	10.7	22.3	**24.3**	**18.8**
Lecture capture	3.2	6.4	6.6	5.2	14.7	**23.7**	**40.2**
Student laptops as learning tools for course-related activities	2.6	9.2	6.6	11.6	27.7	**24.9**	**17.3**
Student tablets as learning tools for course-related activities	2.6	21.1	17.6	12.7	23.1	13.3	9.5
Student smartphones as learning tools	2.9	11.6	18.2	13.0	29.5	16.5	8.4

for course-related activities							
Social media as a teaching and learning tool	2.9	14.7	**20.5**	**15.9**	**24.0**	**13.3**	**8.7**
Software to create videos or multimedia resources as a learning tool for course related activities	2.9	18.8	10.1	11.0	23.1	22.5	11.6
Early-alert systems designed to catch potential academic trouble as soon as possible	2.0	18.8	5.5	5.5	23.1	**22.2**	**23.1**
Search tools to find references or other information online for class work	2.3	11.0	2.3	5.8	29.2	**29.8**	**19.7**
Publisher electronic resources	2.6	4.3	8.1	6.1	28.0	**27.5**	**23.4**
In-class polling tools	2.6	8.7	11.8	9.5	27.7	**22.8**	**16.8**

To what extent do you agree with the following statement?

	Missing	N/A	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I get more actively involved in courses that use technology	2.3	1.4	**3.5**	**16.2**	**42.5**	**29.5**	**4.6**

Factor 4 – *Perception of Instructors Technology Usage*

Thinking about your college/university experiences within the past year, how many of your instructors…

	Missing	N/A or don't know	None	Very few	Some	Most	Almost All	All
…use technology adequately for course instruction	0.6	2.0	2.6	7.8	20.8	32.7	22.8	10.7
…use technology in face-to-face settings to engage you in the learning process	0.9	4.9	**11.3**	**16.8**	**26.6**	**22.5**	**12.1**	**4.9**
..use technology during class to make connections to the learning material or to enhance learning with additional materials	1.2	1.7	3.8	9.0	25.1	28.3	20.8	10.1
…encourages you to use your own technology devices during class to deepen learning	1.2	0.9	**12.7**	**31.2**	**33.5**	12.1	6.4	2.0
…encourage you to use online collaboration tools to communicate/collaborate with the instructor or other students in or outside class	0.9	2.0	5.8	18.5	27.5	24.6	13.0	7.8
…encourage you to use technology for creative or critical-thinking tasks	1.4	4.6	11.0	20.8	30.6	17.9	9.0	4.6

…have you use a tablet as a learning tool in class	1.2	15.0	40.2	20.8	13.0	5.5	2.9	1.4
…have you use a smartphone as a learning tool in class	0.6	1.4	21.4	39.3	26.3	6.1	3.2	1.7
…have you use a laptop as a learning tool in class	0.9	1.7	**6.9**	**23.4**	34.1	**19.7**	**10.1**	**3.2**

Appendix G

Percentage of Student Responses for Research Question 2 (Factor 3)

Boldfaced phrases are referenced within the study.

Factor 3 – *Learning Management System*

Please indicate your satisfaction with using your institution's learning management system:

	Missing	Not offered	Don't use this feature at all	Very dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied
Accessing course content	2.0		1.7	0.9	3.5	17.6	52.0	22.3
Managing your assignments	1.4	0.6	3.8	1.2	7.2	20.8	45.7	19.4
Checking course progress	2.3		0.9	1.2	7.8	20.8	43.9	23.1
Accessing information about your institution's news, events, or activities	1.4	7.2	15.0	4.0	10.7	26.6	27.5	7.5
Submitting course assignments	1.4		1.4	0.6	1.7	12.4	56.9	25.4
Engaging with other students	1.7	2.3	**18.8**	0.6	7.2	**33.2**	**28.9**	**7.2**
Collaborating on projects	1.4	4.0	**21.7**	2.6	11.0	**30.1**	**24.0**	**5.2**
Study groups with other students	1.2	5.8	**28.0**	1.7	7.8	**29.5**	**22.0**	**4.0**
Engaging with your instructors	1.7	1.4	**16.5**	0.9	6.9	**33.5**	**31.5**	**7.5**
Receiving feedback on	1.7	0.3	1.7	1.4	6.6	23.4	46.5	18.2

course assignments								

To what extent do you agree with the following statement?

	Missing	N/A	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
My institution sufficiently prepared me to use institution-specific technology when I started college	2.6	3.5	5.5	17.1	28.6	**36.7**	**6.1**

Appendix H

Percentage of Student Responses for Research Question 3 (Factor 1 and Factor 5)

Boldfaced phrases are referenced within the study.

