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Motivation Factors for Using Mobile Information Systems in M-Learning

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by

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We hereby certify that this dissertation, submitted by Neelima Bhatnagar, conforms to acceptable standards and is fully adequate in scope and quality to fulfill the dissertation requirements for the degree of Doctor of Philosophy.

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Organizations of all types have benefited from the development and use of information systems. With the explosion of mobile applications, also known as mobile information systems, new uses are emerging. One such application of mobile information systems is mobile learning, referred to as m-learning hereafter. M-learning has found its ways in the corporate world for employee training and development, and in higher education for teaching and student learning. However, m-learning has not seen the same extent of usage as distance learning and e-learning, often attributed to technological limitations. Motivational factors, though, may also contribute to the slow adoption of m-learning. If the problems of m-learning usage are not well understood and addressed, then it is possible that usage will decrease and the opportunities inherent in m-learning may be missed. Extant literature includes numerous m-learning studies explicitly focused on student use and perceptions of m-learning. Faculty members, on the other hand, have not been the focus of many studies, despite the integral role that faculty motivation likely plays in the use of m-learning.

The primary goal of the study was to identify motivation factors that would explain the use of mobile information systems. The framework was developed by triangulating the disciplines of Human Computer Interaction and User Experience (HCI/UX), Information Systems, and M-learning. The influence of both intrinsic and extrinsic motivation factors on mobile information systems use (MISU) was tested. Intrinsic motivation factors assessed included perceived enjoyment (PE) and perceived playfulness (PP). One extrinsic motivator factor was assessed, perceived usefulness (PU). Additionally, the influence of personal innovativeness (PI) on PU, PE, and PP was also assessed. An online survey was administered to faculty teaching in the disciplines of computer science, information systems, and business at 60 institutions of higher education (both public and private) who are members of the Association of American Universities (AAU) in the United States. Data was collected using Qualtrics and analyzed using Structural Equation Modeling. The survey also contained questions to help understand how m-learning is being used for teaching, faculty member preparedness, why faculty are not using m-learning and what is impeding its use. A total of 379 faculty responses were analyzed. Results showed that PI does influence PU, PE, and PP. Only PU influences MISU, PE and PP do not. Users of m-learning are generally happy and use it for a variety of activities inside and outside the classroom. Non-users of m-learning provided a variety of reasons for its exclusion from their teaching. Research contributions, implications for future research, and recommendations are also discussed. The research has relevance for both educators and practitioners who use m-learning for workforce development.

Acknowledgements

I dedicate this dissertation in the loving memory of my father Dr. Rakesh Kumar Bhatnagar and my paternal grandfather Dr. Prabhu Lal Bhatnagar - two extraordinary mathematicians, scientists, researchers, educators, and human beings. They inspired me to follow in their footsteps of academia and the pursuit of a doctorate degree.

The dissertation marks the culmination and fulfillment of a lifelong dream, one which I thought would never happen. It has been a long journey in the making, over the course of eight years, while teaching full-time and changing campuses within the University along the way. The persistence and perseverance to seek the degree paid off in the end. It was only made possible with the support and guidance of several individuals.

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Chapter 1

Introduction

Background

The integration of mobile device usage into everyday life has led to innovative uses for mobile devices beyond essential communication. The latest figures show that the worldwide mobile-cellular telephone subscriptions in 2018 were over 8 million (https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx). By the end of 2017, the number of mobile-broadband subscriptions was expected to reach 4.3 billion worldwide (ICT Facts and Figures, 2017). In the United States, currently, 96% of Americans own cell phones (81% of these specifically own smartphones), 75% own a desktop or laptop computer, and 50% own an e-reader ("Mobile Fact Sheet," 2019). During the last few years, personally owned mobile devices also have been used extensively in the workplace. This idea has been termed "bring your own device" (or BYOD). According to one estimate, by 2015 the mobile workforce would have reached 1.3 billion (or 37.2% of the population) globally (Lac, Sukunesan, Cain, Vasa, & Mouzakis, 2014).

People are using mobile devices to access various types of applications as well as information systems (van der Heijden & Junglas, 2006). Hence it can be concluded that these information systems/applications are essentially mobile information systems. Mobile access of information was unheard of until a few years ago (Middleton,

Scheepers, & Tuunainen, 2014). Middleton et al. refer to the access of information using mobile devices as mobile information systems. However, the growing popularity of mobile devices has changed the landscape of how information is sought, business is conducted, or entertainment is delivered. Mobile information systems are becoming ubiquitous and an integral part of peoples' lives, the workplace, and society. Information technology/systems are designed and used by humans, yet in an organizational setting, rewards are only reaped if the systems are used by individuals (Shaikh & Karjaluoto, 2015).

One of the many benefits of using mobile devices in the workplace, as identified by Lac et al. (2014), is for training or employee learning. Other benefits include reduced costs, ability to provide training to many employees effortlessly and efficiently, and allowing employees to seek training anytime anywhere at their convenience (Kahle-Piasecki, Miao, & Ariss, 2012). Pappas (2017) stated m-learning improved knowledge retention and increased employee engagement. In 2014, the annual U.S. investment on workforce training and development amounted to $454 billion (Cappelli, 2014). Corporate training is a $130 billion annual business (Weiss, 2015). The combination of high mobile device ownership and a commitment to workforce training led innovative companies to develop "m-learning." M-learning mainly involves the use of mobile devices and wireless technologies (Pereira & Rodrigues, 2013) for training, learning, and teaching purposes (Sarrab, Elgamel, & Aldabbas, 2012) and this is the definition that was used in the context of this research study.

M-learning provides employees with "just-in-time" learning (Parsons, 2014). It is important to note that "employers are using mobile learning to deliver cost- and time-

effective training to employees dispersed across the globe" (Dabbagh et al., 2016, p. 18). In the corporate world, 67% of organizations offer some type of m-learning, and the m-learning market is expected to reach $37.6 billion by 2020 (https://elogiclearning.com/15-elearning-trends-and-statistics-to-know-for-2017/). Individuals with disabilities can also benefit from m-learning (Hashemi, Azizinezhad, Najafi, & Nesari, 2011). Surprisingly, Weiss (2015) reported that m-learning is prominent on weekends and during evenings until midnight.

Given the flexibility and accessibility of m-learning, the rates of usage are not as high as would be expected, particularly in higher education, as evidenced by the limited research focused on the success of m-learning, and more focused on its limitations or student perceptions for its use. Reasons cited for the lack of progress of m-learning include cost, security, and technical issues. Furthermore, the BYOD phenomenon is causing adaptability challenges. Despite these reasons, learning professionals are developing m-learning strategies to permanently solve the security and technical challenges (Morrison, 2013).

Even with increased use of m-learning for training and development, Pimmer and Pachler (2014), noted that research is lacking on how "…mobile devices can be used effectively for learning competence and development in the workplace…" (p. 193-194). Ferreira, Klein, Freitas, and Schlemmer (2013) also stated that academic research on business m-learning is limited because "…work-based mLearning, [is] a rather immature and emerging field of practice and research" (p. 194), wherein lies the need for additional research and knowledge. On the other hand, "mobile devices can provide opportunities to connect both learning for and at work in that they support learners in situ when those

learners apply abstract knowledge in order to tackle immediate work challenges" (Pimmer & Pachler, 2014, p. 196). Similarly, other authors have indicated that m-learning is an area where additional research is needed because it is a nascent application that requires further understanding (Ferreira et al., 2013; Pereira & Rodrigues, 2013; Pollara, 2011; Sanakulov & Karjaluoto, 2015), and a slowly growing and evolving discipline (Pereira & Rodrigues). M-learning's nasceny may be the reason as to why "...corporate businesses have not been at the forefront of adopting mobile learning" (Lac et al., 2014, p. 2). M-learning's penetration in higher education has been impeded by issues as discussed thus far, which is both surprising and intriguing.

Higher education has also seen a growth in the use of m-learning for teaching and student learning purposes. However, the growth has been slow primarily due to technological challenges as well as culture, motivation, and interface design. Although the impact of culture and interface design were included in the discussion, they were not within the scope of the proposed study which focused solely on motivation.

This type of mobile information system impacts both, students, and faculty members. At present, more research has been conducted looking at student use, while little is known about the reasons and motivations behind faculty members' use of m-learning – as well as their perceptions for the use of m-learning for teaching purposes (Henderson & Chapman, 2012). Some literature indicates that any person born after 1980 is a digital native whereas individuals born before 1980 are considered digital immigrants (O'Bannon & Thomas, 2014). Dee (2013) indicated that digital natives are those who were born between 1980 and the 2000s. Digital natives are individuals who have grown up with technology whereas digital immigrants are individuals who have learned to use it

later in life (Prensky, 2001). Thus, today's college students are digital natives and faculty members generally are digital immigrants. Because today's digital natives are exposed to technology at a much earlier age, Henderson and Chapman (2012) stated that "…engaging students in the classroom has become more and more difficult…" (p. 16). It can also be argued that once college students are exposed to m-learning, they will continue to expect to use it in the workplace. Even though today's students are tomorrow's workforce, understanding instructor motivations is crucial to the success of m-learning in higher education. O'Bannon and Thomas (2014) also made an interesting observation that "Prensky alleged that as this younger generation of educators replaces older teachers in the classroom, technology integration would no longer be an issue" (p. 15). Lumsden, Bryne-Davis, Mooney, and Sanders (2015) made a strong and compelling argument for m-learning. They stated that:

> Mobile devices have become commonplace for learning (and perhaps even the norm) in the classroom, higher education, and the workplace. Early evaluation data from such projects have revealed heterogeneity in the adoption and acceptance of these devices among users. Whilst many see the undoubted benefits, issues including digital literacy and the need to integrate new ways of learning can be a barrier to uptake. With the increasing availability of highly intuitive devices and a generation of learners that access, and indeed process, information in a completely different way than the generations that preceded them, the issue is not whether we adopt these new technologies but whether we make the most of the opportunities they provide. (p. 244)

In the corporate world, trainers would be responsible for making use of m-learning to deliver training to employees. These trainers could be students who used m-learning in college. Faculty members can be thought of as trainers in higher education. Other terms used for faculty members include teachers, educators, and instructors.

For this research study, the motivation to use m-learning was investigated in a higher education setting. Furthermore, the impact of both intrinsic and extrinsic

motivation factors such as perceived usefulness, perceived enjoyment, and perceived playfulness on m-learning usage was investigated. The motivation factors explained the reasons behind the use of m-learning specifically by those teaching students or training employees. Therefore, m-learning has usage implications in both the corporate world as well as in higher education, given that challenges, needs, and uses are similar.

The research study drew upon the Information Systems (IS), Human–Computer Interaction (HCI), and m-learning domains. Specifically, within HCI, user experience (UX) served as a foundation, and provided the framework, to understand the motivation for use as well as for the testing of the proposed theoretical model. The model (see Figure 1) tested the impact of independent variables on the dependent variable. Other domains that are discussed include culture, interface design, and motivation. Additionally, this research study attempted to identify and understand how m-learning is being used. A deeper discussion of the theoretical model and its implications on this research study can be found in Chapter 3.

Problem Statement

Benefits of using m-learning are evident both in corporations and higher education (Ally, Samaka, Ismail, & Impagliazzo, 2013; Eteokleous & Ktoridou, 2009; Gupta & Koo, 2010; Ozdamli, 2012; Sarrab, Al-Shihi & Rehman, 2013). In the corporate world, the number one reason cited for its success is flexibility (Dhruve, 2018; Williams, 2018). Other reasons cited for its popularity for employee training include engagement, collaboration, gamification, microlearning, just-in-time learning, integrated learning paths, and the millennial generation (Dhruve, Williams). As Ally et al. mentioned, organizations can benefit in many ways when employees use m-learning in the

workplace. These include accessing training as well as location-specific access to current information on an as-needed basis.

However, the integration of mobile devices for the use of m-learning in higher education has been challenging for a variety of reasons. Among the reasons for the difficulty in intgegrating m-learning is the inability to remove the existing barriers (Deegan & Rothwell, 2010) and limitations. Other reasons include a lack of understanding of the uses of m-learning (Alrasheedi & Capretz, 2013b; Cruz, Assar, & Boughzala, 2012a; Eteokleous & Ktoridou, 2009) and a lack of understanding of the pedagogical purposes (Pollara, 2011). There is little research on why some individuals are using m-learning while others are not, and their motivation behind its use. Crompton and Burke (2018) provide evidence that despite the benefits of using m-learning for student learning, knowledge is still lacking on how to use mobile technology in higher education. Sanderson and Hanbidge (2017) had also argued that "while extensive m-learning has been completed, there has been limited research about educators and m-learning in higher education settings" (p. 148). Krull and Duart (2017) reported that 78% of studies were focused on students, 10% on faculty, and 12% on both faculty and students. Additionally, Crompton and Burke (2018) stated that "although undergraduate students make up the largest percentage of higher education students, it would be pertinent to conduct more in-depth studies on graduate students and on faculty members using mobile devices in their classrooms" (p. 62).

Despite the technological limitations of mobile devices, benefits derived from m-learning have also been identified. According to Gupta and Koo (2010) "…m-learning can be used as an effective tool to support classroom material, introduce new ways of

learning, and help enhance study skills" (p. 76). "However, technology alone, regardless of its ubiquity and utility, will not determine whether mobile learning benefits large numbers of people" (Conejar, Chung, & Kim, 2015, p. 1). According to Ktoridou and Eteokleous (2005) the integration of m-learning for educational purposes can be done in two ways: as a "supportive" and/or "instructional" tool. As a supportive tool, m-learning allows for communication between faculty members and students through file sharing, on-line discussions, etc. Sinen (2015) identified the benefits of m-learning to include: extending learning beyond the classroom wall; support for situated, collaborative and personalized learning; and improved interactions. Like other findings, Sinen also noted some of the same concerns and limitations of m-learning, namely the small size of devices; variability and accessibility of devices; social, cultural, and organizational factors; advancement and decreasing cost of technology; faculty and student readiness, and the need for professional development for faculty members.

It has already been established that m-learning is relatively new (Ferreira et al., 2013; Pollara, 2011) and is being used by only a handful of educators (Cruz, Boughzala, & Assar, 2012b). Many challenges need to be overcome even though educational benefits abound (Ferreira et al.) and students are "…looking for more interactivity and more dynamic teaching…" (Handal, MacNish, & Petocz, 2013, p. 362).

The central research question that emerged was to determine how to effectively use mobile devices in the context of mobile information system applications such as m-learning. Cruz et al. (2012a) attempted to answer a similar question in their research in the context of education: "how to effectively and successfully use mobile learning in higher education" (p. 2). Exploring how to integrate m-learning effectively (Crow,

Santos, LeBaron, McFadden, & Osborne, 2010; Lam, Yau, & Cheung, 2010) is an important issue that lacks understanding (Eteokleous & Ktoridou, 2009) and is a major barrier for its use. It is not enough to look only at how mobile devices can be integrated. Pollara (2011) also expressed the need to determine their current and actual use (not just "potential use" by educators), m-learning implementation best practices, and "…the type of learning that is best supported by mobile learning" (p. 19). In addition, the pedagogical uses need to be fleshed out (Crow et al.). M-learning use is expanding (Ferreira et al., 2013) despite the lack of understanding. According to Lam et al. understanding how "…educators make use of these technologies in education has become a critical issue" (p. 312). The need identified by Lam et al. must be coupled with 'why it is being used' given all the criticism of m-learning and the extensive evidence of its limitations and challenges. M-learning use by educators may be challenging because educators view m-learning as "…more of a distraction to learning than a tool for learning" (Deegan & Rothwell, 2010, p. 16). Sinen (2015) conducted a meta-analysis of the literature published between 2008 and 2013 seeking answers about the definition of m-learning, along with benefits, limitations, issues, and concerns. Based on his findings, he categorized m-learning into three areas: mobility of technology, mobility of learners, and mobility of learning.

Henderson and Chapman (2012) surveyed 642 business educators to identify their perceptions about the use of mobile phones in the classroom and how these could be used for teaching and learning. They found that 46% of the respondents had used a mobile device for educational purposes. They also found that associate professors were more accepting of the use of mobile devices compared to instructors. The devices were used to

communicate with students through social media (Facebook), to encourage students to work in virtual teams, and to provide continuous learning opportunities for students outside the class. However, they also found some of the same concerns that have been elaborated in this chapter, such as distractions in the classroom. Their recommendation for future research included focusing on disciplines, age, gender, teaching experience, and educational institutions – arguing that these could be replicated not only for other disciplines, but also in other professional organizations. They also suggested the need to identify m-learning strategies.

Schwab, Nagara, and Buse (2015) "…aimed to explore the faculty members' attitudes and educational practices of Mobile Learning in a higher education context" (p. 1620) because "…the current literature shows few studies have investigated faculty's perspectives and educational practices about how they integrate mobile technology in higher education context" (p. 1621-1622).

Al-Emran, Elsherif, and Shaalan (2016) researched both student and educator attitudes towards the use of m-learning at institutions of higher education in Oman and the UAE, in the Arab Gulf Region. From the educator perspective, they examined whether gender, academic rank and experience, country, and smartphone ownership had any impact on usage. Their findings showed no statistical significance or differences of these variables on attitudes towards intention to use m-learning.

The proposed study drew upon the IS, HCI, and m-learning domains. Specifically, within HCI, UX literature served as the frame of reference for this study of motivation factors leading to the testing of the proposed theoretical model. Culture and interface

design are also discussed, along with motivation. The research study also identified the reasons for why and how m-learning is being used.

The study contributed by expanding the body of literature because scholarly research is very limited or nonexistent on attempting to identify and understand answers to questions raised about the use of m-learning. Many questions arise that must be answered, such as: how can m-learning be used as an innovative teaching tool and what learning theories and/or pedagogical framework are best suited for m-learning? Additionally, some attempts have been made to answer questions about how educators view m-learning adoption and what factors are driving m-learning adoption. Other important questions include: What are the uses for m-learning? What is the purpose of m-learning? How and why are faculty using m-learning? What does m-learning bring to the experience of learning for students? Hence, this study allowed for a better understanding of m-learning for instructional purposes (be it in the corporate world for training and development or in higher education for teaching and student learning), identified the characteristics of m-learning users, and determined the pedagogical uses of m-learning. It also helped to identify, more specifically, the type of professional development and training necessary to make m-learning mainstream in higher education. Similarly, organizations looking to use m-learning for the training and development of their employees may also benefit from the results of this study.

Dissertation Goal

The purpose of this research study was to empirically investigate the impact of three independent motivation factors -- Perceived Usefulness (PU), Perceived Enjoyment (PE), and Perceived Playfulness (PP) on the dependent variable Mobile Information Systems Use (MISU). Similarly, the influence of Personal Innovativeness (PI) upon the three independent variables was also investigated (see Figure 1). As such, PU, PE, and PP are the motivation factors that were studied for the use of mobile information systems, more specifically, m-learning, by faculty members teaching in the disciplines of Business, Computer Science, and Information Systems. PE and PP are intrinsic motivation factors, whereas PU is an extrinsic motivation factor. Additionally, the study sought answers to vital questions brought forth in the literature about how mobile devices can be and are being used for m-learning, rather than acceptance or intention to use, or the adoption of m-learning. The focus of the study was on current and actual use rather than potential use. This study informed organizations of all types and sizes whether individuals will use m-learning and how to leverage m-learning for the future workforce. The contributions of the proposed research endeavor were to:

(1) Expand the body of knowledge related to the motivation factors leading to m-learning use by drawing upon the domains of HCI and UX, IS, and m-learning.

(2) Test the proposed theoretical model to determine the motivation factors for use (or non-use) of m-learning to gain a better understanding of the proposed research study.

(3) Identify m-learning best practices for use in any organizational setting.

