UNDERSTANDING VARIATIONS IN ACCEPTANCE AND USE OF TABLET TECHNOLOGY BY STUDENTS AT A PUBLIC FOUR-YEAR UNIVERSITY

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Abstract

The effective use of information and communication technologies (ICT) is an integral component of 21st century learning experiences and is, itself, a fundamental learning outcome. However, this only becomes possible when students accept and meaningfully use technology to effectively participate in 21st century learning. To improve acceptance and use of ICT, it is important to understand (a) the determinants for acceptance and use of technology, (b) the dynamics of the diffusion of innovation, (c) the factors effecting implementations, and (d) the perspective and context of prospective adopters. Variations exist within populations relative to the acceptance and use of technology such that segments of the population may have differing perceptions and lived-experiences relative to the technology. This instrumental, mixed methods case study investigated variations among student populations relative to the acceptance and use of tablet technology for academic purposes at a 4-year, public university. Most specifically, this study explored (a) variations in students' perceptions of the determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) for behavioral intention and use behavior relative to the demographic constructs of socioeconomic status, race/ethnicity, and gender, (b) the strength of the

determinants, and (c) the effects of the moderators (self-efficacy, access, experience, socioeconomic status, race/ethnicity and gender).

Findings from a two-phase electronic survey revealed that these determinants of acceptance and use of technology explained 38% of variance in behavioral intention and 44% of variance in use behavior. The moderators affected to varying degrees the determinants, with differences revealed for Hispanic students, first generation students, and other gender students. Seven thematic findings, derived from photo diary and focus group interviews, reflected students' expressed meaning associated with tablet technology: the situatedness of technology; new ways of practice; choice continuum and resourcefulness; levels of responsiveness to students' brought-technology; naturally occurring segments; expertise across social networks; and meaningful experience matters. The study confirmed that differences exist within segments of populations relative to the perceptions and meanings associated with a technological innovation. These segments can best be understood based on the (a) perceptual predictors of acceptance and use and (b) expressed meanings relative to associated technology. Adjustments to design, implementation, and support for technological innovations should be made to improve alignment with these segments of prospective adopters, which will in turn result in faster, less costly, and deeper integration.

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May we continually be aware of variations in segments of populations to better design, rollout and support meaningful technology/services that improve student outcomes and equity. May I shape and energize systems in ways that enable 21st century learning experiences and equitable outcomes.

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CHAPTER 1: INTRODUCTION

Background

The effective use of information and communication technologies (ICT) is an integral component of 21st century learning experiences and is, itself, a fundamental learning outcome. However, this only becomes possible when students accept and meaningfully use technology to effectively participate in 21st century learning. Factors affecting students' acceptance and use of technology include faculty adoption of technology (Cox, Cox, & Preston, 2000; Margaryan, Littlejohn, & Vojt, 2011; Project Tomorrow, 2013) as well as students' social referents and support systems (Dupagne & Salwen, 2005; Lopez, Gonzalez-Barrera, & Patten, 2013; Warschauer & Matuchniak, 2010). In order to improve the acceptance and use of ICT, it is important to understand the (a) determinants for acceptance and use of technology, (b) the dynamics of the diffusion of innovation, and (c) the perspective and context[1] of prospective adopters. Variations may exist within a population such that a segment (e.g., lower socioeconomic status) of the population may have differing perceptions regarding a specific technology. Therefore, understanding variations within populations relative to the acceptance and use of a technology may lead to design, implementation and support of ICT that results in accelerated adoption, lower costs and deeper integration. This study focused on student acceptance and use of

[1] Context is used in several ways herein: (a) the *situation* or group of conditions that exist where and when something occurs ("Context," n.d.), (b) within diffusion research, the organizational requirements for adoption or certain attributes of the technology such as complexity (Fichman, 2000; Rogers, 2003); and (c) within Human Computer Interaction research, the interactions and interrelations of persons, technology, and work (Dourish, 2004).

tablet technology for academic purposes through students' perspectives, lived-experiences, and socially constructed meanings.