Factor 1 – *Access to Administrative Activities by Handheld Mobile Devices*

Thinking about the past year, please rate your institution's support of the following administrative activities you've experienced on a handheld mobile device.

	Missing Responses	Service not offered/does not function on my mobile device	Haven't used this service in the past year	Poor	Fair	Neutral	Good	Excellent
Accessing library resources	9.8	2.0	**26.3**	6.1	9.2	14.2	20.5	11.5
Checking grades	10.4	.3	4.3	4.6	9.0	7.5	37.0	26.9
Accessing course content	9.8	1.2	5.8	3.8	9.0	14.7	36.4	19.4
Using the learning management system	10.1	1.2	5.5	4.3	9.8	10.4	36.4	22.3
Register for courses	9.8	3.8	**26.3**	11.8	11.8	9.8	15.9	10.7
Reviewing transcript	10.1	1.7	**28.0**	6.6	9.5	10.4	19.9	13.6
Make tuition/fee payments	9.8	3.8	**47.7**	6.1	3.5	10.7	19.4	8.1
Tracking financial aid	10.1	1.7	**35.3**	6.6	7.5	15.6	15.3	7.8
Accessing information about events, student activities, and clubs/organizations	9.8	.6	11.3	8.1	8.7	12.7	32.4	16.5
Providing identification to	10.1	8.1	**28.0**	4.6	6.9	9.8	22.0	10.4

access campus facilities or services								
Verifying/recording attendance for class or campus activities	9.8	6.9	**40.2**	3.5	6.9	9.5	13.6	9.5
Using e-texts	10.1	3.8	**35.8**	6.1	6.1	15.6	13.9	8.7
Communicating with other students about class-related matters outside of sessions	9.8	.9	4.6	1.7	4.6	10.4	32.7	35.3
Communicating with instructors about class-related matters outside of sessions	9.8	.9	8.1	2.0	9.5	9.5	39.0	21.1
Taking notes in class	9.8	2.9	**38.2**	6.4	7.5	11.6	15.9	7.8
Looking up course-related information while in class	9.8	.9	8.4	5.5	8.7	11.6	37.3	17.9
Taking pictures of in-class activities or resources	10.1	1.2	7.8	3.5	6.6	10.7	32.7	27.5
Recording your instructor's lecture or in-class activities	9.8	2.3	**46.0**	4.3	6.1	9.0	13.9	8.7
Answering questions posed in class to generate/tally automatic responses	9.8	4.0	**26.6**	3.5	5.5	11.0	26.3	13.3
Participating in interactive class activities	9.8	2.6	**26.3**	4.3	6.9	13.6	25.4	11.0
Producing content	10.1	4.3	**24.3**	7.2	9.0	14.2	21.7	9.2

Factor 5 – *Online Student Success Tools*

How useful do you find the following online student-success tool provided by your institution?

	Missing	Service not provided	Don't use service	Not at all useful	Not very useful	Moderately useful	Very useful	Extremely useful

Guidance about courses you might consider in the future	1.2	**29.8**	**21.1**	3.8	6.4	15.3	15.9	6.6
Early-alert system designed to catch potential academic trouble as soon as possible	0.9	**19.7**	**28.6**	3.8	4.0	15.9	18.5	8.7
Suggestions for how to improve performance in a course	0.6	22.0	19.9	1.7	8.1	28.0	13.9	5.8
Suggestions about new or different academic resources	1.4	9.5	25.4	2.9	6.1	30.9	18.2	5.5
Degree planning or mapping tools that identify courses needed to complete my degree	1.2	4.9	8.7	2.6	6.4	26.9	31.8	17.6
Degree audit tools that show the degree requirements completed	1.2	2.6	6.9	1.7	4.9	25.4	36.4	20.8
Online self-service tools for conducting student-related business	0.9	1.7	8.7	1.4	4.6	29.5	38.7	14.5
Digital tools that keep a record of services used, advice given, or decisions made	2.0	22.3	28.3	0.9	6.1	21.1	15.3	4.0

To what extent do you agree with the following statement?

	Missing	N/A	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Use of mobile devices in face-to-face classes is distracting to me.	2.9	1.2	7.2	14.7	**28.3**	**34.1**	**11.6**
Use of mobile devices in face-to-face classes is distracting for other students.	3.2	1.7	3.5	11.6	**29.8**	**37.6**	**12.7**
Use of mobile devices in face-to-face classes is distracting for instructors.	2.6	1.4	2.6	8.7	**26.3**	**45.1**	**13.3**