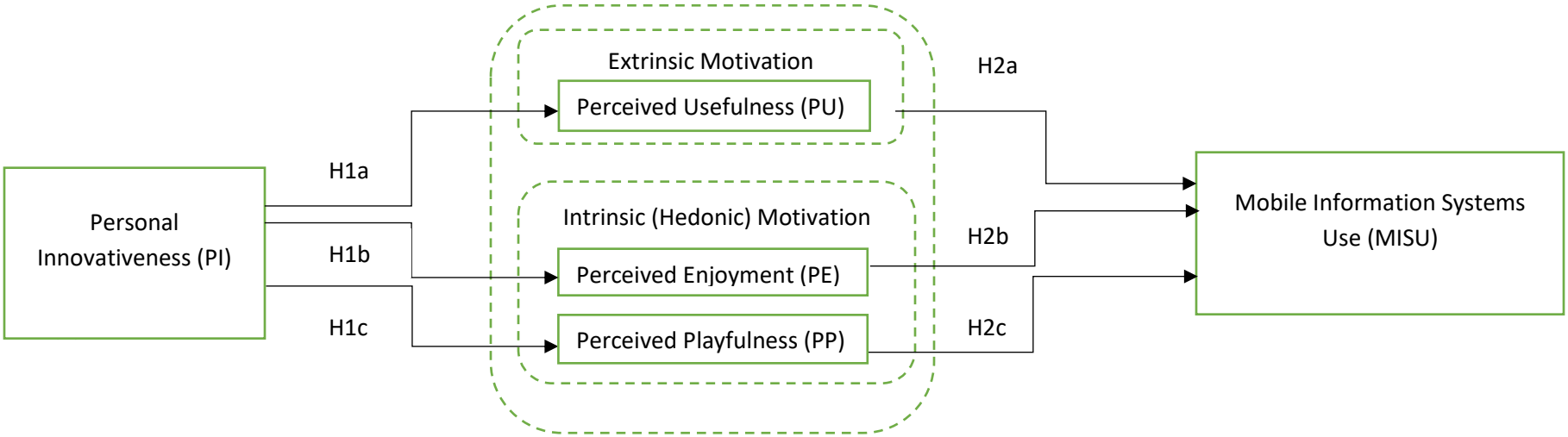

Figure 1. Proposed Theoretical Model (adapted from Hwang, 2014)

Research Questions

The following research questions (RQs) emerged from the current state of m-learning research:

RQ1: What are the motivating factors driving m-learning use?

RQ2. How is m-learning being used for teaching, learning, and training?

Additionally, the survey instrument also revealed reasons for m-learning non-usage and helped answer the following questions:

RQ3. Why are only a few educators using m-learning?

RQ3a. What are the factors impeding m-learning use?

The constructs, related to motivation, were utilized to develop a survey instrument that attempted to identify the motivation factors that were most relevant to m-learning usage. Additionally, the survey also attempted to determine the impact of participants' personal innovativeness on the independent variables. The personal innovativeness construct is further discussed in Chapter 2. Questions to help answer precisely how m-learning is being used for teaching, learning, and training were also included. The survey instrument can be found in Appendix A.

Relevance and Significance

Akour (2009) posited that "users' perceptions of mobile learning can influence acceptance, use, and ultimately the success of mobile learning" (p. 13). According to Rola (2002) (as cited in Percival & Claydon, 2015):

> There are an increasing number of universities and colleges implementing mobile learning initiatives in the form of requiring students to have laptops for learning. These initiatives are motivated by increased market demands for graduates who are technologically literate, and have strong competencies using computers. (p. 250)

Despite these obvious and compelling reasons, m-learning is having a hard time finding its place in higher education and the corporate world. The integration of m-learning continues to be a complicated process. Research on m-learning continues to wrestle with the same issues time-and-time again and has failed to show how this emerging phenomenon can be integrated into higher education successfully – as posited by Cruz et al. (2012a). Rapid advancements in technology are a "major challenge" in research (Pollara, 2011). Despite the rise in ownership and use of mobile devices, the use of these devices for educational purposes, particularly in higher education is not prevalent (Hosler, 2013). It is going to require much work before people use mobile devices for teaching and learning (Ferreira et al.). For now, it seems that disadvantages outweigh advantages.

As has already been noted significant barriers, issues, challenges, and limitations continue to plague the use of m-learning in higher education as well as the corporate world. Preconceived notions and ideas, along with hesitations about m-learning's potential must be remedied. Much of the research in this field has presented the negatives of m-learning or focused on the learners. The most often cited limitation is the physical limitations of mobile devices along with psychological and pedagogical limitations (Cheon, Lee, Crooks, & Song, 2012). Overcoming these challenges is critical to the future success of m-learning to reap the benefits it affords. As Ferreira et al. (2013) stated "…questions about how to promote the acceptance of m-learning by users are still largely unresolved" (p. 62). Rather than continuing to report on why students and faculty members alike have not fully embraced m-learning, more research needs to be conducted to determine and understand why and how mobile devices are being used for teaching

and student learning by some educators. A focus on the positives of m-learning is very much needed.

It is important to recognize that not all students and faculty members own mobile devices conducive to m-learning or know how to use them (Handal et al., 2013). Furthermore, Cruz et al. (2012b) posited that "the availability of mobile technology per se does not guarantee that its potential will be realized" (p.59). Nor does the use of technology guarantee "educational innovation" (Ferreira et al., 2013). According to Corbeil and Valdes-Corbeil (2007) "frequent use of mobile devices does not mean that students or instructors are ready for mobile learning and teaching" (p. 51). It also holds true and applies to employees in an organization.

According to Sarrab, et al. (2012) m-learning augments traditional learning and is not a substitute for it. However, it must also be noted that not all disciplines lend themselves to the use of m-learning (Fong, 2013; Sarrab et al., 2013). Two examples include teaching students programming or SQL (Fong). Perhaps this is also the reason it has been challenging to implement m-learning in disciplines such as Information Technology (IT), Computer Science, Business, and Education (Corbeil & Corbeil, 2011). Krull and Duart (2017) reported that a total of 26 studies in Computer Science and 12 studies in Business had been conducted.

Barriers and Issues

Possible Difficulties in Conducting the Research

The proposed research study was difficult to conduct for the following reasons:

(1) It required identifying and choosing the motivation factors that were most relevant to understanding the use of m-learning that would provide answers to the research questions.

(2) It required bridging the gap in the literature by integrating the HCI, IS, and m-learning domains.

(3) It required the development of a proposed theoretical model.

(4) It required the administration of a well-defined survey instrument to capture the necessary information to answer the research questions.

(5) It required a sufficient number of participants.

(6) It required the use of formal statistical methods to analyze the data and interpret the results.

Technological limitations

M-learning has not seen the same kind of usage as distance learning and e-learning primarily due to technological limitations. Mobile devices were not created to be used for educational purposes (Ivanc, Vasiu, & Onita, 2012). Table 1 summarizes the various categories of limitations that have emerged from a review of the literature.

Table 1

Limitations of m-learning

Category	Limitations	Author (s)
Hardware	Small screen size, inadequate memory, size of the device, battery life, storage capacity, limited processor performance, audio quality, weight, manufacturer, low screen resolution, limited text display, no common hardware platform	Cheon et al. (2012); Eteokleous & Ktoridou, (2009); Fong (2013); Fuegen (2012); Gupta & Koo, (2010); Ivanc et al. (2012); Jacob & Isaac, (2008); Orr (2010); Stanton & Ophoff (2013)
Software	Mobile platforms (iOS, Android, etc.), no standard software platform	Sarrab et al. (2012)
Communication	Slow network speed, limited bandwidth reliability and capacity, security, quality of the connection, Internet accessibility, network connectivity, privacy, poor wireless connectivity	Alrasheedi et al. (2013b); Cheon et al., (2012); Eteokleous & Ktoridou, (2009); Fong (2013); Fuegen (2012); Gupta & Koo, (2010); Handal et al. (2013); Ivanc et al., (2012); Orr (2010); Stanton & Ophoff (2013)
Usability	Types of user interfaces	Deegan and Rothwell (2012); Sarrab et al. (2012)
Other	Lack of standardization and comparability, technical and design obstacles, slow text input, compatibility issues, lack of data import capability, mobility issues, inconsistent platforms, physical environmental conditions	Cheon et al., (2012); Eteokleous & Ktoridou, (2009); Fuegen (2012); Ivanc et al., (2012); Orr (2010)

The issue of small screen sizes is somewhat irrelevant with the inception of tablet PCs which combine features of both smartphones and laptops (Pollara, 2011). Handal et al. (2013) argued that many of the limitations are more myth than reality but these have been presented as potential drawbacks. These drawbacks include faculty members'

concerns about superficial learning, decreased faculty member–student communication, distraction in class, and cheating on exams. Sarrab et al. (2013) also stated the concern regarding cheating on exams. Pollara argued that class distractions and cheating could be dealt with appropriately by teaching students about mobile etiquette. Mobile etiquette entails teaching students "…how to appropriately use and navigate the mobile world within an educational context" (p. 37). According to Pollara, this is an area of research that needs to be investigated further but was not within the scope of the proposed research. It is also common for faculty members to ban the use of mobile devices in the classroom (Frazier, 2013; Pollara) to prevent inappropriate use (Frazier). Additionally, Abu-Al-Aish, Love, Hunaiti, and Al-masaeed, (2013) also mention that technical limitation, a lack of awareness and motivation, and internet connectivity are hindering m-learning use, as is resistance to change and institutional challenges. Henderson and Chapman (2012) cited a study in which it was stated that "…85% of college professors agreed that mobile phones should be banned from the classroom" (p. 18). Table 2 presents a summary of other issues, challenges, concerns, and limitations that have appeared in the literature.

Table 2

Summary of m-learning Issues

Issue/Challenge/Concern/Limitation	Author (s)
Lack of awareness and motivation	Abu-Al-Aish et al. (2013); Ishtaiwa, Khaled, & Dukmak (2015)
Internet connectivity	Abu-Al-Aish et al. (2013); Ishtaiwa et al. (2015)
Institutional challenges, investments	Abu-Al-Aish et al. (2013); Alrasheedi & Capretz (2013b)
Need for training and professional development	Abu-Al-Aish et al. (2013); Corbeil & Corbeil (2011); Crow et al. (2010); Eteokleous & Ktoridou (2009); Ishtaiwa et al. (2015); Ktordiou, Gregoriou, & Eteokleous ((2007)
Slow adoption	Alrasheedi &Capretz (2013b); Corbeil & Corbeil (2011)
Lack of understanding/knowledge/skills (of factors driving ml adoption)	Alrasheedi & Capretz (2013b); Cruz et al. (2012b); Eteokleous & Ktoridou (2009); Ishtaiwa et al. (2015); Ktordiou et al. ((2007)
Limitations of technology	Alrasheedi & Capretz (2013b)
Security and privacy	Alrasheedi & Capretz (2013b)
Uncomfortable with technology	Alrasheedi & Capretz (2013b)
Ban use of mobile devices	Conejar et al. (2015); Henderson & Chapman (2012)
Technological	Corbeil & Corbeil (2011)
Tech support	Crow et al. (2010)
Institutional support	Eteokleous & Ktoridou (2009)

Faculty Member Barriers

According to Crow et al. (2010), "…instructors may feel threatened by new forms of communication fearing their students' allegedly superior technological competence…" (p. 269). Another limitation (or barrier) cited by Hall (2012) is faculty resistance to change. Anxiety plays an important role in determining resistance to change (Mac Callum, Jeffrey, & Kinshuk, 2014). Faculty members may feel uneasy using the technology or have a lack of understanding of how to use m-learning (Alrasheedi et al., 2013b). As stated by Ferreira et al. (2013) "if m-learning practices are not seen as compatible with current teaching methods, leading professors resist its use, a great barrier to adoption might form" (p. 61). It will lead to instructors resisting its use. Fuegen (2012) identified faculty member concerns to include attitude, anxiety, self-efficacy, risk aversion, time commitments, competency with computers, and relevance of technology to pedagogy. Numerous research studies have cited the need for faculty member professional development and training (Corbeil & Corbeil, 2011; Crow et al.,010; Eteokleous & Ktoridou, 2009; Shim & Shim, 2000-2001). Additionally, the lack of technical infrastructures is another major challenge hindering m-learning use (Corbeil & Corbeil). Other concerns include "…adequacy of student support, privacy rights, and the protection of intellectual property for students and instructors alike" (Crow et al., 2010, p. 273).

As Ferreira et al. (2013) stated, the focus of m-learning should not be on the technology but on the fact that it affords mobility in learning. Therefore, research conducted must move beyond the technical limitations of mobile devices (Ting, 2012) and focus on whether their integration in learning activities is worthwhile. M-learning has

potential to increase the "…interaction and collaboration among students and teachers" (Lam et al., 2010, p. 306).

According to Pollara (2011), more research is needed "…in order to not only create a strong foundation for the field, but to be able to keep up with advancements in technology and increased personal ownership, both of which enhance the potential for educational use" (p. 36). As Ferreira et al. (2013) accurately stated, by identifying, understanding, and determining the factors driving m-learning use, "…m-learning's acceptance and impact on higher education practices could be more profound than first thought" (p. 62). On the other hand, if the problems associated with m-learning are not understood and addressed, then it is possible that m-learning usage will decrease and may lead to failure (Cruz et al., 2012a).

Assumptions, Limitations, and Delimitations

Assumptions

It was assumed that the constructs of PI, PU, PE, and PP, and the items within each construct, were the best to determine MISU, specifically m-learning. It was also assumed that the survey would help identify the reasons for how and why educators are using m-learning, or not.

Limitations and Delimitations

One limitation of this study was that the survey was sent to educators teaching only in the areas of Business, Information Systems, and Computer Science. Secondly, it was not possible to survey participants at all institution of higher education in the United States. Instead, a subset of schools was targeted that are closely aligned with the researcher's institution. Therefore, the limitations and delimitations did impact the

internal validity and generalizability of the results because a convenience sample was used.

Cheung and Hew (2009) reported that "a general problem of studies based on self-reported data is that participants usually have correct notions about socially desirable answers, which can be referred to as the tendency to provide answers that cause respondents to look good…" (p. 168). Because survey instruments utilize Likert scales, this can cause "…the respondent to choose the option that looks coherent with society's view or an ideal belief rather than letting the respondent express his or her own belief" (Handal et al., 2013, p. 363). To deal with self-reporting bias is to assure the participants' anonymity, and confidentiality, which may encourage honesty (https://www.encyclopedia.com/social-sciences/applied-and-social-sciences-magazines/self-report-method).

Definition of Terms

Extrinsic Motivation – "…the performance of an activity because it is perceived to be instrumental in achieving valued outcomes that are distinct from the activity itself…" (Davis, Bagozzi, & Warshaw, 1992, p. 1112)

Hedonic Motivation – "…the fun or pleasure derived from using a technology…" (Venkatesh, Thong, & Xu, 2012, p. 161).

Human - "…the unit of analysis or a participant, which includes users, netizens, members, students, faculty members, consumers, customer, employees, workers, managers, executives, and so forth." (Shaikh & Karjaluoto, 2015, p. 542)

Human–Computer Interaction (HCI) - "…the study of the way in which computer technology influences human work and activities" (Dix, 2009, p. 1327).

Information Technology/Systems – "… a set of systems, technologies, processes, business applications, and software." (Shaikh & Karjaluoto, 2015, p. 542)

Innovativeness – "…the degree to which an individual (or other unit of adoption) is relatively earlier in adopting new ideas than other members of a system…" (Rogers, 2003, p. 267).

Intrinsic Motivation - "…the performance of an activity for no apparent reinforcement other than the process of performing the activity per se…" (Davis et al., 1992, p. 1112).

Mobile Information Systems Use (MISU) – involves the use of mobile devices to use an information system to "…carry out tasks and activities on the job for which the information system is designed to support" (Sun & Teng, 2012).

Perceived Enjoyment (PE) – "…refers to the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated…" (Davis et al., 1992, p. 1113).

Personal Innovativeness (PI) - "The willingness of an individual to try out any new information technology" (Agarwal & Prasad, 1998, p. 206).

Perceived Playfulness (PP) – "the extent to which the individual finds the interaction intrinsically enjoyable or interesting" (Moon & Kim, 2001, p. 219)

Perceived Usefulness (PU) - "The degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320).

Summary

A major gap exists in the literature from the faculty member (or educator) and trainer perspective. The same questions appear repeatedly regarding what is needed to make m-learning successful: the need to identify the motivational factors and to better

understand the perceptions and use by educators (Cruz et al., 2012a). “However, there is no research to understand teachers’ perceptions of ML use in higher education” (Cruz et al., 2012a, p. 6). Research on faculty perceptions is an area where research is lacking, hence the need for the proposed research study. Many studies such as the one conducted by Ozdogan, Basoglu, and Ercetin (2012) did not consider actual use, only the attitude toward m-learning. Furthermore, as noted earlier, the development of guidelines and policies (Sarrab et al., 2013) is also necessary. There is also a need to give faculty members time to learn and explore how best to integrate m-learning (Handal et al., 2013). What faculty members need is more information about the integration of m-learning that will improve student learning (Fong, 2013).

Because understanding faculty members’ use of m-learning is essential for its integration (and has significant implications) in higher education, the proposed research addressed m-learning use in higher education from the faculty member perspective. More specifically the proposed study attempted to discover why faculty members are using m-learning despite all the barriers and limitations that exist. What is their reasoning, motivation, and rationale to do so? By answering these types of questions, research identified how faculty members in higher education should integrate m-learning. It also bridged a significant gap that exists in the m-learning usage literature.

From this research study, a theoretical model was tested. It included three independent variables: PE, PP, and PU and one dependent variable, MISU. Additionally, the impact of PI on the three independent variables was also tested. It helped in identifying the motivational factors that are driving m-learning use to answer the questions posed earlier. The research allowed for a better understanding of faculty

member use, identified the characteristics of users, determined the pedagogical uses of m-learning, and identified the type of professional development and training necessary to make m-learning mainstream in higher education. By seeking answers to these central issues, the proposed research filled the void that currently exists in the literature. It will lead to the development of best practices and allow institutions to formulate appropriate avenues for professional development and training for faculty members and technical support. Findings from this research will help promote the use of m-learning in higher education as well in other types of organizations for training and development purposes.

Chapter 2

Literature Review

Introduction

The literature review briefly discusses the three main bodies of research that provided the foundation for the proposed study. In the first section, m-learning is discussed regarding its origins and definition. The second section discusses HCI and UX, Motivation, Culture, and Interface Design. The third, and final section on Information Systems adoption provides further support for the motivation factors of m-learning.

M-Learning

While Lam et al. (2010) claimed that m-learning got its start during the 1970s and proliferated through much of the 2000s, Traxler (2013) posited that research on m-learning started around 2003. Pereira and Rodrigues (2013) viewed m-learning as an "emergent field." Devices used for m-learning include cell phones, smartphones, laptops, pocket PCs, PC tablets, palmtops, and personal media players (Gupta & Koo, 2010; Park, 2011; Sarrab et al., 2012). According to Ferreira et al. (2013) "…as a relatively new phenomenon, the understanding of what exactly is m-learning is still unclear" (p. 49). Therefore, to-date there is no agreed-upon definition for m-learning in academia or industry (Ferreira et al.). Various authors (Cheon et al. 2012; Fong, 2013; Lam et al.; Pereira & Rodrigues; Sarrab et al.) have attempted to define m-learning. Table 3 provides

a sample representation of the various attempts to define m-learning. Essentially, m-learning involves the use of mobile devices and wireless technologies (Pereira & Rodrigues) for training, learning, and teaching purposes (Sarrab et al.). This is the definition that was used in the context of this study.

Table 3

Definition of M-learning

Definition	Author(s)
"Mobile learning or m-Learning is a learning platform that provides learners 'anytime-anywhere access to educational and university resources" (p. 1).	Alrasheedi & Capretz (2013a)
"…learning with the aid of a mobile device" (p. 16.)	Deegan & Rothwell (2010)
"Mobile learning is defined as the method in which materials are delivered using mobile technology, such as mobile devices and wireless networks" (p. 302).	Fong (2013)
"Mobile learning is defined as using mobile devices such as cell phones, laptops, pocket PCs, PC tablets, PDS and other handheld device in conjunction with wireless Internet network to enable multimedia communication using text, voice, video, and graphics data" (p. 78).	Gupta & Koo (2010)
"Mobile learning refers to the use of mobile or wireless devices for the purpose of learning while on the move" (p. 79).	Park (2011)
"Mobile learning (m-learning) is an extension of distance education, supported by mobile devices equipped with wireless technologies" (p. 27).	Pereira & Rodrigues (2013)
"The term mobile learning or in short M-Learning refers to the use of mobile and handheld IT devices, such as mobile telephones, laptops, PDAs and tablet PC technologies, in training, learning, and teaching" (p. 31).	Sarrab et al. (2012)

Definition	Author(s)
"Mobile learning is the combination of mobile technology and its affordances that create a unique learning environment and opportunities that can span across time and place" (p. 501).	Stanton & Ophoff (2013)

The findings regarding the origins of m-learning are somewhat contradictory. Georgiev, Georgieva, and Smrikarov (2004) proposed that m-learning is a subset of e-learning (i.e., electronic learning) which in turn is a subset of d-learning or distance learning (Figure 2).