Technology, including "tablet" technology, is not an abstract notion, but a *social fact* for which meaning is negotiated within a specific *context* (Dourish, 2004). Herein, it is understood that ICT, defined as "information and communication technologies", be considered a *cluster* (Rogers, 2003) or a *bundle of material and cultural properties* (Orlikowski & Iacono, 2001) having meaning within their interactions and relationships to their everyday use by agents (Suchman, Blomberg, Orr & Trigg, 1999). The cluster herein termed "tablet" technology shall include its use as tool, proxy, and ensemble (Orlikowski & Iacono, 2001) and intentionally include "tablet" as a social fact emerging from students' interactions and interrelations with this cluster. The purpose of this study is to better understand students' personally-owned socially-constructed meanings regarding tablet use for academic purposes.

Using Gilbert Ryle's example of the wink versus the twitch, Geertz (1973) showed that an artifact, such as tablet technology, cannot meaningfully stand outside its social meaning. A temporary closing of the eye can be interpreted as a wink, a twitch, a parody, a coy enjoinder, etc. This interpretation is dependent upon the *context* of the interaction between the agents. If, as Geertz suggested, that "man [sic] is an animal suspended in webs of significance he himself has spun" (p. 5), then the aim of research includes the meaningful explication of social expressions within *thick description*. Similarly, in the *Gods Must Be Crazy* (1980), Xi, a Sho of the Kalahari Desert whose tribe has no knowledge of the outside world, experienced a bottle falling from the sky with the words "coke" inscribed. Sho initially experienced the bottle as a meaningless object, an anomaly, and then the bottle presented itself as a crisis calling into question the

tribe's belief in the sufficiency of the natural world. Rogers (2003) described numerous examples where agents failed to get technology adopted due to misunderstanding the meanings inherent within a given social system. The failure to garner adoption of water boiling, after a 2-year attempt by a public health worker in a Peruvian village, was due to a mismatch in meaning where this technology, water boiling, was considered inappropriate given local beliefs equating hot foot with illness (Rogers, 2003). These misinterpretations of the meaning associated with technological artifacts, by agencies seeking to drive adoption, can have significant impacts on social and personal outcomes (Rogers, 2003). Rohr (2004) described a rite of passage among an Australian aboriginal culture whereby boys, who had shown themselves teachable and ready to exercise power for the good of the tribe, were allowed to make an axe of flint from the nearby sacred site Kojunnup, "the place of the sacred axe" (p. 15). The ax, in the hands of the newly anointed man, symbolized that the man could handle power. Ironically, early English and Irish settlers, perhaps in an attempt to improve the productivity of the aborigines, gave every young man an ax thereby undermining the maturation process and social discipline within these aboriginal tribes (Rohr, 2004). Technology exists within webs of meaning derived from the interactions and interrelations of agents. A tablet dropped from the sky on Sho might contain little inherent meaning. However, that same tablet in the hands of students may convey meaning, perhaps even individually different meanings. Therefore, it is important to better understand variations among populations in their perceptions and constructed meanings related to the use of technology for academic purposes.

Problem Statement

ICT design and implementation often reflects diffusion research's perspective that adoption is a function of time as individuals respond within a

social system to a new technology. This conceptualization, as shown in Figure 1, illustrates the rate of adoption over time until most individuals within the social system have adopted the technological innovation. This technology-centric, pro-innovation perspective can lead to longer or failed adoption cycles if variations within user populations are not considered during the design and rollout of the technological innovation.