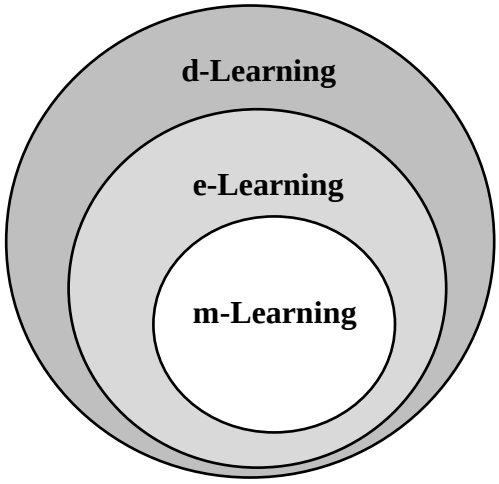

Figure 2. E-learning framework (Georgiev et al., 2004).

Cruz et al., (2012b) took it a step further indicating that distance learning is a subset of flexible learning. Tick (2006), on the other hand, posited that distance learning was changing into e-learning due to innovations in Information and Communication Technologies (ICTs), but the author also mentioned that e-learning is not always d-learning. As can be seen in Figure 3, m-learning is a subset of the intersection of d-learning and e-learning (Tick), implying that it combines elements of both.

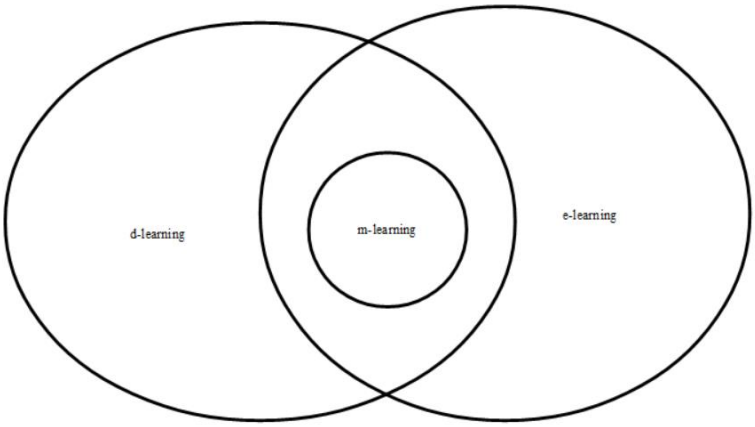

Figure 3. The interrelation of e-learning and m-learning (Tick, 2006)

Low and O'Connell (2006) viewed m-learning as a combination of e-learning and flexible learning (Figure 4) and defined flexible learning as the "'just enough, just in time, just for me'" type of learning.

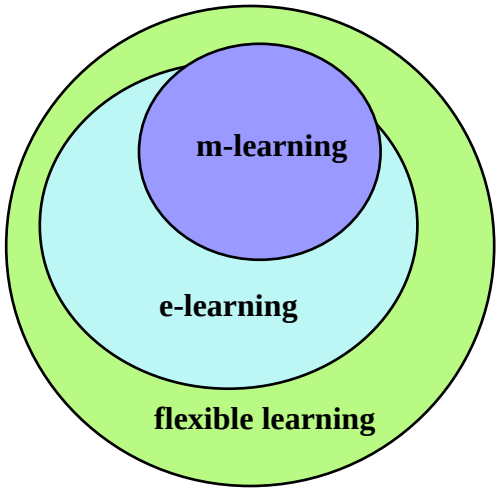

Figure 4. M-learning framework (Low & O'Connell, 2006).

Eteokleous and Ktoridou (2009) referred to m-learning as a successor of e-learning. They defined e-learning as learning that takes place with the use of digital electronic tools and media. Finally, m-learning is viewed as an extension of distance education (Pereira & Rodrigues, 2013) providing anytime, anywhere access to materials

(Alrasheedi & Capretz, 2013a; Fong, 2013; Stanton & Ophoff, 2013) using mobile devices while on-the-go (Gupta & Koo, 2010; Lam et al., 2010; Park, 2011). Pereira and Rodrigues (2013) provided their interpretation of the evolution of the various learning models over the years (Figure 5).

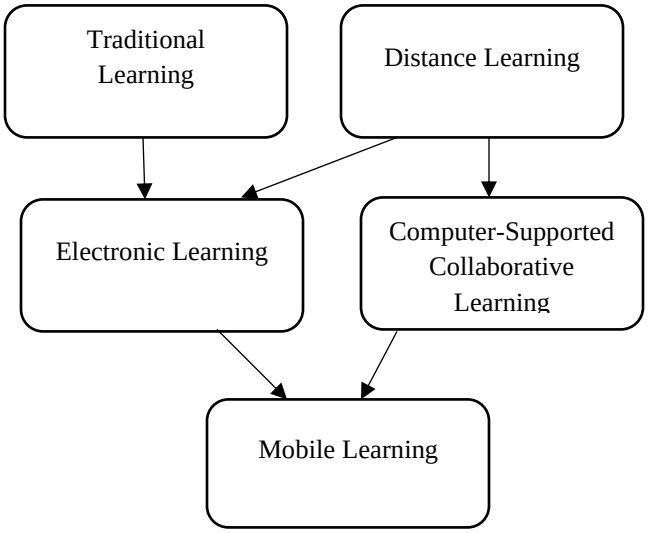

Figure 5. Illustration of the evolution of the learning models (Pereira & Rodrigues, 2013).

According to Sarrab et al., (2012) the first two waves of learning occurred with the use of mainframes and desktop computers and now m-learning is the third wave of learning. Ferreira et al. (2013) listed m-learning practices to include: discussion forums, video classes, quiz, podcasting, mobile virtual worlds, mobile LMS, mobile games, mobile social networks, contextual learning, and short text message (SMS) (Figure 6).

Figure 6. M-Learning Practices (Ferreira et al., 2013).

Human–Computer Interaction (HCI) and User Experience (UX)

The literature on HCI and UX helped to frame the discussion of motivational factors in m-learning use. HCI is often described in terms of waves. The first wave focused primarily on the usability of desktop computers (Bødker, 2006). According to Roto and Lund (2013), the first wave "…investigated human capabilities in computer use, focusing on cognitive psychology and ergonomics" (p. 2521-2522). Harrison, Tatar, and Sengers (2007) described first wave HCI as "…an amalgam of engineering and human factors" (p. 4). They go on to state that "the goal in this paradigm, then, is to optimize the fit between humans and machines; the questions to be answered focus on identifying problems in coupling and developing pragmatic solutions to them" (p. 4). The second wave focused on interactions of humans with computers and applications (Bødker, 2006). According to Roto and Lund, "the second wave brought in the idea of the user as an active individual that controls the system, and the focus shifted to ease of use and user-friendliness" (p. 2522). First and second wave HCI "…methods tend to require problems to be formalized and expressed in terms of tasks, goals, and

efficiency." (Harrison et al., 2007, p. 6). Both waves were task-oriented whereas the third wave is interaction oriented (Harrison et al.). The third wave of HCI is characterized to include culture, emotion, and experience (Bødker, 2006).

UX is characterized as "… a person's perceptions and responses that result from the use and/or anticipated use of a product, system or service…" (Vermeeren et al., 2010, p. 521). UX is about feelings in using a product (Vermeeren et al.). UX originated from the field of HCI (Law, van Schaik, & Roto, 2014). UX consists of three characteristics: user involvement, user interaction with anything consisting of a user interface, and user experience which "…is of interest, and observable or measurable" (Albert & Tullis, 2013, p. 4).

According to Mäkelä and Fulton Suri (2001) (as cited in Vermeeren et al., 2010), "a user's motivation and expectations play a larger role in UX than in traditional usability" (p. 522). Kim, Kim, and Wachter (2013) mentioned that engaging in technology only occurs after acceptance of the technology. Furthermore, Kim et al. specified that "technology acceptance and technology engagement conceptually overlap, but they are different in terms of definition, conceptual foundation, and application" (p. 361).

Motivation

According to Barker, Krull, and Mallinson (2005), "motivation implies the extent to which the m-learning environment motivates learners to engage with their learning and encourages teachers to develop innovative ways of using the devices to complement traditional teaching methods" (p. 8). Kim et al. (2013) discussed that "studying users' motivation to engage in activities using mobile technology can provide insight to further

explain their continuing engagement behavior" (p. 362). Pagani and Mirabello (2011), explained that being engaged implies "…being involved, occupied, retained, and intrinsically interested in something…" (p. 44). In the context of the study conducted by Kim et al. engagement motivation dealt with people's "…motivation to engage in activities using their smartphones" (p. 363).

Motivation can be grouped into three categories: functional (e.g., efficiency, ease of use, saving time), hedonic (e.g., fun, enjoyment, pleasure), and social (e.g., desire to connect and share with others) (Kim et al., 2013). In information systems research hedonic motivation is conceptualized as perceived enjoyment, which has a direct influence on technology acceptance and use directly (Venkatesh et al., 2012). "Enjoyment refers to the extent to which the activity of using a computer system is perceived to be personally enjoyable in its own right, apart from any performance consequences that may be anticipated…" (Davis et al., 1992, p. 1113). Motivation is also characterized as either intrinsic or extrinsic motivation. Enjoyment, as well as perceived enjoyment, (Cheng, 2014; Hwang, 2005) and playfulness (Wakefield & Whitten, 2006) are intrinsic motivation, whereas perceived usefulness is extrinsic motivation (Hwang). Based on the definition of intrinsic motivation provided by Vallerand et al., (1992), it is the same as hedonic motivation. This research study attempted to understand and investigate both intrinsic and extrinsic motivational factors for using mobile information systems, specifically m-learning.

Culture

Culture usually is interpreted as and thought to be "…a group of people of who have certain aspects of life in common" (Jhangiani & Smith-Jackson, 2007, p. 513). As stated by Jhangiani and Smith-Jackson, "in the definition of culture, groups or categories of people refers to people that are in contact with each other or that have something in common (e.g., nationality, gender, religion, ethnicity)" (p. 513). However, Hofstede (1997) (as cited in Jhangiani & Smith-Jackson) defined culture as "the collective programming of the mind which distinguishes the members of one group or category of people from another" (p. 513). As such, Hofstede's focus was on national cultures with the following dimensions: power distance, individualism vs. collectivism, femininity vs. masculinity, uncertainty avoidance, and long-term orientation (Jhangiani & Smith-Jackson, 2007).

Culture plays a crucial role in technology usage because "…culture has a fundamental effect on how users interpret a system's interface and features…" (Choi, Lee, & Kim; 2006, p. 171-172). Salgado, Pereira, and Gasparini (2015) stated that "culture strongly influences people's values, expectations, behavior, and even perceptions and cognitive reasoning" (p. 60) as such "…culture plays a key role in interactions between human and computer…" (p. 175). This is an important reminder of the fact that "…user-experience elements appropriate for one culture may not be appropriate for others, and it is necessary to localize user-interface designs for different cultural groups…" (p. 172).

Interface Design

Within HCI, interface design (also called interaction design or user-centered design), focuses on "…how to design computer technology so that it is as easy and pleasant to use as possible. A key aspect of the design discipline is the notion of 'usability'" (Dix, 2009, p. 41). Nielsen (2003) defined usability in terms of the ease-of-use of user interfaces. Usability is measured with concern for learnability, efficiency, memorability, errors, and satisfaction (Nielsen, 2003). According to Shneiderman, Plaisant, Cohen, Jacobs, and Elmqvist (2016) the eight golden rules to interface design include: (1) strive for consistency, (2) seek universal usability, (3) offer informative feedback, (4) design dialogs to yield closure, (5) prevent errors, (6) permit easy reversal of actions, (7) keep users in control, and (8) reduce short-term memory load.

Adoption

A brief discussion on adoption is relevant and justified within the context of the proposed research because Hwang (2005) showed that intrinsic motivation (among other antecedent factors) contributed to Enterprise Resource Planning (ERP) systems adoption. It can be argued that adoption implies the current or actual use of technology. The goal of the proposed study was to understand the current or actual use of mobile information systems in the context of m-learning. The discussion that ensues shows an interconnectedness between the HCI and IS domains as it relates to the constructs of PE, PP, PU, and PI.

In an organizational setting, rewards are only reaped if the systems are used by individuals (Shaikh & Karjaluoto, 2015). Because of this organizations have a personal stake in seeing adoption and the continued use of systems (Shaikh & Karjaluoto, 2015).

Shaikh and Karjaluoto argued that while the need to understand the intention to use (pre-adoption) technology by humans continues to be integral, there is also a need to focus on the continued use (post-adoption) of information technology/systems (IT/S). Figure 7 shows progression through the adoption stages based on the discussion by Shaikh and Karjaluoto. According to Shaikh and Karjaluoto (2015), "…the adoption and the usage of IT/S continue to be an important consideration for organizations" (p. 542). As Shaikh and Karjaluoto further noted:

> …acceptance (or pre-adoption) generally refers to an individual's decision to use IT/S for the first time; continuous usage (or post-adoption) refers to the individual's decision to embrace the IT/S well beyond its first use and continuously exploit and extend the functionality built into IT/S. (p. 542)

Figure 7. Stages of Adoption

Although significant research has been and continues to be conducted looking at student adoption, little is known about the reasons and motivations behind faculty member use of m-learning. By better understanding, the motivating factors driving m-learning usage, adoption (i.e., current or actual use) will follow. The proposed study on m-learning has adoption and usage implications in higher education, as well as in the corporate world, given that challenges, needs, and uses are similar.

Motivation (intrinsic and/or extrinsic), discussed earlier, has been cited as a reason for non-adoption of technology (Sanakulov & Karjaluoto, 2015). Examples cited included mobile banking, mobile-TV, mobile-marketing, and m-learning, as these are all in "…their infancy and adoption is advancing slowly" (Sanakulov & Karjaluoto, 2015, p.

245). Difficulties exist in the adoption of m-learning not only in higher education but also in the workplace, for teaching, learning, and training.

Another reason for the non-adoption of systems and technology often occurs due to a resistance to change (i.e., resistance to use IT/S) (Abu-Al-Aish et al., 2013). According to Laumer, Maier, and Eckhardt (2010) "…the problem of resistance has been presented and discussed as one of the most frequently encountered reasons for the non-use of innovations" (p. 2). Laumer et al. further noted that "within IS research it has been recognized that the acceptance of a technology is often preceded by resistance to the new information system and the changes resulting from it and that this must be first overcome by potential users…" (p. 3-4). Much of the adoption or non-adoption of an IT/S is based on human behavior, which has not been researched enough (van der Heijden & Junglas, 2006). Adoption has been slow (Alrasheedi & Capretz, 2013b). Frazier (2013) stated that some people think the slow adoption rate is due to a "…huge disconnect between faculty instructional methods and student demands" (p. 7).

Summary

The research was impacted by other fields such as HCI/UX, Culture, Motivation, and Interface Design. Motivation influences adoption. Motivational factors (both intrinsic and extrinsic) play a crucial role in determining m-learning use. Although m-learning occurs passively, resistance to its use in higher education is strong. So, it remains to be determined what is the motivation to use m-learning? Is it voluntary or forced upon faculty members? The research study focused on motivation and did not include adoption. A brief review of the m-learning research landscape (see Appendix B) revealed that although research regarding faculty use of m-learning is taking place around the

world, a majority of the research is being conducted in the United States. Most of the studies were not grounded in theory (i.e. no research model was applied) and focused on researching faculty perception regarding the use of mobile devices across disciplines. Half of the studies were quantitative (i.e., survey-based). The second most popular method used was mixed methods, and a handful of the studies were qualitative. None of the studies attempted to address m-learning use by faculty by considering motivation factors, a significant gap that the proposed study attempted to eliminate.

Chapter 3

Methodology

Research Approach

The purpose of this research study was to empirically investigate the motivational factors for the use of mobile information systems, more specifically, m-learning, by faculty members teaching in the disciplines of Business, Computer Science, and Information Systems at institutions of higher education in the United States. Identification of constructs was followed by the use of an expert panel to provide feedback. Confirmatory factor analysis was then used to validate the model. Survey data was analyzed using partial least squares structural equation modeling (PLS-SEM). The constructs, related to motivation, were utilized to develop a survey instrument (see Appendix A) that attempted to identify motivational factors that were most relevant to m-learning usage. Specifically, the survey measured the impact of perceived usefulness (PU), perceived enjoyment (PE), and perceived playfulness (PP) on mobile information systems use (MISU). At the same time, the impact of personal innovativeness (PI) on PU, PE, and PP was also measured. Additionally, the survey also contained questions to help answer precisely how m-learning is being used for teaching, learning, and training. The proposed theoretical model (Figure 8) was used to test the hypotheses for the research questions posed in Chapter 1.

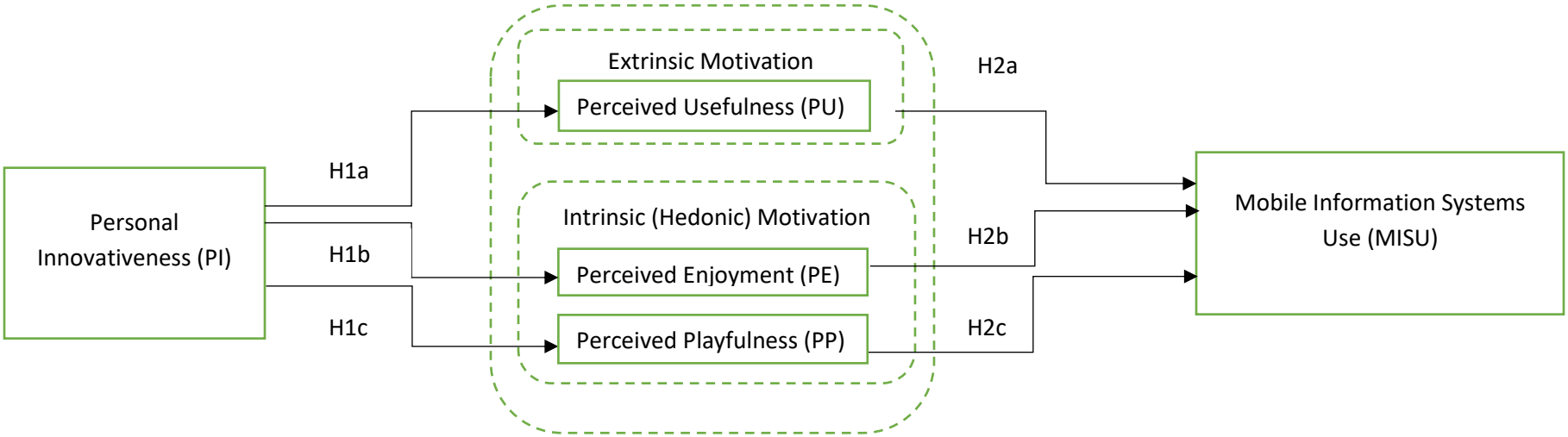

Figure 8. Proposed Theoretical Model (adapted from Hwang, 2014)

According to Sekaran and Bougie (2009), a "theoretical framework represents your beliefs on how certain phenomena (or variables or concepts) are related to each other (a model) and an explanation of why you believe that these variables are associated with each other (a theory)" (p, 69). Sekaran and Bougie (2009) have identified the following advantages of using surveys: they can be administered anonymously without concerns for geographic limitations, they can be deployed quickly at little or no cost, and participants can complete the surveys at their convenience. However, Sekaran and Bougie also noted disadvantages of administering surveys: low response rates, inability to clarify questions, and the need to follow-up to increase response rates. They stated that a 30% response rate is acceptable.

Hypothesis Testing

The following hypotheses were tested using the proposed theoretical model to answer RQ1. RQ2 was answered via four questions in the survey instrument and RQ3 was answered via three questions (see Table 4).

H1a: PI will positively and significantly influence PU.

H1b: PI will positively and significantly influence PE.

H1c: PI will positively and significantly influence PP.

H2a: PU will positively and significantly influence MISU.

H2b: PE will positively and significantly influence MISU.

H2c: PP will positively and significantly influence MISU.

Table 4

Research Questions and Hypothesis

Research Questions	Hypotheses	Construct	Survey Item
RQ1: What are the motivating factors driving m-learning use?	$H_0$1: PU, PE, and PP positively and significantly influence MISU.	PU, PE, and PP	11
RQ1a. How does PI impact PU?	H1a: PI will positively and significantly influence PU.	PI	7
RQ1b. How does PI impact PE?	H1b: PI will positively and significantly influence PE.	PI	7
RQ1c. How does PI impact PP?	H1c: PI will positively and significantly influence PP.	PI	7
RQ1d. How does PU impact MISU?	H2a: PU will positively and significantly influence MISU.	PU	8
RQ1e. How does PE impact MISU?	H2b: PE will positively and significantly influence MISU.	PE	9
RQ1f. How does PP impact MISU?	H2c: PP will positively and significantly influence MISU.	PP	10
RQ2. How is m-learning being used for teaching, learning, and training?			6, 15, 23, 24
RQ3. Why are only a few educators using m-learning?			2, 3, 4
RQ3a: What are the factors impeding m-learning use?			2, 3, 4

Institutional Review Board (IRB) Approval

The study was conducted after IRB approvals, from both the institution where the researcher is currently employed (University of Pittsburgh) and the institution where the doctoral degree was being pursued (Nova Southeastern University) were received. Participants were contacted via email and requested to serve on the expert panel, participate in the pilot study, and final study. Three experts participated on the expert panel review of the survey instrument. They were recruited through the University Center for Teaching and Learning. Additionally, a colleague in the Information Systems discipline also helped validate the survey. The pilot study included four participants at a regional campus of the University of Pittsburgh with which the researcher was previously affiliated. Participants for the final study were recruited from 60 US AAU member institutions (see Appendix C). A total of 13,839 initial emails were sent for the final study and the final sample size was 379. Participants for the pilot and final study were informed that participation was entirely voluntary and that no personally identifiable information would be asked of them. They were also told that all responses were anonymous and that the data would be analyzed in aggregate. They were asked to provide an online consent. Participants were also sent reminder emails during the study to yield a reasonable response rate.

Development Process for Survey Instruments

Hinkin (1998) laid out a six-step scale development process for survey instruments (see Figure 9). In the first step, items for each construct are developed. What is essential at this stage is that the construct is given an operational definition so that construct validity can be met. Construct validity is defined as "…the extent to which the

scale measures what it is purported to measure" (Hinkin, 1998, p. 105). Content validity assessment serves as a pre-test, allowing conceptually inconsistent items to be removed. Factors loadings of 0.40 or greater should be achieved. Each construct should have at least four items so that the homogeneity of items can be tested within each latent construct. The second step is to administer the survey to a sample of the population to assess "…the psychometric properties…" of measures (Hinkin, 1998, p. 110). The third step involves item reduction using factor analysis. In step four, confirmatory factor analysis is conducted. The fifth step involves testing convergent and discriminant validity. Finally, in step six, replication takes place.

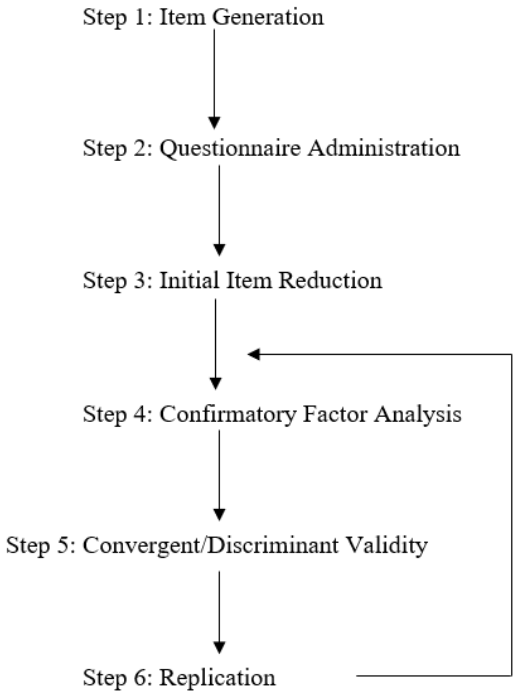

Figure 9. Scale Development Process (Hinkin, 1998)

Because the purpose of the study was to focus on faculty members' use of m-learning, the survey instrument also included a question to pre-screen participants as to whether they are current users of m-learning (see Appendix A, question 1). Pre-screening was necessary because it was not possible to know in advance if the participants were already using m-learning before requesting their participation in the completion of the survey. The question provided users with six options. Based on the option chosen, participants were directed to answer the appropriate set of survey questions. All participants, users and non-users, were required to answer questions about demographics.

Validity and Reliability

An expert panel comprised of three instructional technologists was identified and contacted through the University Center for Teaching and Learning at the researcher's institution. The expert panel was considered to be a valid group since as instructional technologists they are knowledgeable in m-learning. Their feedback helped validate the content of the survey instrument, which also helped address internal validity issues as explained by Straub (1989). The expert panel participants were not included in the pilot or final study.

Validity of the Instrument

In survey-based research, validity attempts to guarantee that "… we are indeed measuring the concept we set out to measure and not something else?" (Sekaran & Bougie, 2009, p. 158). Therefore, "several types of validity test are used to test the goodness of measures…" (Sekaran & Bougie, 2009, p. 158). Two of these measures include content and construct validity. According to Sekaran and Bougie (2009), "content validity ensures that the measure includes an adequate and representative set of items that

tap the concept. The more the scale items represent the domain or universe of the concept being measured, the greater the content validity" (p. 158). Content validity was measured by having the survey validated by an expert panel (http://www.statisticshowto.com/content-validity/). Construct validity, on the other hand, "…testifies how well the results obtained from the use of the measure fit the theories around which the test is designed" (Sekaran & Bougie, 2009, p. 160). In other words, construct validity "…asks whether the measures chosen are true constructs describing the event or merely artifacts of the methodology itself (Campbell and Fiske, 1959; Cronbach, 1971)" (Straub, 1989, p. 150). Construct validity can be measured using confirmatory or principal factor analysis (Straub, 1989). Convergent and discriminant validity are the two most common measures used to determine construct validity. In this study, confirmatory factor analysis (CFA) was used along with convergent and discriminant validity. Convergent validity is defined as "…the degree to which multiple attempts to measure the same concept are in agreement: two or more measures of the same item should co-vary highly if they are valid measures of the concept" (Moon & Kim, 2001, p. 222-223). Discriminant validity "… is established when, based on theory, two variables are predicted to be uncorrelated, and the scores obtained by measuring them are indeed empirically found to be so" (Sekaran & Bougie, 2009, p. 160). Convergent validity was measured using structural equation modeling and examining the values of outer loadings and the average variance extracted. Discriminant validity was measured by evaluating indicator cross loadings and the Fornell-Larcker criterion. Convergent and discriminant validity should be at least 0.70 and "…should not exceed the construct's correlation with other constructs" (Hwang, 2014, p. 230). In the case where convergent validity falls

below 0.40, the indicator in question should be eliminated. On the other hand, if convergent validity falls between 0.40 and 0.70, a careful examination of the impact of removing the indicator on the average variance extracted and composite reliability must be performed (Hair, Hult, Ringle, & Sarstedt, 2014). Similarly, discriminant validity that falls below the threshold can be improved by eliminating one or more indicators. Although this may improve discriminant validity, it may reduce content validity (Hair et al.).

Internal and External Validity

Determining both internal and external validity are essential and necessary when conducting quantitative research. Whereas internal validity "…raises the question of whether the observed effects could have been caused by or correlated with a set of unhypothesized and/or unmeasured variables" (Straub, 1989, p. 151), external validity. "…is an important determinant of the usefulness of survey research results" (King & He, 2005, p. 880). External validity represents "…the generalizability of sample results to the population of interest, across different measures, persons, settings, or times" (King & He, 2005, p. 882). Generalizability "…refers to the scope of applicability of the research findings in one organizational setting to other settings." (Sekaran & Bougie, 2009, p. 22) moreover, "the more generalizable the research, the greater its usefulness and value" (p. 22). Similar to the study done by Dooley (2015), internal validity was addressed by having an expert panel provide feedback on the survey instrument, which included constructs that had been previously tested in other studies. This allowed for any threats to internal validity to be minimized. External validity was established by developing a

survey instrument that could be used in organizations as well in other disciplines in higher education.

Reliability

According to Straub (1989) reliability "…is an evaluation of measurement accuracy…" (p. 151), which "…occurs when a test measures the same thing more than once and results in the same outcomes" (Salkind, 2012, p, 115). Cicchetti, Showalter, and Tyrer (1985) indicated that "…reliability increases steadily up to 7 scale points, beyond which no substantial increases occur, even when the number of scale points is increased to as many as 100" (p. 31). Cronbach's alpha "…is a reliability coefficient that indicates how well the items in a set are positively correlated to one another" (Sekaran & Bougie, 2009, p. 324). Hence, internal consistency reliability was tested by calculating Cronbach's alpha (Hinkin, 1998). As stated by Johanson and Brooks (2010) "…Cronbach's coefficient alpha is arguably the most commonly reported measure of internal consistency in survey research" (p. 396). Cronbach's alpha below 0.6 is considered poor, 0.7 is considered acceptable, and above 0.8 is considered good (Sekaran & Bougie, 2009, p. 325). According to Tan and Teo (2000), a minimum Cronbach's alpha of 0.60 is necessary for early stages of research and subsequently, if within the range of 0.625-0.9406, then "…the constructs are deemed to have adequate reliability for the next stage of validity analysis" (p. 22). Internal consistency reliability increases as Cronbach's alpha reaches close to 1 (Sekaran & Bougie, 2009, p. 324).

Threats to Validity and Reliability

A threat to external validity, as discussed by King and He (2005) is that of nonresponse error. They classified respondents as either being active or passive. Active respondents do not complete a survey for reasons such as – it takes too long, it is not relevant, or they get too many requests to complete surveys (King & He, 2005, p. 885). Passive respondents on the other hand just forgot to complete the survey or were not able to get to it in time. King and He suggested four methods to assess non-respondent errors: archival, follow-up, wave, and intentions. The follow-up method was utilized by sending reminder emails to help increase the response rate. Other threats to external validity include population validity, ecological validity, and external validity of operations (Onwuegbuzie, 2000, p. 7). One of the significant threats is that of the generalizability of the study. As Onwuegbuzie mentioned, "even if a particular finding has high internal validity, this does not mean that it can be generalized outside of the study context" (p. 7).

Internal validity as defined earlier "…is threatened when plausible explanations cannot be eliminated" (Onwuegbuzie, 2000, p. 7). There are eight threats to internal validity: history, maturation, testing, instrumentation, statistical regression, differential selection of participants, mortality, and interaction effects (p. 7). None of these were applicable within the context of this study.

Constructs

The key constructs (or measures) that were used to evaluate the impact of both intrinsic and extrinsic motivation on the use of mobile information systems were PU, PE, and PP. Additionally, the impact of PI on these three measures was also analyzed, along with the dependent variable MISU. Table 5 shows the number of items in each construct

along with some of the sources from which the items were obtained and modified in the context of this study. Sources for other questions in the survey instrument include Cheng (2014), Frazier (2013), Marrs (2013), and Rellinger (2014).

Table 5

Number of Items per Construct

Construct	Number of Items	Author(s)
Personal Innovativeness (PI)	4	Cheng (2014), Hwang (2014)
Perceived Usefulness (PU)	4	Cheng (2014), Hwang (2014)
Perceived Enjoyment (PE)	4	Cheng (2014), Hwang (2014), Venkatesh et al. (2012); Liao, Tsou, & Shu (2008)
Perceived Playfulness (PP)	5	Rdonaldson.com
Mobile Information Systems Use (MISU)	7	Cheng (2014), Venkatesh et al. (2012), Hoehle & Venkatesh (2015)

Following Sekaran and Bougie (2009), the constructs were operationalized by defining them, identifying the content of each measure, developing a response format, and assessing validity and reliability. All the constructs identified in the theoretical model, along with question 21, was measured using a seven-point Likert scale, anchored at 1 “strongly disagree” to 7, “strongly agree.” For the question pertaining to one’s comfort level with m-learning (question 14) the seven-point Likert scale was anchored at 1 “very uncomfortable” to 7, “very comfortable” based on https://www.extension.iastate.edu/Documents/ANR/LikertScaleExamplesforSurveys.pdf.

Questions 17 and 18 asked about prior experience using m-learning for which the responses were anchored at 1 “none” to 7, “substantial”. For questions 19, 27, and 30 the Likert scale was anchored at 1 “completely dissatisfied” to 7, “completely satisfied”. Finally, for questions 22 and 23, the Likert scale was anchored at 1 “never” to 7 “always”.

Pilot Study

The survey instrument then underwent pilot testing. Pilot studies are helpful in survey instrument development (Johanson & Brooks, 2009) and help address content and face validity (Bazile, 2016). Johanson and Brooks reported the works of various authors showing that the number of participants can range anywhere from 12 to 30, stressing that rather than the number of participants, representing the population is most important. Thus, the pilot testing was done at one of the four regional campuses of the University of Pittsburgh, with which the researcher was previously affiliated, and a total of 13 faculty members were contacted. These faculty members were representative of the disciplines identified earlier; namely Information Systems, Computer Science, and Business. Purposive sampling was used in that the survey was only administered to full-time faculty members in the specific disciplines listed above. Convenience sampling was also used because access to the participants was readily available due to the investigator’s affiliation with the university and campus. According to Thabane et al., (2010) “the sample used in the pilot may be included in the main study…” (p. 5). However, in this study, the pilot study participants were not included in the final study. Figure 10 shows the steps that were used in the research study. The expert panel was comprised of three

participants. The pilot study involved four participants and the actual study sample size was 379.

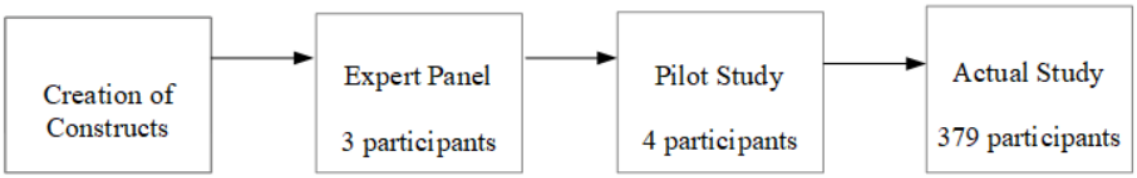

Figure 10. Research Steps

Population and Sample

The survey was administered to full-time faculty members at institutions of higher education in the United States teaching in the following disciplines: Information Systems, Computer Science, and Business. As noted earlier, Corbeil and Corbeil (2011) assessed these disciplines, along with Education, as having the hardest time in implementing m-learning. The Education discipline was not included, as it was not within the scope of this study. The researcher's institution (a state-related university) is a member of the Association of American Universities (AAU), which is comprised of 62 doctorate-granting research institutions (See Appendix C). The AAU membership is comprised of 34 public, 26 private, and two Canadian institutions. The two Canadian institutions were not included in the proposed study because the focus of the study was to survey faculty members teaching in the United States. Therefore, participants were drawn from the 60 U.S. institutions that were comparable or closely aligned with the researcher's institution.

Using the researcher's institution as a benchmark, the total number of faculty combined in Business (which includes Information Systems) and Computer and Information (which includes Computer Science) without regard to the participant's appointment status yielded 247 faculty. Therefore, a general estimate of the potential

population size was 14,820. Assuming a 95% confidence level and a ± 5% margin of error yielded a sample size of 375 (https://www.surveymonkey.com/mp/sample-size-calculator/). The final count for the number of responses received was 379 (N=379). Neither the expert panel nor the pilot study participants were a part of final study.

Data Collection

Each institution's website was visited to identify the appropriate full-time faculty members teaching the disciplines specified earlier. An email extractor software was purchased to expedite the collection of email addresses and email addresses were entered into an Excel spreadsheet. The data collection process spanned over six weeks. A total of 13,839 emails were collected. The study did not require contacting additional faculty because a sufficient number was found, so the original group is all that were surveyed. The survey was administered online using Qualtrics (licensed by the researcher's institution and required for all research studies conducted at the institution).

Pre-Analysis Data Screening

Once the survey had been administered during the final phase of this research, initial pre-screening of the data was conducted to identify missing data and any outliers by calculating the Mahalanobis distance. One way to avoid missing data is to require participants to respond to all questions – this is the method that was used. The accepted Mahalanobis distance value is that which is significant beyond $p < .001$.

Partial least squares (PLS) was used to assess the model. PLS is a Structural Equation Modeling (SEM) tool that "…utilizes a component-based approach to estimation" (Hwang, 2014, p. 230). CFA was used to test the constructs (Hwang, 2014).

PLS was then used to examine the internal consistency reliability along with convergent and discriminant validity (Hwang, 2014) of the constructs.

Analysis Plan

Statistical software packages namely SPSS and SmartPLS were utilized to analyze the results of the survey. Quantitative analysis of data involving several independent variables and one dependent variable (i.e., multivariate analysis) can be done using multiple regression or path analysis (Mertler & Vannatta, 2013). Regression techniques are used to predict the relationship between independent and dependent variables. Multiple regression is a first-generation technique and confirmatory (Hair et al., 2014). Confirmatory methods are used when "…testing the hypotheses of existing theories and concepts…" (Hair et al., p. 3). To overcome deficiencies found in first-generation techniques, Hair et al. recommended using second-generation techniques. Second-generation multivariate methods are referred to as SEM (Hair et al., 2014). Therefore, for the proposed study, SEM was utilized to analyze the results of the final study. Of the two types of SEM, covariance-based SEM (CB-SEM) and partial least squares SEM (PLS-SEM) the latter was used for this research study. The difference between the two is that CB-SEM is used to confirm or reject theories whereas PLS-SEM is "…used to develop theories in exploratory research" (Hair et al., 2014, p. 4).

For the proposed research study CFA was used instead of exploratory factor analysis (EFA). EFA's "…goal is to describe and summarize data by grouping variables that are correlated" (Mertler & Vannatta, 2013, p. 245). On the other hand, CFA "…is often used to test a theory about latent (i.e. underlying, unobservable) processes that might occur among variables" (Mertler & Vannatta, p. 245).

Formatting for Presenting Results

A detailed narrative along with tables and graphs was utilized to present the results and interpret the findings of the survey-based research. The analyses included interpretation of both descriptive and inferential statistics.

Resource Requirements

A personal computer was utilized with SPSS, Email Extractor, and SmartPLS installed. The survey instrument was constructed and administered online using Qualtrics (as mandated by the researcher's institution for all IRB-based research). The university has licensing agreement for Qualtrics and SPSS. The free version of SmartPLS was utilized.

Summary

The study used a survey-based method to answer three research questions and test six hypotheses. The impact of one extrinsic (PU) and two intrinsic motivation factors (PE and PP) along with PI on MISU was tested. A survey instrument was administered to faculty members teaching at both public and private institutions which are closely aligned with the researcher's institution. Before conducting the final study, a panel of experts reviewed the survey instrument; it then underwent a pilot study. Results of the study were analyzed using SPSS and SmartPLS. SEM was utilized to analyze the results of the final study. The expert panel was comprised of three instructional technologists and a colleague from the information systems discipline. The pilot study was conducted on one regional campus of the university due to the researcher's affiliation with the university and regional campus. The pilot study included contacting 13 full-time faculty members teaching in the disciplines of Business, Information Systems, and Computer Science who

are representative of the sample that had been selected for the final study. However, only four participants completed the survey for analysis purposes. During the final study, 13,839 full-time faculty members at institutions who are members of the AAU were emailed and asked to participate in the study, as previously discussed. A total of 379 participants responded to the survey. Neither the expert panel nor the pilot study participants were included in the final study.

Chapter 4

Results

Overview

This chapter presents the findings from the expert panel review, pilot study, and final study conducted as part of this research on faculty perceptions and use of m-learning in higher education. The objective of this research was to determine which of the motivational factors perceived usefulness (PU), perceived enjoyment (PE), and perceived playfulness (PP) had the most significant impact on mobile information systems use (MISU). Additionally, the model also tested the impact and significance of personal innovativeness (PI) on PU, PE, and PP (see Figure 11). The study also investigated how m-learning is being used for teaching, learning, and training, why only a few educators are using m-learning and what factors are impeding its use.

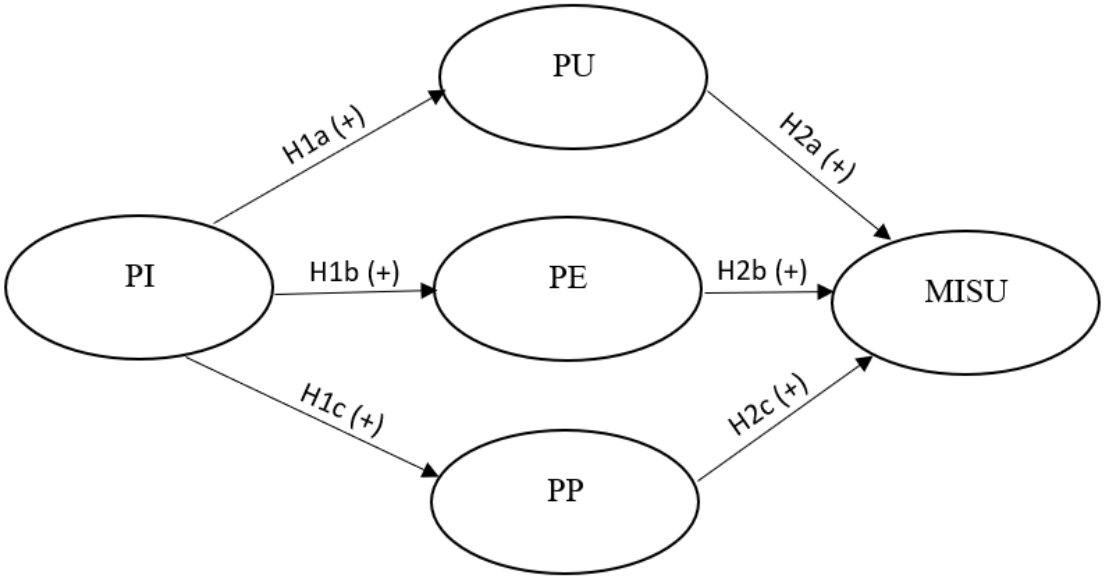

Figure 11. Conceptual Map of the Research Model

Expert Panel

Several difficulties were encountered in identifying faculty who are currently users of m-learning. The Director of the University Center for Teaching and Learning was contacted on multiple occasions, but she was unable to provide assistance due to her busy schedule. It was suggested that Deans of the various schools be contacted. In lieu of this, an Instructional Technologist in the same center was contacted. It was suggested that instead of faculty, instructional technologists serve on the panel since they would have a better understanding of m-learning due to their knowledge and educational background. For this reason, they were considered to be a valid group. In the end, three experts were identified, contacted, and provided feedback on the survey. Their suggestions were used to modify the survey. Additionally, a colleague with a background in the Information

Systems field also provided input. Content validity was measured by having the expert panel validate the survey instrument.