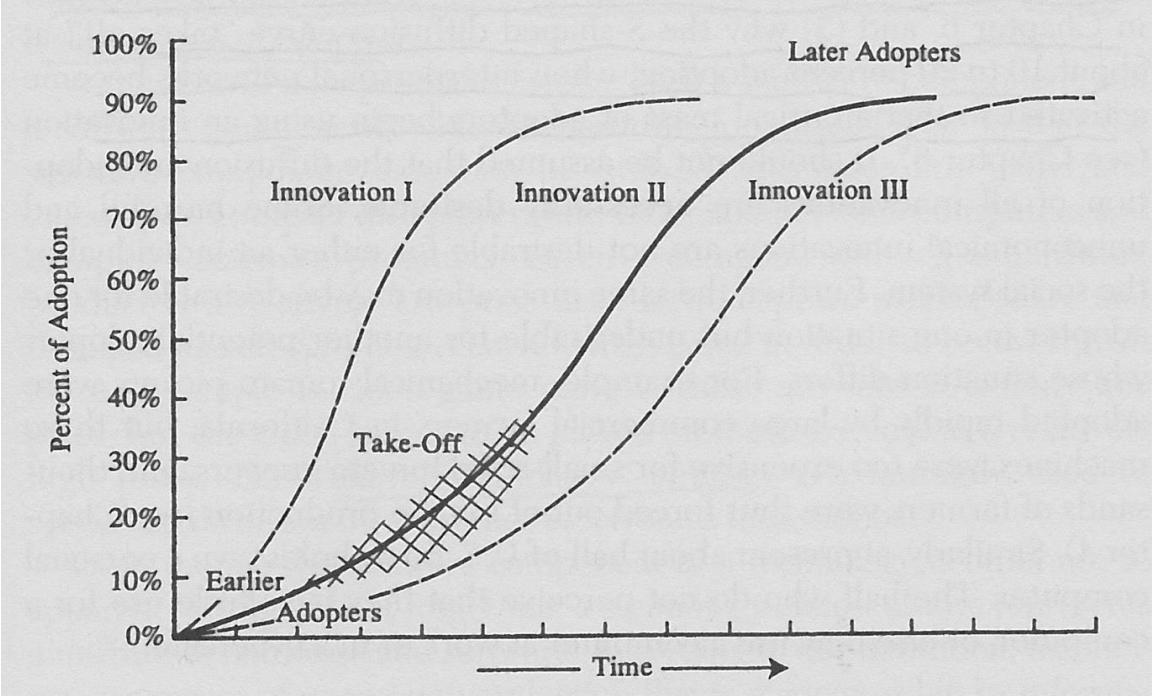


Figure 1. Adoption of innovations within populations over time.
The graph depicts the adoption of a technological innovation over time among the members of a social system. The X-Axis is the progression of time and the Y-Axis is the percent of population. The S-curved line represents the cumulative number of adopters over time with the slope of the line indicating the rate of adoption. Here three innovations are represented, each with their respective S-curves. From Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York, NY: Simon and Schuster. Reprinted with permission.

Technology life cycles are growing shorter and technological innovations more frequent. Higher education institutions are often pursuing technological innovations without fully realizing the benefits from effective acceptance and use

of innovations. However, there are ways to improve the adoption and diffusion of technological innovations. Better understanding of variations within populations can improve the design, rollout and supports for new technology resulting in accelerated adoption, lower cost, and deeper integration. For example, understanding variations within populations, such as variations in perceived usefulness by a segment of the population, may allow adjustments in the technology's design and rollout in ways that improve perceived usefulness for that segment and hence improves adoption. Understanding and effectively responding to the variations within student populations, especially the meaning emerging from students' interactions and interrelations with tablet technology for academic purposes, is essential.

Effective acceptance and use of technological innovations is especially important for higher education institutions serving disadvantaged student populations (e.g., lower socioeconomic status) where 21st century competencies include the rapid acceptance and effective use of information technology. Otherwise, without understanding these particular segments of the population and working with them to improve acceptance and use of technology, these students leave the university further disadvantaged.

Purpose of the Study

This study investigated variations among student populations relative to the acceptance and use of tablet technology for academic purposes at a 4-year, public university. Specifically, this study explored variations in students' perceptions of the determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) for behavioral intention and use behavior relative to the demographic constructs of socioeconomic status, race/ethnicity and gender as illustrated in Figure 2.

Additionally, this study explored the strength of the determinants for behavioral intention and use behavior as well as the effects of the moderators (self-efficacy, access, experience, socioeconomic status, race/ethnicity and gender). Lastly, this study explored the variations in determinants directly from students' perspectives, lived-experiences, and socially constructed meanings.

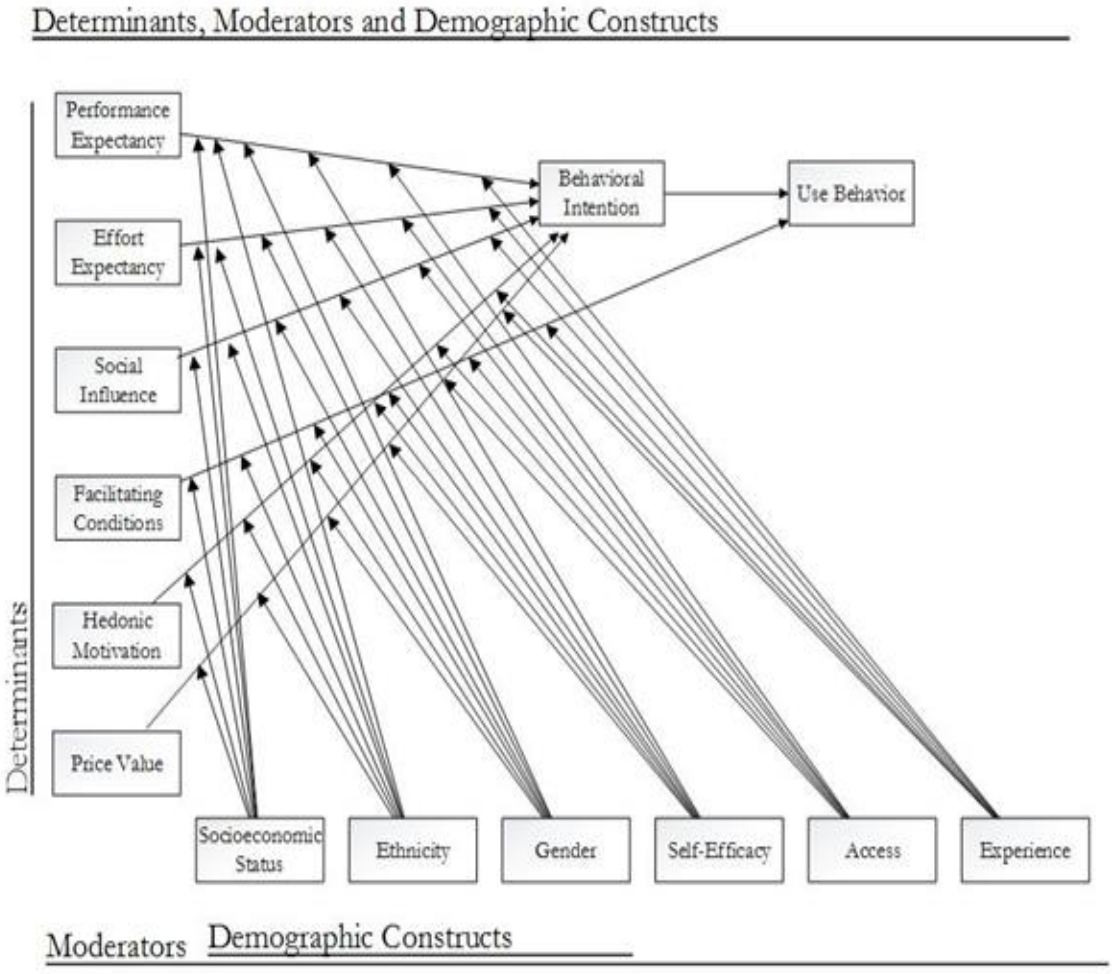


Figure 2. Determinants of behavioral intention and use behavior.

The determinants for behavioral intention include performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation and price value. The determinants of use behavior include facilitating conditions and behavioral intention. The strength of each determinant is moderated by self-efficacy, access, and experience as well as the demographic constructs of socioeconomic status, race/ethnicity, and gender.

Context of Study

This study recognizes its place within a broader discourse in the United States regarding technology. When studying the shared and special meaning of respondents to a particular technological innovation within a given context, it is important to appreciate the broader socially constructed meanings given to technology and technological innovations. These socially constructed meanings are especially relevant given that the diffusion of technological innovations is the process in which an innovation is communicated through channels within social systems over time (Rogers, 2003). This study focused, in situ, on a specific population considering a particular innovation within a specific social system at a specific point in time. As a result, it is important to briefly acknowledge these larger social systems and related communications to understand the web of meaning in which this study is grounded.

The concerned parties within this larger consideration include institutions, organizations, and persons. These concerned parties are each, to varying degrees, interested, impacted, supportive and critical of technological innovations. Corporate concerned parties are interested in adoption of their given innovation (e.g., Amazon, Apple, Google, Microsoft). Critics of technological innovations (e.g., Braun, 2014; Ellul & Merton, 1967; Grant, 1969) have noted the United States' partiality to technology regardless of the inherent value or impact of the

technology innovation. Cultural observers noted shifts to society resulting from technological innovations (Friedman, 2006; Reich, 1991). Higher education institutions compete with each other for prestige, faculty, and students with the perception that technological advancement can lead to competitive advantage (DeMillo, 2011). The expectations of prospective, incoming, and current students are shaped by their lived-use of technology.