Pilot Study

The pilot study took place on a regional campus of the University with which the researcher was previously affiliated. A total of 13 participants were identified and contacted. Seven participants completed the survey (54%), but only four were fully usable (representing 57% response rate). An initial factor analysis on the five main constructs, was unsuccessful. After eliminating MISU5 and MISU6 (see Appendix A), the analysis provided some results. Since the number of responses was significantly low, it did not justify the elimination of MISU5 and MISU6 at this stage of this research. As such, the analysis was deferred until after the final study was completed.

Data Collection

The websites of all 60 US AAU institutions were visited and faculty teaching in the disciplines of computer science, business, and information systems were identified. An email extractor software was purchased to aid in the email collection process. For many of the websites, email addresses had to be manually entered in an Excel spreadsheet. The process of collecting email addresses spanned approximately six weeks. Qualtrics was used to administer the survey and email participants. A total of 13,464 emails were delivered (excluding duplicate, failed, bounced, and complaint emails). After the initial email, two additional reminder emails were sent. A total of 657 participants started the survey, but only 404 submitted survey responses. Of the 404 survey responses, five did not provide consent. An additional 20 survey responses were blank, hence resulting in a sample size of 379. An analysis of the 379 consent responses is presented in Table 6 broken down by the response provided to the initial pre-screening question. As

participants began to complete the survey some had emailed the researcher indicating that there were some errors in the wording of the 7-point Likert scale. These were corrected as soon as the error was brought to the attention of the researcher. Similarly, other minor mistakes also had to be corrected as the data collection process proceeded. This did not adversely affect the data that had already been collected for the analysis. These errors primarily occurred in setting up the survey in Qualtrics. It is surprising that the errors were not brought to the researcher's attention during the pilot study.

Table 6

Pre-Screening Responses Breakdown

Pre-screening question: Which of the following best describes your use of m-learning in your teaching?

Option	Initial # of Responses	Other findings	Final # of Responses
I am using m-learning currently	144	45 completely blank	99 responses
I am not using m-learning currently	110	15 completely blank	95
I would like to use m-learning	10	No issues	10
I want to learn more about using m-learning	45	No issues	45
I am not interested in using m-learning	49	3 blank	46
Other: please specify	21	2 blank	19
TOTAL	379		

The pre-screening question also determined the set of survey questions each participant would answer (see Appendix A). The survey was essentially organized into three sections: m-learning integration (questions 6-25), faculty member preparedness (questions 26-35), and demographics (questions 36-52). Two of the questions pertained to collecting names and email addresses of individuals who were interested in being contacted to either learn more about m-learning or to share their knowledge with others. Questions 8-12 pertained to the model constructs. See Table 7.

Table 7

Survey questions

Pre-screening question: Which of the following best describes your current view of the use of m-learning in the classroom?	
Options	Survey questions answered
I am currently using m-learning	6-52
I am not using m-learning currently	2, 36-52
I would like to use m-learning	4, 36-52
I want to learn more about using m-learning	5, 36-52
I am not interested in using m-learning	3, 36-52
Other (please specify)	36-52

Demographics Analysis

The demographics section of the survey included questions about gender, age, academic rank, highest education level achieved, among others. The analysis showed that the survey was completed primarily by males (52%). The age range is clustered anywhere between 30-69 years old with 17% between the ages of 30-39, 25% between the ages of 40-49, 17% between the ages of 50-59, and 16% between the ages of 60-69. Assistant (59/379 or 16%), associate (45/379 or 12%), and full professors (88/379 or 23%) accounted for 51% of the responses. Overwhelmingly 62% have earned doctorate degrees

and 50% teach in Business. The disciplines in which participants obtained their higher degree was wide ranging. From the 273 responses for this question, the top six include: computer science, business, accounting, economics, finance, and marketing. Of the 185 respondents that listed the business discipline they currently teach in was also wide ranging but those that emerge at the top are: marketing, accounting, finance, management, and organizational behavior. Around 40% teach both at the undergraduate and graduate levels. It was interesting to find that 54% of them teach on-campus (i.e. in-person, face-to-face) and 61% are full-time faculty. A breakdown of the frequencies for on-campus, online, and hybrid courses (see Appendix D) showed that most of them (38% on-campus, 77% online, and 79% hybrid) have been teaching these types of courses between 0-10 years. Some responses were not included because they did not fit the criteria. More participants are at public (48%) institutions then private (24%) and are either tenured (30%), not on tenure track (29%), or currently on tenure-track (12%). Regarding the participants' length of contracts, 14% are currently on multiyear contracts. Participants have on average around 19 years of teaching experience with 35% between 0-10 years, 23% between 11-20 years, 20% between 21-30 years, and 14% between 31-40 years (see Appendix D). In cases where respondents' answers included symbols such as +, >, <, or were in text form, they were included in the appropriate frequency ranges. Others were not included because they were not relevant such as "1 week per year for 14 years." Similarly, participants have been in higher education around 20 years with 33% between 0-10 years (see Appendix D).

Table 8

Descriptive Statistics and Demographics of Participants (N=379)

Item	Frequency	Percentage (%)
Gender		
Male	198	52%
Female	77	20%
Self-identify	1	0%
Prefer not to respond	5	1%
No answer provided	98	26%
Age		
20-29	4	1%
30-39	65	17%
40-49	57	25%
50-59	66	17%
60-69	59	16%
70-79	26	7%
80 and Over	4	1%
No answer provided	98	26%
Academic Rank		
Lecturer	49	13%
Instructor	11	3%
Assistant Professor	59	16%
Associate Professor	45	12%
Professor	88	23%
Emeritus	11	3%
Other	18	5%
No answer provided	98	26%
Highest Education Level		
Master's	26	7%
Doctorate	235	62%
Professional Degree	9	2%
Other	4	1%
No answer provided	105	28%
Program/area discipline		
Information Systems	15	4%
Business	191	50%
Computer Science	68	18%
No answer provided	105	28%

Item	Frequency	Percentage (%)
College level – teaching		
Undergraduate	59	16%
Graduate	69	18%
Both graduate & undergrad	146	39%
No answer provided	105	28%
Teaching location		
On-campus	203	54%
Online	4	1%
Hybrid	30	8%
On-campus and off-campus	12	3%
On and off-campus, hybrid	15	4%
On-campus and hybrid	10	3%
No answer provided	105	28%
Hiring status		
Full-time	231	61%
Part-time	42	11%
No answer provided	106	28%
Affiliation		
Public	183	48%
Private	90	24%
No answer provided	106	28%
Tenure Status		
Tenured	115	30%
Tenure-track	45	12%
Not on tenure-track``	111	29%
Tenure not available	2	1%
No answer provided	106	28%
Length of Contract		
One term contract	18	5%
9-12 months contract	24	6%
Multiyear contract	54	14%
Continuous appointment	16	4%
No answer provided	267	70%

Pre-Analysis Data Screening

The data was first cleansed by removing blank records. Secondly, the data was coded and grouped by answers provided for the pre-screening question.

Missing Data

The data pertaining to the conceptual research model revealed missing data for the PP and MISU constructs in 12 cases, reducing the number of cases from 99 to 87 (see Table 6). As such the analysis was conducted first by removing the cases with missing data. Secondly, the missing data was imputed using the multiple imputation technique in SPSS. Although any given number of datasets can be generated, for the purposes of this study the number of datasets to be generated was set to one. The imputed dataset was further analyzed, and the results compared with the dataset with no missing data. The results are discussed later in this chapter.

Outliers

Outliers, or extreme cases, in the data were evaluated for all datasets mentioned above using both the univariate and multivariate techniques. Since the data was coded on a 7-point Likert scale a visual inspection of the data showed no univariate outliers. With 24 items, the degrees of freedom is 24 and the critical value for chi-square at $p<.001$ equals 51.179. This resulted in 6 cases with a value greater than 51.179 so they were eliminated from further analysis (see Table 9, Figure 12, and Figure 13).

Table 9

Mahalanobis Distance Extreme Values

			Case Number	ID	Value
Mahalanobis Distance	Highest	1	72	327	62.86193
		2	63	293	58.91649
		3	27	156	56.92469
		4	25	148	55.40059
		5	60	267	51.72009
	Lowest	1	61	268	4.18849
		2	77	338	4.81146
		3	80	349	5.26834
		4	65	305	6.28024
		5	40	195	6.63620

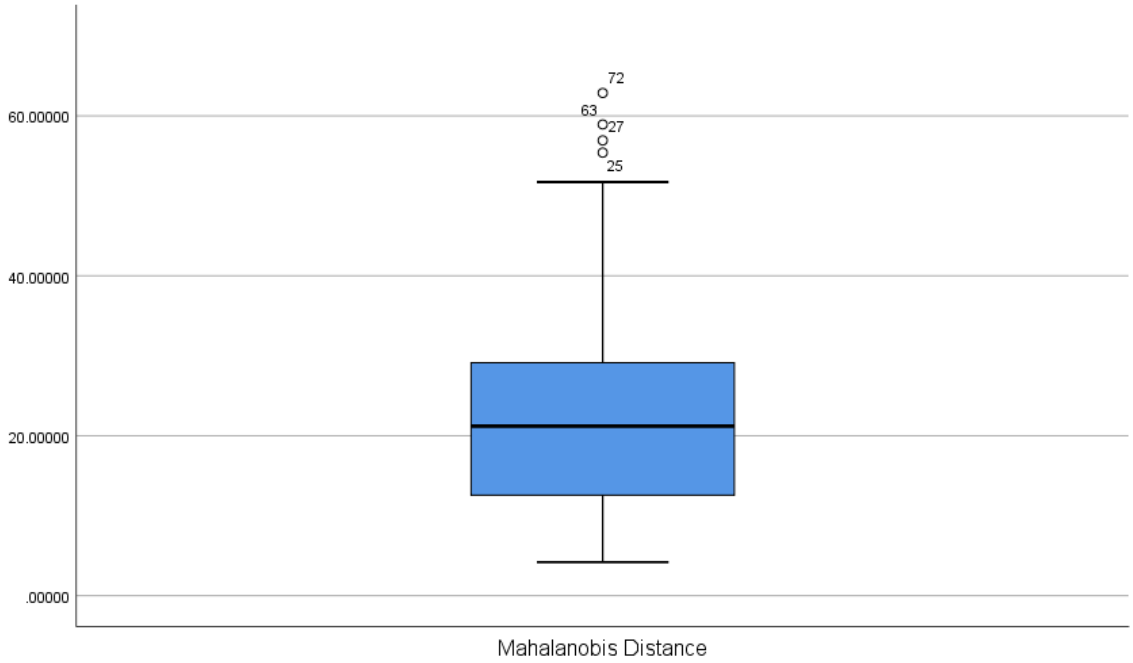

Figure 12. Mahalanobis Distance Results

Mahalanobis Distance Stem-and-Leaf Plot

Frequency		Stem & Leaf
14.00	0 .	44566777888999
25.00	1 .	0001111133344555677789999
27.00	2 .	011111233333344556677777789
7.00	3 .	0223469
8.00	4 .	00114457
2.00	5 .	11
4.00	Extremes	(>=55)

Stem width: 10.00000

Each leaf: 1 case (s)

Figure 13. Mahalanobis Distance Stem-and-Leaf Plot

Structural Model Analysis

According to Hair et al. (2013) "assessment of reflective measurement models includes composite reliability to evaluate internal consistency, individual indicator reliability and average variance extracted (AVE) to evaluate convergent validity. In addition, the Fornell-Larcker criterion and cross loadings are used to assess discriminant validity" (p. 100). Both the measurement and structural models were evaluated using SPSS and PLS-SEM. A confirmatory factor analysis was performed.

Evaluation of Measurement Model

Internal consistency reliability. SmartPLS was used to calculate composite reliability and Cronbach's alpha because internal consistency reliability is measured using Cronbach's alpha. Cronbach's alpha "…provides an estimate of the reliability based on the inter-correlations of the observed indicator variables" (Hair et al., 2013, p. 101). However, due to Cronbach's limitations, Hair et al. also propose looking at the composite reliability. Composite reliability ranges between zero and one. The higher the

number, the higher the composite reliability. Cronbach's alpha greater than 0.8 are good. As a result, it can be concluded that the model showed strong internal consistency reliability (see Table 10).

Table 10

Internal Consistency

Construct	Composite reliability	Cronbach's alpha	Number of items
MISU	0.965	0.917	7
PE	0.960	0.945	4
PI	0.893	0.841	4
PP	0.892	0.873	5
PU	0.920	0.886	4

Convergent validity. The two most common measures of construct validity are convergent and discriminant validity. According to Hair et al. (2013) any reflective indicator whose outer loading is below 0.4 should be removed. However, indicators with outer loadings between 0.4 and 0.7 should be further analyzed by looking at the impact on composite reliability and average variance extracted (AVE) before any elimination takes place. The outer loading for MISU7 is below 0.4 and the outer loadings for PP1, and PP2 is between 0.4 and 0.7 (Table 11). As can be seen in Table 11 composite reliability, Cronbach's alpha, and AVE greatly improve by removing MISU7, PP1, and PP2, as noted in red. Therefore, these three indicators were removed before proceeding with the rest of the analysis. The indicator reliability represents the squared value of an indicator's outer loading.

Table 11

Convergent Validity

Construct	Indicator	Outer Loading	Indicator Reliability	AVE	AVE if Indicator is deleted	Cronbach's Alpha	Cronbach's Alpha if item is deleted
Mobile Information Systems Use	MISU1	0.965	0.931	0.841		0.917	0.907
	MISU2	0.986	0.972				0.906
	MISU3	0.986	0.972				0.906
	MISU4	0.964	0.929				0.905
	MISU5	0.986	0.972				0.906
	MISU6	0.991	0.982				0.906
	MISU7	**-0.358**	**0.128**		**0.969**		**0.919**
Perceived Enjoyment	PE1	0.963	0.927	0.859		0.945	0.903
	PE2	0.964	0.929				0.903
	PE3	0.923	0.852				0.905
	PE4	0.851	0.724				0.904
Personal Innovativeness	PI1	0.837	0.701	0.676		0.841	0.907
	PI2	0.788	0.621				0.908
	PI3	0.792	0.627				0.910
	PI4	0.869	0.755				0.907
Perceived Playfulness	PP1	**0.641**	**0.411**	0.636	**0.690**	0.873	**0.912**
	PP2	**0.495**	**0.245**		**0.733**		**0.912**
	PP3	0.865	0.748				0.905
	PP4	0.945	0.893				0.906
	PP5	0.940	0.884				0.904
Perceived Usefulness	PU1	0.767	0.588	0.744		0.886	0.908
	PU2	0.887	0.787				0.906
	PU3	0.866	0.750				0.906
	PU4	0.922	0.850				0.905

Discriminant validity: Discriminant validity is assessed by examining the indicator cross loadings (Table 12) and the Fornell-Larcker criterion (Table 13). Both were met without any issues, as noted in yellow.

Table 12

Indicator Cross Loadings

Construct	Indicator	MISU	PE	PI	PP	PU
MISU	MISU1	0.968	0.147	0.243	0.090	0.297
	MISU2	0.993	0.124	0.236	0.083	0.358
	MISU3	0.991	0.109	0.247	0.073	0.335
	MISU4	0.970	0.210	0.275	0.156	0.430
	MISU5	0.989	0.147	0.265	0.093	0.367
	MISU6	0.995	0.144	0.247	0.101	0.362
PE	PE1	0.157	0.963	0.527	0.714	0.478
	PE2	0.135	0.965	0.524	0.677	0.476
	PE3	0.073	0.923	0.455	0.676	0.361
	PE4	0.204	0.851	0.361	0.730	0.538
PI	PI1	0.286	0.461	0.837	0.272	0.341
	PI2	0.176	0.408	0.789	0.350	0.325
	PI3	0.145	0.306	0.791	0.186	0.192
	PI4	0.217	0.468	0.868	0.284	0.264
PP	PP3	0.072	0.793	0.268	0.861	0.503
	PP4	0.051	0..658	0.272	0.945	0.399
	PP5	0.140	0.643	0.376	0.945	0.450
PU	PU1	0.249	0.354	0.152	0.310	0.767
	PU2	0.304	0.469	0.305	0.436	0.886
	PU3	0.361	0.373	0.305	0.397	0.868
	PU4	0.338	0.500	0.394	0.509	0.921

Table 13

Fornell-Larcker criterion

	MISU	PE	PI	PP	PU
MISU	0.984				
PE	0.151	0.927			
PI	0.257	0.510	0.822		
PP	0.103	0.750	0.342	0.918	
PU	0.368	0.496	0.351	0.489	0.862

Evaluation of Structural Model

The structural model is assessed by evaluating collinearity, the significance of path coefficients, the level of R^2 values, the f^2 effect size, the predictive relevance (Q^2), and the q^2 effect size (Hair et al., 2013). These are discussed next.

Collinearity assessment. SPSS was used to assess collinearity. Collinearity involves examining tolerance levels and the variance inflation factor (VIF). Tolerance levels below 0.2 and VIF above 5.0 are indicators of collinearity. Based on the results presented in Table 14, there were no collinearity issues.

Table 14

Collinearity Assessment

Construct	Tolerance	VIF
PE	0.431	2.321
PI	0.799	1.251
PP	0.474	2.108
PU	0.709	1.411

Structural model path coefficients. Path coefficients should be between -1 and +1. Coefficients that are close to +1 represent a strong positive relationship, -1 a strong negative relationship, and close to zero a weak or nonsignificant relationship (Hair et al., 2013). Since the hypotheses for the study are unidirectional, this implies a one-tailed test. As shown in Table 15, two of the paths were not significant, from PE to MISU (rejecting H2b) and from PP to MISU (rejecting H2c).

Table 15

Results of PLS Analysis

Structural Paths in Model	Sign	PLS Path Coefficient	t-statistic	*p*-value	Significance Level
H1a: PI → PU	+	0.351	3.172	0.002	**
H1b: PI → PE	+	0.510	5.769	0.000	***
H1c: PI → PP	+	0.342	4.706	0.000	***
H2a: PU → MISU	+	0.409	3.994	0.000	***
H2b: PE → MISU	+	0.048	0.270	***0.787***	***NS***
H2c: PP → MISU	-	-0.134	0.690	***0.490***	***NS***

*** *p* < 0.05**
**** *p* < 0.01**
***** *p* < 0.001**
NS - Not Significant

Coefficient of determination (R^2). The R^2 value ranges from 0 to 1 and there is no agreed upon value for an acceptable R^2 value (Hair et al., 2013). However, Hair et al. stated that values of 0.75 (substantial), 0.50 (moderate), and 0.25 (weak) can be used as a rule of thumb. Therefore, according to Table 16, it can be concluded that MISU, PE, PI, and PP have weak predictive accuracy.

Table 16

R^2 Values

	R^2	Predictive Accuracy
MISU	0.144	Weak
PE	0.261	Weak
PI	0.117	Weak
PP	0.123	Weak

Effect Size (f^2). According to Hair et al. (2013), f^2 values of 0.02 (small), 0.15 (medium), and 0.35 (large) are the effect sizes that should be used to evaluate the structural model. From Table 17 it can be concluded that only PI has a large effect on PE while PI has a medium effect on PP. PI has a small effect on PU and PU has a small effect on MISU.