Conversations abound about the pertinence of technological innovation for curriculum, instruction, and assessment. Within the academic domain, research explores the diffusion of technological innovations, individual acceptance and use of technology, and barriers and enablers to technological adoption as well as the principles and practices for the design of technological innovations. Outside of the education sector, there are expositions on the failures in the diffusion of innovations (Rogers, 1962), the assimilation of technology within organizations (Hall, 2010), and innovations that were not adopted and diffused due to ecosystem readiness for the innovation (Adner, 2012). However, research is sparse on the failure of adoption within institutions and the associated direct and indirect costs of such failures. Gros, Garcia, and Escofet (2012) provided a poignant observation on a core constraint in faculty adoption of educational technology – namely the innovators are dissimilar to the early majority who are primarily concerned with what will reliably and effectively improve teaching and learning.

Unfortunately, research focused on institutional change, leadership support, and faculty adoption shifts attention away from students' lived-experiences with acceptance and use of technology; however, a few exceptions exist such as the Educause Center for Analysis and Research's (ECAR) study of undergraduate students and information technology (Dahlstrom, Walker, & Dziuban, 2012). Few conversations occur with and on behalf of the students expected to adopt and

implement technological innovations, and even fewer discussions take place about the effects of technological adoption and its impact on equity. This study, while recognizing this broader discourse, engages in the academic conversations to increase understanding, improve practice, and reduce equity gaps. This study adds to adoption, diffusion, and implementation research a model of inquiry that distinguishes variations within populations as articulated by those populations.

The specific setting of this study was a Hispanic-serving institution and an Asian American and Native American Pacific Islander-serving institution, 4-year public university in central California (U.S. Department of Education, n.d.b.). The university is comprised of over 20,000 students with most students entering from high schools and community colleges within 100 miles of the university. The university launched an initiative in August 2014 to introduce tablet computers to approximately 1,000 students for the purpose of academic use. The university enlisted approximately 40 faculty members to teach at least one course where the faculty member would intentionally use tablet computers within the course. The participants in this study included a combination of students enrolled in at least one course designated as a *tablet use* course and students not enrolled in such a course. The university was used as the context of the study given that students at the university were being introduced to a technological innovation.

Theoretical Framework

The theoretical framework for this study is a synthesis of four research streams: diffusion of technological innovations, acceptance and use of technology, information systems implementation, and design and implementation with and for persons.

Diffusion research provides insights into how, over time, individuals within a social system decide whether to adopt a technological innovation and how

information about this technological innovation is conveyed (Rogers, 1983). This research stream provides insights into the personal dynamics of adoption and social dynamics of diffusion. Diffusion research also distinguishes how specific contexts (e.g., organization, technology) shape adoption and diffusion processes. The diffusion of innovation model presents a normal curve representing the adoption over time by individuals. This curve is valid for successful adoptions, and an individual's time to adopt determines the categorization of the individual (e.g., early adopter). The model is retrospective and not predictive. The research provides rich descriptions of adoption and rejection grounded in people's personal beliefs, social norms, and interpersonal dynamics. Diffusion of innovation research may have a pro-innovation, pro-adoption bias (Rogers, 1983) and a resultant technological determinism (Selwyn, 2004) in which the technology determines individuals' adoption. Diffusion of innovations can further inequity as early adopters, often more affluent, adopt technologies that lead to increased capital (Rogers, 2003).

Acceptance and use research builds on social cognitive theories articulating that personal beliefs made explicit can predict behavioral intention. The development of this research stream is dynamic, beginning with Social Cognitive Theory, moving to the Theory of Reasoned Action and the Theory of Planned Behavior, and concluding with the Technology Acceptance Model and the Unified Theory of Acceptance and Use of Technology Model. The acceptance and use models improved the ability to predict behavioral intention and use behavior (Venkatesh, Morris, Davis, & Davis, 2003). Venkatesh et al.'s UTAUT model identified four determinants (performance expectancy, effort expectancy, social influence and facilitating conditions) and four moderators (age, gender, experience, and voluntariness of use) that explain most of the variance in

behavioral intention and use behavior. These determinants and moderators provide salient constructs to understand variations within populations, and this understanding can lead to interventions in the design, implementation, and support for people experiencing a technological innovation, especially where these differences are articulated by persons within the population (Venkatesh et al., 2003).