Table 17

f^2 Effect Size

	f^2	Effect
H1a: PI → PU	0.141	Small
H1b: PI → PE	0.352	Large
H1c: PI → PP	0.132	Medium
H2a: PU → MISU	0.141	Small
H2b: PE → MISU	**0.001**	No effect
H2c: PP → MISU	**0.009**	No effect

Blindfolding and Predictive Relevance (Q^2). According to Hair et al. (2013), Q^2 "…is an indicator of the model's predictive relevance" (p. 178). The values used to assess are the same as those for f^2 that is 0.02 (small), 0.15 (medium), and 0.35 (large). From Table 18 it can be concluded that the model has some predictive relevance even if minimal.

Table 18

Q^2 Values

	Q^2	Effect
MISU	0.124	Small
PE	0.203	Medium
PI	---	---
PP	0.087	Small
PU	0.080	Small

Effect Size (q^2). According to Hair et al. (2013), in the same manner that f^2 effect size is used to assess R^2 values, "…the relative impact of predictive relevance can be compared by means of the measure to the q^2 effect size…" (p. 183). The equation to calculate the q^2 effect size is equal to (Q^2 included – Q^2 excluded) / (1-Q^2 included). The values of 0.02, 0.15, and 0.35 show small, medium, or large predictive relevance. As shown in Table 19, all predictor variables have a very small effect size.

Table 19

q^2 Effect size

	Q^2 included	Q^2 excluded	Predictive Relevance	Effect Size
PE	0.114	0.114	0.0000	Small
PU	0.114	0.017	0.1095	Small
PP	0.114	0.106	0.0090	Small

Imputed Data Analysis

An analysis for missing outliers resulted in the elimination of four cases, compared to six cases for the no missing data set. These outliers were removed based on the critical value of chi-square at $p<.001$ of 51.179. Appendix E contains all of the supporting tables and figures from the analysis.

Evaluation of Measurement Model

The internal consistency reliability also showed a high composite reliability and Cronbach's alpha above 0.8 for all constructs. When performing the convergent validity analysis, results showed that MISU7, PP1, and PP2 fell below the threshold identified earlier and both AVE as well as Cronbach's alpha increased significantly with their removal. The indicator cross loadings and Fornell-Larcker criterion were both met without any issues.

Evaluation of Structural Model

No collinearity issues were found. Results of the PLS Analysis were like those of the no missing dataset, however while the same two paths were not significant, PE to MISU resulted in a strong negative relationship whereas in the earlier analysis it was a strong positive relationship. All the R^2 values show weak predictive accuracy. The f^2 effect sizes are the same except for H1a. In this case the effect size is medium instead of small. Based on Q^2 values the model has some predictive relevance even if minimal. The q^2 effect size shows that PU has a large predictive relevance.

Based on these results it can be concluded that the results are consistent with a few minor exceptions between the two datasets.

Users of M-Learning

To address the research question regarding how m-learning is being used for teaching, learning and training (RQ2), the survey instrument included questions related to m-learning integration. The results are discussed next.

M-learning integration

Participants were asked to identify how they use m-learning at their current institutions (see Appendix A, question 6 for options provided). A breakdown of the responses shows that 18% use four out of the five options provided. These include in-class activities, out-of-class activities, online course, and hybrid course. Around 8% of the participants use one or more combinations of the options provided. The use of m-learning for professional development/training was less than 0.5%. Over 70% did not respond to the question. The types of activities being used for m-learning in teaching is wide ranging. These include assignments, case analysis & discussion, case studies, chapter readings, quizzes, classroom polling, simulations, discussion board threads, presentations, attendance verification, comprehension questions, group projects, homework and assignments, flipped classroom activities, videos of lectures, self-assessment, lectures, MOOC, online text, chat rooms, access LMS, video conferencing and lectures, video interviews, and others.

Of the 87 participants who identified themselves as users of m-learning, three (3%) stated that they had been using m-learning for less than one year, 55 (63%) started using m-learning between 1 to 6 years ago, seven (8%) between 7 to 10 years, and 22 (25%) had started using it over ten years ago. Seventy-six (87%) use it anywhere from several times a day to 3-5 days a week. The remaining 11 participants (or 12%) use it less

frequently. Sixty-three (72%) of the 87 participants stated that they felt moderately or very comfortable using m-learning.

Teaching resources provided on a mobile device resulted in 61 combinations of choices. The top three choices accounted for 17% of the resources used. These include using a combination of lecture PPT slides, audio and video recordings, print content, eBooks, hyperlinks to course-related reference material, and Blackboard. Some participants also provided information on other resources provided to students on a mobile device. The most commonly listed system was Canvas.

A majority (85%) had prior experience in using m-learning as an instructor and 90% indicated that their level of experience ranged from moderate to substantial on a 7-point Likert scale. The number of participants who had prior experience in using m-learning as a student was significantly low at only 29%. Of these, about 84% had little to extensive experience in using m-learning as a student on a 7-point Likert scale.

In general, most participants (86%) expressed a level of satisfaction in using m-learning that ranged between somewhat to mostly satisfied. Participants were also asked to identify their level of agreement with whether using m-learning is problematic and whether m-learning is an innovative approach to teaching. The former statement revealed that over 50% disagreed with this statement while 18% neither agreed or disagreed and 15% slightly agreed with the statement. The latter showed a stronger support with 71% agreeing that m-learning is an innovative approach to teaching. Participants were asked if they found m-learning to be beneficial for teaching. A majority 67% found this to be the case either frequently or usually. Another 21% found it to be beneficial sometimes.

Participants were also asked to provide information about how frequently they engaged in 18 different activities using mobile device to support their teaching. Table 19 shows a breakdown of their responses.

Table 20

Mobile Device Use for M-Learning Activities for Teaching

Activity	Never	Rarely	Occasionally	Sometimes	Frequently	Usually	Always
Email students	4	4	1	10	31	15	11
Email colleagues	4	4	2	7	32	17	10
Text students	38	12	5	9	6	2	4
Text colleagues	21	12	11	10	14	2	6
Post grades	25	7	4	4	7	11	18
Post to discussion board	17	8	6	15	12	7	11
Access course site	5	6	4	14	18	14	15
Access library resources	16	14	9	12	8	8	9
Access social networking	25	10	3	8	11	11	8
Order textbooks	41	8	6	6	5	5	5
Search internet	4	3	2	8	21	20	18

Activity	Never	Rarely	Occasionally	Sometimes	Frequently	Usually	Always
Provide tutoring services	46	13	4	6	6	0	1
Prepare lessons	21	13	6	13	7	9	7
Conduct seminars	39	14	7	7	4	3	2
Collect content for coursework	15	7	5	13	12	13	11
Read eBooks	16	9	12	13	11	9	6
Take pictures or make videos for course	15	9	6	19	11	10	6
Other (please specify)	57	1	2	7	4	0	5

Hardware used for m-learning primarily includes generic laptops, phones, video cameras, computers, and e-readers. Next would be all the Apple products (iPhone, iPad, mac, MacBook). The predominant software used is Canvas. Others used are wide-ranging.

Seventy-four participants provided insights on their reasons for using m-learning for teaching. These reasons include its convenience, especially when it comes to teaching in an online or hybrid environment – in which case it is almost a necessity. M-learning has also been found to be efficient and easy for the distribution of course materials,

provides the ability to award students extra points, helps part-time students who cannot attend class for in-class review sessions, for auto-grading purposes, requires less lecturing so the focus can be on learning, to help in managing large class sizes (including taking attendance), helps monitor student activity in class, to stay ahead of the curve, and to provide quicker feedback. Many also indicated that it increases student engagement (also for different learning styles). Others stated that it fosters experiential learning (for teams and individuals), promotes student learning, improves the classroom experience, increases student interactions (especially those not inclined to talk as much), and for motivating students. One participant commented that m-learning makes it "easier to access student submissions – no paper, no waste, do not have to read student handwriting." Another stated that "flipped classroom to allow for more hands-on engagement". One faculty uses it to text students and has them text him/her back. Other reasons provided include that it makes it easier to connect with students, it's faster than the traditional approaches, provides scalable access, provides support outside the classroom, and provides flexibility in the classroom which students appreciate. From the student perspective m-learning gives students ease of access, they are embracing m-learning and using it. But as one faculty stated is that m-learning fits with the students' lifestyle.

Many of the comments make a strong and compelling argument for the inclusion in m-learning for teaching beyond what has already been stated. As such, several of the comments were enlightening. One respondent stated that "it is expected, necessary for course functioning." Another stated that "Support from McGraw Hill reps. It's relevant to students who may be using it in the workplace - and who are using it now for learning."

Many institutions are encouraging, requesting, supporting or even mandating the use of m-learning. Some comments alluded to the fact that having training helped, or that it simply happened.

Faculty member preparedness

Of the 75 respondents, 16% indicated they had not received any type of support (technical, administrative, instructional or other). The majority had received a combination of support with 19% receiving technical, administrative, and instructional support; 21% receiving technical and instructional support, and 17% receiving technical support only. As far as satisfaction with the support received is concerned 57% were mostly or completely satisfied with the technical support received, 33% were neither satisfied or dissatisfied and 30% were mostly satisfied with the administrative support they received. Satisfaction with instructional support was similar with 33% neither satisfied or dissatisfied, 28% mostly satisfied, and 18% completely satisfied. In the other category, 74% were neither satisfied nor dissatisfied.

Participants were asked about the type of training they received or did not receive. The two options provided were formal or informal training. Of the responses received, 51% received formal training and 68% received informal training. Of the respondents that stated they had received training, a majority found both formal and informal training to be adequate. The level of satisfaction with the training received showed that 58% were either mostly or completely satisfied with the formal training they received while 71% were once again mostly or completely satisfied with the informal training they received. Overall, 90% are happy with their current use of m-learning and 35% were willing to share their knowledge and experience with others.

Users indicated that they are happy with their current use of m-learning for a myriad of reasons. These include its usefulness, effectiveness, ease of use, serving needs, student engagement, identification of uses through training, availability of adequate documentation, high student satisfaction with m-learning resources, a necessity to teach, convenient for students and faculty, and enhances course. Unhappiness with m-learning is a result of concerns about its effectiveness compared to in-class instruction, the need for better exam monitoring software, difficulty of using tools associated with m-learning, and slow learning management systems.

Recommendations and suggestions on what could make m-learning usage better was far and wide. Some of these recommendations and suggestions include better device interfaces, better training on how to use software, more training, better class management features, better institutional support, better tools and integration of the these tools along with content delivery, new approaches to instruction, more user friendly and intuitive, more awareness and better support across devices, more flexibility, more time, simpler devices and programs, voice-activated commands, and technology that measures student attention. Presented below are some of the comments provided:

- “Experimentation by fellow faculty members that could allow for deeper conversations about the availability and effectiveness of new technologies.”
- “more tech and admin support needed in academic institutions otherwise professors will cease using.”
- “remembering that it doesn't have to always be technology-based. It can be minimalistic too.”

- “Creators of m-learning tech need participation from educators. I've asked some m-learning companies if they have educators on staff and they don't even know the answer. The position of "3 designer" means something within my university. But companies steal that term to re-brand their marketing staff as having 3 knowledge they usually do not. Questions tend to be of the form "How could you use our technology in your class?" as opposed to "What are your biggest 3 challenges (in general)?"

Non-users of M-Learning

The discussion and analysis of responses provided by non-users of m-learning has been organized by the choices that were provided to participants. This section addresses RQ3 and RQ3a.

Option 2 - “I am not using m-learning currently”

A total of 96 responses were analyzed and the results show that participants are not using m-learning for the following reasons: they’ve never heard of it, they don’t know what m-learning is, don’t know how to incorporate it and what would be involved, don’t see a need for it, courses do not lend themselves or require it, teach face-to-face classes, are not comfortable with it, or because they are not interested. Many are unsure how m-learning would improve student outcomes, enhance teaching or student learning (over traditional methods), and question its effectiveness. Concerns over cost and benefits associated with m-learning are also an issue.

Other reasons for the lack of m-learning use stems from difficulties associated with implementation, course redesign, lack of time or the amount of time it would take to transition to m-learning, lack of institutional support, university constraints, no training received on how to use it, or simply because “[I find] mobile device use to be a gimmick.” One participant had tried it but found out that did not work well. Additionally, not every course is suited for m-learning, it can cause student distraction, and not all

students have access to internet-connected mobile devices. One faculty member stated that “found through my own research that students are more focused and do better with a technology ban. Ironic, as I’ve published papers on clickers in the classroom and the like.”

Option 3 – “I would like to use m-learning”

Ten participants indicated that they would like to use m-learning. The m-learning devices they would be most interested in using in their courses: four chose laptop, three indicated that they had no preference and were open to using any mobile device, one chose mobile phone, one chose laptop and that they would be open to using any mobile device, and one chose iPad or other tablets.

Option 4 – “I want to learn more about using m-learning”

Forty-five participants indicated they wanted to learn more about using m-learning. When asked if they would be interested in being contacted by someone to learn more about m-learning, 13 said yes, 31 said no, and one did not respond.

Option 5 – “I am not interested in using m-learning”

Again, many see no value or application relevant to the courses they teach, don’t see it as being effective, think m-learning is anti-intellectual, don’t know enough about it, or don’t think it is necessary. Below are a few additional responses:

- “I think technology in the classroom is a scam designed to enrich the university-textbook industrial complex and "make work" for the university IT professionals and administrators.”
- “The over reliance on technology woven into university pedagogy risks creating students who are ill equipped to handle non-technological situations (i.e. effective note taking by hand) as such I’ve chosen to keep a most analog structure, using technology only to disseminate grades and collect some assignments.”
- “I feel it detracts from the educational experience far more than it helps it.”

Option 6 – "Other: please specify"

Out of 21 who chose this option, two left the response blank and two stated they don't teach. Others were single responses that included: they were retired, it did not fit the scope of their courses, they had never heard of m-learning, asked if external projects count, stated most of learning takes place outside of class, will use m-learning next semester, uses a digital text which students can access on mobile devices, using m-learning on a very limited basis, wasn't sure based on definition that was provided, stated that everyone would be using it based on definition, teaches exclusively online, uses Piazza and email (but neither are necessarily mobile), didn't understand the definition and stated that it's too broad - everything is m-learning, partially using m-learning via course CMS, thinks he/she is using it, and one uses outside of class electronic support extensively (particularly Piazza).

Summary

Chapter 4 presented the results of the survey instrument that was administered to participants. The survey contained questions related to demographics, m-learning integration, faculty member preparedness, and questions related to the proposed research model. Of interest was the data related to the research model which focused on RQ1. Through the data analysis and comparison of the two data sets (missing data and no missing data) it was discovered that items MISU7, PP1, and PP2 had low outer loadings and their removal significantly improved both the average variance extracted (AVE) and Cronbach's alpha which are both indicators of strong internal consistency reliability as well as convergent validity. The model also met discriminant validity based on the indicator cross loadings and Fornell-Larcker criterion. The model did not display any issues with collinearity. Of significance were the results of the PLS analysis which

showed that with no missing data, the only path with a strong negative relationship is between PP and MISU – so PP does not positively and significantly influence MISU (rejecting H2c) and H2b was also rejected since this path was also found to be non-significant. That is, PE does not positively and significantly influence MISU. The R^2 values revealed that MISU, PE, and PI have weak predictive accuracy. The effect size (f^2) was small for H1a and H2a, medium for H1c, large for H1b, and H2b and H2c have no effect. Also based on the Q^2 values it was determined that all five constructs have some predictive relevance even if minimal. Similarly, the q^2 effect size was very small for PE, PU, and PP. The analysis with missing data imputed using multiple imputation in SPSS showed consistent but slightly different results. The difference from the results of the PLS analysis showed a strong negative relationship between PE and MISU. However, the same two hypotheses, H2b and H2c were also rejected due to the significance levels. Another difference that was encountered was in the analysis of effect size (f^2) where in the dataset with no missing data H1a had a small effect while with the imputed data, H1a had a medium effect. Table 21 compares the results of both analyses.

Table 21

Comparative Analysis of Results

	No missing data	Missing data – imputed
Measurement model	Strong internal consistency reliability	Strong internal consistency reliability
	Convergent validity achieved after removing MISU7, PP1, and PP2	Convergent validity achieved after removing MISU7, PP1, and PP2
	Discriminant validity was achieved	Discriminant validity was achieved
Structural model	No collinearity issues were found	No collinearity issues were found
	All paths except H2c were positive	H2b path was negative
	H2b and H2c were rejected as they were not significant	H2b and H2c were rejected as they were not significant
	R^2 values showed weak predictive accuracy	R^2 values showed weak predictive accuracy
	Effect size (f^2) was small for H1a and H2a, medium for H1c, and large for H1b	H1a has a medium effect size
	Q^2 values indicated model has minimal predictive relevance	Q^2 values indicated model has minimal predictive relevance
	f^2 effect size very small for PE, PU, and PP.	f^2 effect size large for PU and not significant for PE and PP.

The results of the qualitative data, primarily open-ended questions, helped address RQ2, RQ3 and RQ3a. The results are mixed with those that see a value in using m-learning and have benefited from its integration in their courses to those that still question its usefulness and value. Many of the concerns expressed are those that were encountered in the literature such as those discussed by Alrasheedi et al. (2013b) and Fuegen (2012).

The analysis of the demographics showed that more males than females completed the survey, most have earned doctorates and teach in the disciplines in which they obtained their highest degree. Most participants teach at public institutions and are at the assistant professor rank or higher. Given that the schools these participants teach at are doctoral granting institutions, a majority teach both undergraduate and graduate classes, predominantly in-person or face-to-face. The numbers were about equally split between tenured and not on-tenure-track faculty.

M-learning integration by faculty is being done using a wide variety of methods such as for in-class and out-of-class activities, for face-to-face, online, as well as hybrid courses. Activities include assignments, cases analysis, quizzes, polling, projects, homework, etc. Most of the faculty have been using m-learning between 1-6 years (63%) and use it anywhere from several times a day to 3-5 days per week (87%). The majority of faculty feels moderately to very comfortable using m-learning. Distribution of course materials is most common (lecture slides, recordings, ebooks, etc.). Participants had most experience using m-learning as a faculty but not when they were students themselves. Their level of satisfaction in using m-learning was high (86%), 71% of the them thought that m-learning is an innovative approach to teaching, and 67% of them stated that m-learning was beneficial to teaching frequently or usually. The two activities that faculty

mostly engaged in was emailing students and colleagues. A wide variety of reasons were offered about why faculty have adopted m-learning. Some of these include convenience, efficiency and ease with which course materials can be distributed, auto-grading features of applications, active learning, and student engagement among others.

Investigating faculty preparedness was another important component of this research. Based on the results, this is an area that needs more attention. The successful integration of m-learning can only happen if there is support for training. Only 16% of the respondents had not received any type of support. The remaining had received a combination of technical, administrative, and instructional support. Satisfaction with the support received was high. Both informal and formal training was delivered to the participants. Overall, the participants are happy with their current use of m-learning for a wide variety of reasons, but they also expressed some concerns and offered recommendations and suggestion on ways to improve the use of m-learning.

Participants who are currently not using m-learning offered the following reasons: never having heard of it, not knowing what it is, unaware of how to integrate it, don't see a need or relevance related to the courses they teach, among others. Concerns were also expressed regarding its effectiveness.

Chapter 5

Conclusions, Implications, Recommendations, and Summary

Conclusions

The primary goal of the dissertation research was to understand the motivation factors for using mobile information systems in m-learning. This was accomplished by empirically testing the impact of perceived usefulness (PU), perceived enjoyment (PE), and perceived playfulness (PP) on mobile information systems use (MISU). The impact of personal innovativeness (PI) on PU, PE, and PI was also tested. The research model helped answer RQ1. RQ2 and RQ3 were answered by including both closed-ended and open-ended questions in the survey. The three research questions are listed below.

RQ1: What are the motivating factors driving m-learning use?

RQ2. How is m-learning being used for teaching, learning, and training?

RQ3. Why are only a few educators using m-learning?

RQ3a. What are the factors impeding m-learning?

The research objectives were met satisfactorily by first having the survey instrument validated by an expert panel. The expert panel included three participants and a colleague in the information systems discipline. A pilot study was conducted next which included contacting 13 participants, however only four participants completed the

survey. During the final research study phase, faculty from the disciplines of computer science, information systems, and business teaching at 60 US AAU member institutions were surveyed. The final sample size was 379.

Discussion

The research framework that was developed to answer RQ1 regarding the motivation factors driving m-learning use included five constructs: PI, PU, PE, PP, and MISU. This resulted in the testing of six hypotheses. The six hypotheses that were tested are:

- H1a: PI will positively and significantly influence PU.
- H1b: PI will positively and significantly influence PE.
- H1c: PI will positively and significantly influence PP.
- H2a: PU will positively and significantly influence MISU.
- H2b: PE will positively and significantly influence MISU.
- H2c: PP will positively and significantly influence MISU.

The model was tested with and without missing data. Although the results were consistent, there were some differences. The model assumed that PI would positively and significantly influence PU, PE, and PP and PU, PE, and PP would positively and significantly influence MISU (the dependent variable).

Several important conclusions emerge from the analysis. First, PI did positively and significantly influence PU, PE, and PP. This led to accepting H1a, H1b, and H1c. Hwang's (2014) research had explored testing the impact of personal innovativeness of IT (PIIT) on the intrinsic motivation factors perceived enjoyment (PE) and perceived ease of use (PEOU) and the extrinsic motivation factor of perceived usefulness (PU) as it related to the use of ERP systems. Hwang arrived at similar conclusions with PIIT influencing PE, PEOU, and PU. In the context of this study, the fact that PI positively and

significantly influences PE, PU, and PP implies that the participants are willing to try using new technologies, such as mobile information systems, because they find these systems to be useful, enjoyable, and like interacting with these.

Second, PU was found to positively influence MISU. This implies that participants are using mobile information systems (m-learning) because they find m-learning to be useful for teaching and student learning. Chen, Meservy, and Gillenson (2012) had studied the impact of PU on IS continuance intention and had found that PU did positively impact IS use. They indicated that it was supported because "…multiple studies had previously tested and validated relationships between those constructs in other contexts" (p. 140). However, PE and PP do not influence MISU which means that using mobile information systems for m-learning is not perceived to be enjoyable or interesting to use or that enjoyment and playfulness are not the reasons that would influence using mobile information systems, such as m-learning. This led to accepting H2a and rejecting H2b and H2c. This is contrary to what had been expected given that Praveena and Thomas (2014) had found PE to be "…a strong determinant of attitudes towards using Facebook…" (p. 24), when using TAM. Dumpit and Fernandez (2017) in their study of the use of social media by students in higher education institutions found that happiness, not leisure and interest influenced intention to use. They had reported other studies that had arrived at the same conclusion that perceived playfulness "…did not affect intention to use…" (Results section, para 9). Perhaps because m-learning is still not fully accepted or understood would explain the rejection of H2b and H2c. Third, based on R^2 and Q^2 values, the model has a weak predictive accuracy and minimal predictive relevance. Fifth, the f^2 of PE and PP has no effect on MISU, which also

confirmed the rejection of H2b and H2c while the other effect sizes confirm accepting H1a, H1b, H1c, and H2a. Lastly, the q^2 effect size showed mixed results with little to no significance with missing data for PE, PU, and PP and a large effect size for PU and no significant effect size for PE and PP with no missing data.

M-learning is being integrated in a variety of ways by those who identified themselves as users. It is being used for in-class as well as out-of-class activities and for online as well as hybrid courses. Participants identified a wide range of activities that have proven beneficial with m-learning. Examples include case analysis & discussions, case studies, quizzes, presentations, among others. Most of the users had been using m-learning in the 1-6 years range (63%). Resources provided to students via m-learning include lecture slides, audio and video recordings, etc. Participants with prior experience in the use of m-learning as an instructor expressed their experience levels with m-learning to be between moderate to substantial (90%). More participants had prior experience using m-learning as an instructor (85%) but not as a student (29%). Which indicates that perhaps they adopted it as part of their teaching realizing its potential, necessity, or as a mandate. Satisfaction with m-learning among users is high ranging from somewhat to mostly satisfied (86%). Half of the respondents stated that m-learning in not problematic and over 70% consider it to be an innovative approach to teaching and 67% found it to be beneficial for teaching frequently or usually. This finding was surprising and contradictory to what has been stated by non-users of m-learning. Use of mobile devices to email students (75% use it frequently, usually or always) and colleagues (80% use it frequently, usually, or always) is the most widely used activity performed among 18 different activities listed in the survey. Receiving training did seem

to have made a difference in the use of m-learning. Training received was a combination of technical, administrative, and instructional as well as formal and informal. Satisfaction of the training received was high. Most respondents were happy with current use of m-learning (90%). Reasons cited included its usefulness, effectiveness, necessity, convenience, etc. Participants also provided ways in which m-learning usage could be better.

Similarly, the participants provided insights into why m-learning is not being used and what is impeding its use. Table 22 provides a summary of the advantages listed by users of m-learning along with disadvantages or reasons against the use of m-learning by non-users. These reasons address RQ3 and RQ3a.

Table 22

Comparative Analysis of Users vs Non-Users of M-Learning

	Advantages	Disadvantages	Other
Users	Convenience, efficient, ease of distribution of course materials, auto-grading, less lecturing, attendance taking, stay ahead of curve, quicker feedback, experiential learning, promotes student learning, improves classroom experience, increases student interactions, motivating students	Poor device interfaces, lack of training, poor class management features, lack of institutional support, need for new approaches to instruction, need for more user friendliness and intuitive use, lack of awareness, lack of support across devices, need for more flexibility, need more time, need simpler devices and programs,	Need for experimentation and sharing with colleagues, more support,
Non-Users		Difficult to implement, requires course redesign,	Haven't heard of m-learning, don't know what it

Advantages	Disadvantages	Other
	lack of time, lack of institutional support, university constraints, no training received, causes student distractions, not all students have internet-connected devices, not relevant to courses taught, ineffective, anti-intellectual	is, don't know how to incorporate it and what would be involved, don't see a need for it, courses don't lend themselves, are not comfortable with it, unsure how it would improve learning outcomes, question its effectiveness, unnecessary

As reported in previous studies, faculty perceptions have hindered m-learning integration (Alrasheedi et al., 2013b; Crow et al., 2010; Ferreira et al., 2013; Fuegen, 2012; Hall 2012; MacCallum et al., 2014) and the acceptance issue remains unresolved (Ferreira et al.). The research study found that those participants who are using it do so because they want to, because it is mandated, or because it is expected. Those who are not using it find it be of little or no value, irrelevant, ineffective, haven't heard of m-learning, or simply don't know how to integrate it into the classroom. This clearly indicated that continued research is needed, and more importantly higher education institutions need to do a better job of supporting faculty in ways that will encourage m-learning use for teaching and student learning. The successful integration of m-learning (Fong, 2013) will depend on the establishment of guidelines and policies (Sarrab et al., 2013). As O'Bannon and Thomas (2014) had discussed, as today's students pursue teaching in higher education, the problems associated with using technology will be a thing of the past. Increasing awareness, providing professional development and training (Corbeil & Corbeil, 2011; Crow et al., 2010; Eteokleous & Ktoridou, 2009; Shim & Shim

(2001-2002), release time (Handal et al., 2013) to allow faculty to develop courses using m-learning are important. For industry practitioners, m-learning offers the flexibility to deliver training to employees, particularly those working remotely. Advantages cited include boost to productivity, better retention and just-in-time support, use of mobile device applications, offline access, reduced costs, consistency of training delivered, and employee retention (Hughes, 2019).

Despite the very large number of faculty who were emailed to participate in this research study, only faculty teaching at 60 US AAU member institutions were targeted. This may have affected the generalizability of the study. Another limitation of the study was the low number of responses received with missing data for many of the survey questions. This could have been the result of non-response error, due to both active and passive respondents. This limited a deeper understanding of the results. A third limitation was that this research study was survey-based which may have introduced bias in the responses received.

Implications

The results achieved from the study are valuable and provide significant contributions to the body of knowledge. The research helped 1) identity motivation factors driving the use of mobile information systems for m-learning, 2) understand how m-learning is being used for teaching, learning, and training, 3) understand why only a few educators are using m-learning, and 4) identify factors impeding m-learning use. Additionally, the study identifies best practices for m-learning use in any organizational setting, not just higher education. The research extends prior research on m-learning which has been deficient in understanding faculty use of m-learning. No prior research studies were found that looked at motivation factors for the use of m-learning and were

limited on understanding faculty use with most research focused on student use. Research on information systems use is ample but research focusing on mobile information systems use is limited or nonexistent. This is the unique contribution of this research to the fields of HCI/UX, Information Systems, and M-learning. It is possible that there may be other factors that would better explain m-learning non-use such as resistance to use as noted by Abu-Al-Aish et al. (2013). Although in a study conducted by Levy and Danet (2010), which involved surveying participants at the NASA Langley Research Center to understand "…the impact of users' involvement, resistance, and computer self-efficacy on the implementation success of a centralized identification system" (p, 19) found that in the context of their study, resistance had "…little or no effect on IS usage…" (p. 27-28).

Recommendations

Research on m-learning is currently ongoing. The results of this research indicate that more research is needed. The research should be expanded to consider culture and interface design, which were beyond the scope of this study. Future research on m-learning should also be expanded to include more institutions of higher education and additional disciplines. Non-response rate and the generalizability of the study must also be accounted for. Grounding the study in other information systems theories that may better explain use or non-use is also suggested. This would allow investigating other factors beyond PI, PU, PE, and PP, such as resistance to use. Third wave HCI, housed in experience, suggests performing a qualitative study or perhaps even a mixed-methods study. Additionally, faculty preparedness is an area that needs to be investigated further. Finally, as suggested by Ball and Levy (2008) "additional research on how to encourage instructors to use emerging educational technology in the classroom would also benefit both researchers and practitioners" (p. 439).

Summary

This research study explored the motivation factors for the use of mobile information systems for m-learning. M-learning is used in the corporate world to provide training to employees whereas in higher education, it has become a medium for teaching, student learning, and professional development. While there is no agreed upon definition for m-learning, various studies have attempted to provide insights into what exactly m-learning is (Cheon et al., 2012; Gupta & Koo, 2010; Fong, 2013; Lam et al., 2010; Park, 2011; Pereira & Rodrigues, 2013; Sarrab et al., 2012), it involves using mobile devices to access information anywhere, at any time. The purpose of this research was to gain a deeper understanding of m-learning to understand how m-learning can be integrated more effectively in higher education by faculty as discussed by Crow et al. (2010), Lam et al. (2010), and Pollara (2011) since educators are training the future workforce, comprised of millennials, who have grown up with technology. Furthermore, Krull and Duart (2017) reported that 78% of studies were focused on students, 10% on faculty, and 12% on both faculty and students. So significant research has already taken place on students' use and perceptions of m-learning, but not faculty. The successful integration of m-learning is dependent upon technological advancements, culture, interface design, and motivation. The third wave of HCI is characterized to include culture, emotion, and experience (Bødker, 2006). In turn, user experience is influenced by motivation (Vermeeren et al., 2010). One of the three motivation categories is hedonic which includes emotions such as fun, enjoyment, and pleasure (Kim et al., 2013). In information systems literature hedonic motivation is conceptualized as perceived enjoyment (Venkatesh et al., 2012). Motivation is further classified as either intrinsic or extrinsic. Intrinsic and hedonic motivation are the same (Vallerand et al., 1992). Perceived enjoyment (PE) and

perceived playfulness (PP) are intrinsic motivation factors and perceived usefulness (PU) is an extrinsic motivation factor (Cheng, 2014; Hwang, 2005; Wakefield & Whitten, 2006). The research framework model, adapted from Hwang (2014) focused on investigating the impact of PU, PE, and PP on mobile information systems use (MISU). Additionally, the influence of personal innovativeness (PI) on PU, PE, and PP was also investigated.

The extensive literature review that was conducted identified both advantages and disadvantages of using m-leaning, both in corporations as well as higher education. Lumsden et al. (2015) had argued in favor for the need for m-learning. Numerous studies discussed benefits of using m-learning in the corporate workplace (Ally et al., 2013; Dabbagh et al., 2016; Dhruve, 2018; Hashemi et al., 2011; Kahle-Piasecki et al., 2012; Lac et al., 2014; Pappas, 2017; Parsons, 2014; Williams, 2018). Similarly, Ferreira et al. (2013), Gupta and Koo (2010), Ktoridou and Eteokleous (2005), and Sinen (2015) discussed benefits of using m-learning in higher education. However, in higher education, m-learning use is not as widespread as it was expected to be – due to many implementation challenges articulated in the m-learning body of research (Abu-Al-Aish et al., 2013; Alrasheedi & Capretz, 2013b; Cheon et al., 2012; Cruz et al., 2012a, 2012b; Corbeil & Corbeil 2007; Deegan & Rothwell, 2010; Eteokleous & Ktoridou, 2009; Ferreira et al., 2013; Frazier, 2013; Handal et al., 2013; Pollara, 2011). The literature kept stating the need for researching m-learning (Crompton & Burke, 2018; Ferreira et al., 2013; Lam et al., 2010; Pereira & Rodrigues, 2013; Pimmer & Pachler 2014; Pollara, 2011; Sanakulov & Karjaluoto, 2015; Sanderson & Hanbidge, 2017) in higher education, but that is as far as it went. Several studies also indicated that m-learning is not applicable

to all disciplines (Fong, 2013; Sarrab et al., 2013). Corbeil and Corbeil (2011) had identified four disciplines in which m-learning use was difficult to implement: business, information technology, computer science, and education. Hence not only was the study aimed at faculty in higher education, but the scope was narrowly focused on the disciplines of information systems, computer science, and business.

Using a quantitative, survey-based approach the study attempted to answer three research questions:

- RQ1: What are the motivation factors driving m-learning use?
- RQ2: How is m-learning being used for teaching, learning, and training?
- RQ3: Why are only a few educators using m-learning?
    - RQ3a: What are the factors impeding m-learning use?

The research framework to answer RQ1 included four independent variables and one dependent variable. The independent variables included PI, PU, PE, and PP. The dependent variable was MISU. This resulted in testing six hypothesis:

- H1a: PI will positively and significantly influence PU.
- H1b: PI will positively and significantly influence PE.
- H1c: PI will positively and significantly influence PP.
- H2a: PU will positively and significantly influence MISU.
- H2b: PE will positively and significantly influence MISU.
- H2c: PP will positively and significantly influence MISU.

Before the study was conducted, IRB approval was received from the University of Pittsburgh and Nova Southeastern University. The analysis of the research model was performed using structural equation modeling (SEM). In the first step, content validity was established through an expert panel review of the survey instrument. In the second step, a pilot study was conducted at a regional campus of the University of Pittsburgh to further help validate the survey instrument. The third and final step involved

administering the survey using Qualtrics as part of the final study. For the final study, faculty from 60 US AAU member institutions teaching in the disciplines of computer science, information systems, and business were emailed requesting their voluntary participation in the study. A total of 379 responses were analyzed.

The results showed that the elimination of MISU7, PP1, and PP2 greatly improved the model's internal consistency reliability and convergent validity. While the model also showed discriminant validity and did not have any collinearity issues, the structural paths showed that PE and PP did not significantly and positively influence MISU. This resulted in rejecting H2b and H2c. An analysis of R^2 and Q^2 revealed a model with a weak predictive accuracy and minimal predictive relevance. The q^2 effect size was also not very promising. Results obtained from imputing the data to replace missing values for PP and MISU in 12 cases were similar but with some differences.

RQ2, RQ3, and RQ3a provided additional insights into how m-learning is being used, why it is being used on a limited basis, and what factors are impeding its use. Users of m-learning are using it as a tool for active learning, student engagement, and for improving the classroom experience. Benefits cited included the ability to use tools that allow for auto-grading and attendance taking, to administer assignments, quizzes, and projects, and to provide course materials. Non-users provided a variety of reasons why they were not or did not want to use m-learning. Reasons included not knowing what m-learning is, not having heard of it, not knowing how to incorporate it, questioned its effectiveness, did not have enough support and training, etc. The need for professional development and training had been previously discussed by Shim and Shim (2001-2002), Eteokleous and Ktoridou (2009), Crow et al. (2010), and Corbeil and Corbeil (2011).

In conclusion, this research study conducted an in-depth review and analysis of the use of mobile information systems, particularly m-learning in higher education. The development of the research framework required triangulating the fields of HCI/UX, Information Systems, and M-learning – which had not been done in any prior studies. The main research contribution of the study was to address the gap in the literature wherein previous studies had mentioned the need to survey faculty use of m-learning, but no studies had attempted this. Much of the research in m-learning has focused on students. Prior studies did not attempt to understand the motivation factors behind the use of m-learning by faculty. While the model indicated a weak predictive accuracy and minimal predictive relevance, the research contributions pave a way for future research.

Future research on m-learning should focus on aspects such as culture and interface design. Extending this research to include more institutions of higher educations and disciplines is also recommended. Investigating faculty preparedness is an area that needs to be further researched. Factors other than PI, PU, PE, and PP to determine MISU should be identified. Besides a quantitative study, qualitative or mixed methods studies are also suggested. The research is of importance to both practitioners and educators.

Appendix A

Faculty member survey instrument

[Pre-screening of non-users of m-learning]

Options:

1A - answer question #6 and complete users and demographics section
1B - answer question #2 and complete demographics section
1C - answer question #4 and complete demographics section
1D – answer question #5 and complete demographics section
1E - answer question #3 and complete demographics section

1. Which of the following best describes your current view of the use of m-learning in the classroom? (M-learning is a broad term that embraces access to learning both within and outside of the classroom rather than learning only happening in a fixed location. It also involves incorporating technological and mobile devices to complement, enhance, and further learning in the classroom.)

a) I am using m-learning currently
b) I am not using m-learning currently
c) I would like to use m-learning
d) I want to learn more about using m-learning
e) I am not interested in using m-learning
f) Other (please specify) _____

2. If you are not using m-learning, please explain why?

3. If you are not interested in using m-learning, please explain why?

4. What m-learning devices are you interested in using in your course(s)? Choose all that apply.

a) iPad
b) Laptop
c) Other tablets
d) Other (please specify)
e) No preference (I'm open to any mobile device)
f) No preference (I don't have enough background knowledge to make a choice)
g) I prefer not to use any mobile learning devices

5. Would you be interested in being contacted by someone to learn more about mobile learning?

a) Yes
b) No

[If the answer is yes: please provide your name and email address]

[USERS OF M-LEARNING]

M-learning integration

6. Which of the following best describes YOUR use of m-learning at your current institution? Please check all that apply.

a) For in-class activities
b) For out-of-class activities
c) For an online course
d) For a hybrid course
e) For professional development/training

7. Personal Innovativeness (PI) – "willingness of an individual to try out any new information technology." (Agarwal & Prasad, 1998, p.260)

Strongly Disagree 1	Disagree 2	Slightly Disagree 3	Neither agree or disagree 4	Slightly agree 5	Agree 6	Strongly Agree 7
PI1. If I hear about new information technology, I will look for ways to experiment with it.						
PI2. Among my peers, I am usually the first to try out new information technologies.						
PI3. In general, I am not hesitant to try out new information technologies.						
PI4. I like to experiment with new information technologies.						

8. (Perceived) Usefulness (PU) – "degree to which a person believes that using a particular system would enhance his or her job performance." (Davis, 1989, p. 320)

Strongly Disagree 1	Disagree 2	Slightly Disagree 3	Neither agree or disagree 4	Slightly agree 5	Agree 6	Strongly Agree 7
PU1. Using m-learning makes it easier to teach.						
PU2. Using m-learning enhances my teaching effectiveness.						
PU3. Using m-learning gives me greater control over teaching.						
PU4. I find m-learning to be useful in my teaching.						

9. Perceived Enjoyment (PE) – "extent to which the activity of using the computer is perceived to be enjoyable in it's own right, apart from any performance consequences, that may be anticipated." (Davis et al., 1992, p. 1113)

	Strongly Disagree 1	Disagree 2	Slightly Disagree 3	Neither agree or disagree 4	Slightly agree 5	Agree 6	Strongly Agree 7
PE1. Using m-learning is fun							
PE2. Using m-learning is enjoyable							
PE3. Using m-learning is very entertaining (pleasant)							
PE4. Using m-learning is interesting.							

10.Perceived Playfulness (PP) – "the extent to which the individual finds the interaction **intrinsically enjoyable or interesting." (Moon & Kim, 2001, p. 219)**

	Strongly Disagree 1	Disagree 2	Slightly Disagree 3	Neither agree or disagree 4	Slightly agree 5	Agree 6	Strongly Agree 7
PP1. When using m-learning, I will not realize the time elapsed.							
PP2. When using m-learning, I will forget the work I must do.							
PP3. Using m-learning will give enjoyment to me for my teaching.							
PP4. Using m-learning will stimulate my curiosity.							
PP5. Using m-learning will lead to my exploration.							

11. Mobile Information Systems Use (MISU) - – involves the use of mobile devices to use an information system to "…carry out tasks and activities on the job for which the information system is designed to support" (Sun & Teng, 2012). Examples would include using learning management systems such as Blackboard and Banner.

Strongly Disagree 1	Disagree 2	Slightly Disagree 3	Neither agree or disagree 4	Slightly agree 5	Agree 6	Strongly Agree 7
MISU1. I use mobile information systems on a regular basis.						
MISU2. I will continue to use mobile information systems in the future.						
MISU3. I intend to continue using mobile information systems.						
MISU4. I want to continue using mobile information systems rather than discontinue.						
MISU5. I predict I will continue using mobile information systems.						
MISU6. I plan to continue using mobile information systems.						
MISU7. I will stop using mobile information systems in the future.						

12. How long ago did YOU start using m-learning?

a) Less than 1 year
b) 1-2 years
c) 3-4 years
d) 5-6 years
e) 7-8 years
f) 9-10 years
g) More than 10 years

13. How often do YOU use m-learning? Please check all that apply.

a) Several times a day
b) about once a day
c) 1-2 days a week
d) 3-5 days a week
e) every few weeks
f) less often
g) never

14. What is your level of comfort in using m-learning?

a) Very uncomfortable
b) Moderately uncomfortable
c) Slightly uncomfortable
d) Neutral
e) Slightly comfortable
f) Moderately comfortable
g) Very comfortable

15. Which of the following teaching resources do YOU provide on a handheld mobile device? Select all that apply.

a) Lecture PPT slides
b) audio recordings (e.g., recordings of lectures, school information)
c) videos (e.g., course-related, recordings of lectures, school information)
d) print content
e) ebooks
f) flashcards and other interactive educational games
g) hyperlinks to course-related reference material
h) Blackboard
i) Other _____

16. Do you have any prior experience using m-learning?

	Yes (1)	No (2)
As an instructor (1)?		
As a student (2)?		

17. Please indicate level of experience in using m-learning as an instructor:

a) None
b) Minimal
c) Little
d) Some
e) Moderate
f) Extensive
g) Substantial

18. Please indicate level of experience in using m-learning as a student:

a) None
b) Minimal
c) Little
d) Some
e) Moderate
f) Extensive
g) Substantial

19. Rate your level of satisfaction with the use of m-learning.

a) Completely dissatisfied
b) Mostly dissatisfied
c) Somewhat dissatisfied
d) Neither satisfied nor dissatisfied
e) Somewhat satisfied
f) Mostly satisfied
g) Completely satisfied

21. Rate the following statements.

	Strongly disagree 1	Disagree 2	Slightly disagree 3	Neither agree or disagree 4	Slightly agree 5	Agree 6	Strongly agree 7
Using m-learning is problematic (1)							
M-learning is an innovative approach to teaching (2)							

22. M-learning is beneficial for teaching.

a) Never
b) Rarely
c) Occasionally
d) Sometimes
e) Frequently
f) Usually
g) Always

23. How frequently do you engage in the following activities using your mobile device(s) to support student learning?

Activity	Never	Rarely	Occasionally	Sometimes	Frequently	Usually	Always
	1	2	3	4	5	6	7
a) E-mailing students							
b) E-mailing colleagues							
c) Texting students							
d) Texting colleagues							
e) Posting grades							
f) Posting to discussion boards							
g) Accessing course site							
h) Accessing library resources							
i) Accessing social networking							
j) Ordering textbooks							
k) Searching the internet							
l) Providing tutoring services							
m) Preparing lessons							
n) Conducting seminars							
o) Collecting data for coursework							
p) Reading e-books							
q) Taking pictures or making videos to include in your courses							
r) Other (please specify)							

24. What technologies do you use for m-learning (hardware, software)?

25. What are other reasons for why you decided to use m-learning for teaching?

26) What type of support did you receive? Check all that apply

(1) Technical
(2) Administrative
(3) Instructional
(4) None
(5) Other: please specify

27) Rate your level of satisfaction for each of the support you received.

Completely dissatisfied 1	Mostly dissatisfied 2	Somewhat Dissatisfied 3	Neither satisfied or dissatisfied 4	Somewhat satisfied 5	Mostly satisfied 6	Completely satisfied 7
Technical						
Administrative						
Instructional						
Other						

28) Did you receive any type of training?

	Yes (1)	No (2)	No training provided (3)
Formal training (classroom instruction, workshop, vendor provided) 1			
Information training 2			

29) Was the training adequate?

	Yes (1)	No (2)
Formal training (1)		
Informal training (2)		

30) Rate your level of satisfaction with the training you received.

Completely dissatisfied 1	Mostly dissatisfied 2	Somewhat dissatisfied 3	Neither satisfied or dissatisfied 4	Somewhat satisfied 5	Mostly satisfied 6	Completely satisfied 7
Formal training 1						
Informal training 2						

31) Are you happy with current use?

a) Yes
b) No

32) Please explain your response to the previous question.

33) What could make m-learning usage better?

34) Would you be interested in sharing your knowledge and experiences with using mobile devices and/or Apps with other faculty members?

a) Yes
b) No
c) Other (please specify)

35) If you answered yes to the previous question, please provide your name and email address.

Demographics

36) Please indicate your gender.

a) Male
b) Female
c) Prefer to self-identify:
d) Prefer not to respond

37) Please indicate your age group.

a) 20-29
b) 30-39
c) 40-49
d) 50-59
e) 60-69
f) 70-79
g) 80 and over

38) Your number of years of teaching experience: _____

39) Your number of years in higher education: _____

40) Your academic rank.

a) Lecturer
b) Instructor
c) Assistant professor
d) Associate professor
e) Professor
f) Emeritus
g) Other: (please specify)

41) Please indicate highest education level achieved.

a) Master's
b) Doctorate
c) Professional degree (please specify)
d) Other: (please specify)

42) Please indicate the discipline in which you obtained your highest degree.

43) Please indicate your program/area/discipline in which you are currently teaching:

a) Information Systems
b) Business (please specify): _____
c) Computer Science

44) What college level are you teaching?

a) Undergraduate
b) Graduate
c) Both undergraduate and graduate

45) Do you teach courses for students? Select all that apply

a) on-campus
b) off-campus (purely online)
c) hybrid (on-campus and online)

46) How long have you been teaching on-campus (i.e. in-person, face-to-face) courses?

47) How long have you been teaching online courses?

48) How long have you been teaching hybrid courses?

49) Do you teach full-time or part-time?

a) full-time
b) part-time

50) Please indicate the type of university you are currently affiliated with.

a) Public
b) Private

51) What is your tenure status?

a) Currently hold tenure at this institution
b) Currently on tenure-track at this institution
c) Not on tenure-track at this institution
d) Tenure is not available at this institution

52) What is the length of your contract?

a) One term contract
b) Nine to twelve months contract
c) Multiyear contract
d) Continuous appointment

Appendix B

Summary of M-Learning Research

Table B1

M-Learning Research

Country	Research Model	Research Purpose	Research Method	Data Collection Method	Context	Author(s)
Australia		Computer Science faculty attitudes towards the use of mobile technology during programming lectures. Two factors: willingness to integrate and those that influence successful integration	Qualitative study	Semi-structured interviews	Ten faculties were invited; 7 accepted from a School of Computer Science and Technology. Thirty-minute interviews; xix interviews were audio-recorded.	Alsaggaf, Hamilton, & Harland (2012)
Oman and UAE	UTAUT	Attitudes towards the use of m-learning	Quantitative	Surveys	383 students and 54 instructors from five universities	Al-Emran, Elsherif, & Shaalan (2016)

Country	Research Model	Research Purpose	Research Method	Data Collection Method	Context	Author(s)
Saudi Arabia	None	Attitudes towards m- learning	Quantitative	Survey with 37 items	362 faculty at King Saud University in 2012-2013.	Alwraikat & Tokhaim (2014)
USA	TAM	Factors that determine faculty adoption of student in-class use of mobile computing technologies	Mixed Methods	Survey and interviews.	Survey completed during the interview. 29 faculty participated. All were from a Business College.	Benham & Carvalho (2016)
Korea and USA	None	Faculty use and perception of mobile ICT for teaching.	Mixed methods	Survey and interviews.	59 participants with 44 respondents (13 US and 31 Korean) at three different institutions (2 large 4-year research universities in Korea and one large public research university in the northeast U.S.).	Biddix, Chung, & Park (2016)

Country	Research Model	Research Purpose	Research Method	Data Collection Method	Context	Author(s)
USA	None	Students and Faculty	Quantitative	Survey	263 graduate and undergraduate students enrolled in 24 online courses; 74 full- and part-time faculty.	Corbeil & Corbeil (2011)
USA	None	Faculty	Qualitative	Semi-structured interviews	Three participants from a mid-size public university.	Crow et al. (2010)
France	None	Understand use and adoption of mobile technologies by faculty	Mixed methods	Survey and interviews	Fourteen faculties in a French Business School.	Cruz, Assar, & Boughzala (2012a)
China	None	Factors influencing the use of modern instructional technology	Mixed methods	Survey and interviews.	320 full-time faculty at a mid-sized North China University of Technology	Du (2010)

Country	Research Model	Research Purpose	Research Method	Data Collection Method	Context	Author(s)
Cyprus	None	Evaluate faculty readiness and feasibility of mobile technology integration	Mixed methods	Survey and interviews	Three private universities. 200 faculty members were sent the survey. Twenty were interviewed.	Eteokleous & Ktoridou (2009)
USA	Not available	Faculty perceptions about the role of new learning technologies in graduate management education and how to bridge the gap.	Quantitative	Survey	Not available	Hall (2012)
Australia	None	Explore academic's perceptions about the use of mobile devices for teaching and learning	Mixed methods	A survey with three open-ended questions.	177 participants.	Handal, MacNish, & Petocz (2013)

Country	Research Model	Research Purpose	Research Method	Data Collection Method	Context	Author(s)
USA	None	Faculty perceptions of the use of mobile devices, student use, and perceived barriers.	Mixed methods	Survey and interviews	1152 faculty from Midwestern Land-grant university were sent the survey. 594 surveys were completed. 28 faculty were interviewed.	Hauptman (2015)
USA	None	Perceptions of business educators regarding mobile device use in the classroom.	Quantitative, descriptive.	Survey	642 Business educators belonging to Delta Pi Epsilon were contacted, and 195 completed the survey.	Henderson & Chapman (2012)

Country	Research Model	Research Purpose	Research Method	Data Collection Method	Context	Author(s)
UAE	None	Faculty perceptions about integration, affordances, and challenges of m-learning were investigated.	Qualitative	Semi-structured interviews	Thirteen full-time faculty members from the colleges of Business Administration, Education, Humanities and Social Science, Pharmacy, and Law at Al Ain University of Science and Technology.	Ishtaiwa, Khaled, & Dukmak (2015)
India	None	Faculty perception towards m-learning adoption and usage.	Quantitative	Survey	Three institutions, 150 were sent a survey, 120 were analyzed.	Kalyani, Pandeya, & Singh (2012)

Country	Research Model	Research Purpose	Research Method	Data Collection Method	Context	Author(s)
India	None	Faculty attitude towards m-learning, motivators, and barriers towards m-learning use.	Quantitative	Survey	One hundred management faculty at various institutions, 80 questionnaires were analyzed.	Kalyani, Singh, & Pandey (2012)
Unknown	TAM with three additional variables: digital literacy, ICT anxiety, and ICT teaching self-efficacy	Faculty acceptance of m-learning.	Quantitative	Survey	196 respondents with 175 valid responses.	Mac Callum, Jeffrey, & Kinshuk (2014)
USA	M-Learning Acceptance Model (extension of TAM)	Faculty and Student	Quantitative	Survey	Online undergraduate and graduate faculty and students at one university.	Marrs (2013)

Country	Research Model	Research Purpose	Research Method	Data Collection Method	Context	Author(s)
USA	None	Faculty and Students' attitudes, ownership, and classroom use of mobile devices	Quantitative	Survey	Campus-wide survey at East Tennessee State University.	Melton & Kendall (2012)
USA	None	Faculty perceptions of benefits and barriers to mobile computing in higher education	Quantitative	Survey	98 full-time faculty on one of two campuses at a large private university in the northeast received the survey. Responses received from 39 faculty members.	Shim & Shim (2000-2001)
Turkey	Diffusion of Innovation	ICT usage as an indicator of diffusion.	Quantitative	Survey	814 faculty members across 22 universities.	Usluel, Askar & Bas (2008)
Malaysia		Educator perceptions	Qualitative	Lecture and tutorial sessions; interviews	12 Multimedia faculty at a private university over seven months in 2010	Zulkafly Koo, Shariman, & Zaimuddin (2011)

Appendix C

AAU Membership: Public and Private[1]

Public	Private	Canadian
Georgia Institute of Technology	Boston University	McGill University
Indiana University	Brandeis University	University of Toronto
Iowa State University	Brown University	
Michigan State University	California Institute of Technology	
The Ohio State University	Carnegie Mellon University	
The Pennsylvania State University	Case Western Reserve University	
Purdue University	Columbia University	
Rutgers University-New Brunswick	Cornell University	
Stony Brook University-State University of New York	Duke University	
Texas A&M University	Emory University	
University at Buffalo, The State University of New York	Harvard University	
The University of Arizona	The Johns Hopkins University	
University of California, Davis	Massachusetts Institute of Technology	
University of California, Berkeley	New York University	
University of California, Irvine	Northwestern University	
University of California, Los Angeles	Princeton University	
University of California, San Diego	Rice University	
University of California, Santa Barbara	Stanford University	
University of Colorado Boulder	Tulane University	
University of Florida	The University of Chicago	
University of Illinois at Urbana- Champaign	University of Pennsylvania	
The University of Iowa	University of Rochester	
The University of Kansas	University of Southern California	
University of Maryland at College Park	Vanderbilt University	
University of Michigan	Washington University in St. Louis	
University of Minnesota, Twin Cities	Yale University	
University of Missouri, Columbia		
The University of North Carolina at Chapel Hill		
University of Oregon		
University of Pittsburgh		
The University of Texas at Austin		
University of Virginia		
University of Washington		
The University of Wisconsin-Madison		

[1] Retrieved from https://www.aau.edu/who-we-are/our-members.

Appendix D

Demographics Data Analysis

Table D1

On-campus, Off-campus, Hybrid Courses

Frequency range	On-campus		Online		Hybrid	
	Count	Percentage	Count	Percentage	Count	Percentage
0-10	89	38%	24	77%	42	79%
11-20	48	20%	6	19%	7	13%
21-30	49	21%	1	3%	3	6%
31-40	32	14%	0	0%	1	2%
41-50	14	6%	0	0%	0	0%
51 or more	0	0%	0	0%	0	0%

Table D2

Years of Teaching Experience

Frequency Range	Count	Percentage (%)
0-10	99	35%
11-20	63	23%
21-30	55	20%
31-40	40	14%
41-50	20	7%
51 or more	3	1%

Table D3

Years in Higher Education

Frequency Range	Count	Percentage
0-10	91	33%
11-20	72	26%
21-30	46	17%
31-40	44	16%
41-50	15	5%
51 or more	6	2%

APPENDIX E

Imputed Data Analysis

Table E1

Mahalanobis Distance Extreme Values

			Case Number	Value
Mahalanobis Distance	Highest	1	82	61.66690
		2	73	54.75683
		3	17	54.62580
		4	30	51.84678
		5	33	51.05868
	Lowest	1	69	3.99537
		2	87	5.07912
		3	90	5.62444
		4	47	6.38207
		5	75	6.42427

Figure E1. Mahalanobis Distance Results

```
Mahalanobis Distance Stem-and-Leaf Plot

 Frequency    Stem &  Leaf

    15.00        0 .  355667788899999
    27.00        1 .  00112223333444556678889999
    35.00        2 .  01111222223333344555555666678889999
     8.00        3 .  00123688
     9.00        4 .  012334677
     2.00        5 .  11
     3.00 Extremes    (>=55)

 Stem width:  10.00000
 Each leaf:        1 case(s)
```

Figure E2. Mahalanobis Distance Stem-and-Leaf Plot

Table E2

Internal Consistency

Construct	Composite reliability	Cronbach's alpha	Number of items
MISU	0.960	0.908	7
PE	0.963	0.949	4
PI	0.914	0.875	4
PP	0.892	0.866	5
PU	0.912	0.874	4

Table E3

Convergent Validity

Construct	Indicator	Outer Loading	Indicator Reliability	AVE	AVE if Indicator is deleted	Cronbach's Alpha	Cronbach's Alpha if item is deleted
Mobile Information Systems Use	MISU1	0.922	0.850	0.823		0.908	0.911
	MISU2	0.984	0.968				0.910
	MISU3	0.977	0.955				0.911
	MISU4	0.959	0.920				0.909
	MISU5	0.979	0.958				0.910
	MISU6	0.984	0.968				0.910
	MISU7	**-0.378**	**0.143**		**0.945**		**0.923**
Perceived Enjoyment	PE1	0.964	0.929	0.868		0.949	0.907
	PE2	0.967	0.935				0.907
	PE3	0.930	0.865				0.909
	PE4	0.862	0.743				0.908
Personal Innovativeness	PI1	0.845	0.714	0.727		0.875	0.910
	PI2	0.828	0.686				0.911
	PI3	0.849	0.721				0.912
	PI4	0.888	0.789				0.910
Perceived Playfulness	PP1	**0.672**	**0.452**	0.636	**0.683**	0.866	**0.914**
	PP2	**0.466**	**0.217**		**0.741**		**0.916**
	PP3	0.869	0.755				0.908
	PP4	0.944	0.891				0.909
	PP5	0.929	0.863				0.908
Perceived Usefulness	PU1	0.755	0.570	0.724		0.874	0.912
	PU2	0.888	0.789				0.910
	PU3	0.823	0.677				0.911
	PU4	0.927	0.859				0.909

Table E4

Indicator Cross Loadings

Construct	Indicator	MISU	PE	PI	PP	PU
MISU	MISU1	0.926	0.129	0.271	0.216	0.261
	MISU2	0.985	0.140	0.265	0.157	0.349
	MISU3	0.983	0.140	0.239	0.121	0.339
	MISU4	0.964	0.228	0.286	0.188	0.414
	MISU5	0.983	0.144	0.236	0.114	0.362
	MISU6	0.989	0.138	0.234	0.120	0.353
PE	PE1	0.160	0.964	0.568	0.690	0.523
	PE2	0.139	0.967	0.561	0.656	0.515
	PE3	0.096	0.930	0.502	0.648	0.422
	PE4	0.210	0.861	0.422	0.692	0.550
PI	PI1	0.275	0.515	0.846	0.342	0.370
	PI2	0.190	0.462	0.828	0.425	0.361
	PI3	0.199	0.386	0.848	0.315	0.259
	PI4	0.226	0.512	0.888	0.404	0.326
PP	PP3	0.087	0.788	0.387	0.860	0.533
	PP4	0.119	0.614	0.368	0.952	0.408
	PP5	0.204	0.596	0.448	0.943	0.443
PU	PU1	0.219	0.402	0.183	0.298	0.755
	PU2	0.319	0.505	0.365	0.469	0.886
	PU3	0.331	0.385	0.298	0.364	0.827
	PU4	0.339	0.524	0.424	0.522	0.926

Table E5

Fornell-Larcker Criterion

	MISU	PE	PI	PP	PU
MISU	0.972				
PE	0.160	0.931			
PI	0.262	0.555	0.853		
PP0.000	0.154	0.719	0.440	0.919	
PU	0.362	0.538	0.391	0.500	0.851

Table E6

Collinearity Assessment

Construct	Tolerance	VIF
PE	0.447	2.236
PI	0.738	1.355
PP	0.509	1.966
PU	0.693	1.443

Table E7

Results of PLS Analysis

Structural Paths in Model	Sign	PLS Path Coefficient	t-statistic	*p*-value	Significance Level
H1a: PI → PU	+	0.391	4.787	0.000	***
H1b: PI → PE	+	0.555	8.489	0.000	***
H1c: PI → PP	+	0.440	7.188	***0.000***	***
H2a: PU → MISU	+	0.389	4.008	0.000	***
H2b: PE → MISU	-	-0.041	0.149	***0.882***	***NS***
H2c: PP → MISU	-	-0.011	0.161	***0.872***	***NS***

*** *p* < 0.05**
**** *p* < 0.01**
***** *p* < 0.001**
NS - Not Significant

Table E8

R^2 Values

	R^2	Predictive Accuracy
MISU	0.133	Weak
PE	0.308	Weak
PP	0.193	Weak
PU	0.153	Weak

Table E9

f^2 Effect Size

	f^2	Effect
H1a: PI → PU	0.180	Medium
H1b: PI → PE	0.446	Large
H1c: PI → PP	0.240	Medium
H2a: PU → MISU	0.120	Small
H2b: PE → MISU	0.001	No effect
H2c: PP → MISU	0.000	No effect

Table E10

Q^2 Values

	Q^2	Effect
MISU	0.105	Small
PE	0.246	Medium
PI	---	---
PP	0.142	Small
PU	0.093	Small

Table E11

q2 Effect size

	Q^2 included	Q^2 excluded	Predictive Relevance	Effect Size
PE	0.096	0.097	-0.0011	Not significant
PU	0.096	0.016	0.0885	Large
PP	0.096	0.097	-0.011	Not significant

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