Information systems implementation research explores the critical factors affecting adoption and diffusion. Even when the determinants for adoption and conditions for diffusion indicate prospects for success, factors in the implementation of the information system may hinder adoption and diffusion. Critical success factors are identified, ranked and their significance demonstrated. One such factor critical to successful implementations is the involvement of prospective adopters (Covington, Petherbridge, & Warren, 2005; Cox et al., 2000; Dennison, 2014; Dooley, 1999; Singh & Hardaker, 2014; Vaughan, 2001).

The research stream herein entitled 'design and implementation with and for persons' includes participative design, design thinking, and human computer interaction. This research stream provides methods, mindsets and practices for the design and implementation of technological innovations with and for persons (Holmlid, 2009; Kumar, 2013; Suchman et al., 1999). This research stream underscores the importance of a phenomenological methodology that gives voice to persons and situated action within a person's work (Carroll, 2013; Dourish, 2004; Suchman et al., 1999). This research stream is explored for its antecedents, principles, and application within industry and academia.

The four research streams were deliberately chosen to cultivate a holistic understanding of adoption, diffusion, and integration of technological innovations with and for persons within educational contexts. This theoretical frame builds on

the social dynamics of diffusion research, the predictive uses of determinants from acceptance and use research, mindfulness of the factors that help promote adoption and diffusion from information systems implementation research, and stakeholder perspectives and meaning from the research on design and implementation with and for persons.

Four themes emerged across these research streams: (a) innovation emerges within a dynamic interchange of persons, work, technology and social systems; (b) context affects dynamics of adoption and diffusion; (c) innovation affects equity; and (d) variations exist within populations. First, technological innovations emerge within a dynamic interchange between persons, the work, the technology and the social system.

Second, context affects the dynamics of adoption and diffusion. Both adoption and diffusion models require refinement to their constructs based on situational context and technology type (Fichman, 2000). For example, Rogers (2003) and Fichman (2000) found that specific dynamics affect diffusion within organizational contexts compared to the dynamics affecting diffusion within the contexts of social systems. Similarly, when studying adoption within a consumer context, Venkatesh, Thong, and Xu (2012) identified additional determinants (hedonic motivation, price value, and habit) to predict behavioral intention to use a technological innovation. Situational contexts include the mandatory or volunteer nature of acceptance of the innovation. Context also pertains to the situated actions of agents interacting with technology and work (Dourish, 2004; Suchman et al., 1999). Lastly, context is contained within larger systems where components interact with and factors influence adoption and diffusion (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004).

Third, technological innovation affects equity, which means that those with capital tend to have greater access to technology and are more inclined to be earlier adopters of technological innovations than their peers (Reich, 1991; Rogers, 2003). Additionally, a gap exists among K-12 students in the United States relative to the level and quality of access to and meaningful use of technology (Selwyn, 2004).

Fourth, variations exist within populations relative to the acceptance and use of technological innovations (Rogers, 2003; Venkatesh et al., 2003, 2012). This study's theoretical frame considered variations within populations relative to the acceptance and use of technological innovations and explored these variations to better understand pertinent social dynamics and individual determinants. This understanding of variations can shape technology design and implementation in ways that are acceptable and benefit stakeholders as well as achieve faster, less expensive adoption and yield deeper integration (Standish Group, 2013; Venkatesh et al., 2003).

Significance

Contribution to Research

This study contributes to the research through an intentional synthesis of four research streams within the theoretical frame that integrates aspects of diffusion of innovation, acceptance and use research, information systems implementation research, and the research on design and implementation with and for persons. Both Rogers (2003) and Venkatesh et al. (2003) articulated the importance of using multiple data collection methods to inform the field and expand adoption or diffusion research. This study's use of mixed methods expands quantitative data to yield a more in-depth understanding of the

phenomenon in question. The UTAUT studies informed the diffusion research stream, which used multiple methods to predict, validate, and explore adoption. Research that uses multiple methods to explore variations in individuals' perceptions of determinants for acceptance and use of technology is of significant value and greatly enhances the acceptance and use research stream. Information systems research benefits from an emphasis on human factors that lead to successful implementations and these human factors are informed by the individual adoption decision process, social dynamics affecting diffusion, and the participative practices from design thinking. This study integrates design thinking practices from industry, thereby contributing to adoption, diffusion, and information systems implementation research streams. This study also infuses participative design practices within academic research in ways that include the person within the intersection of person, work, technology and social systems.

Contribution to Practice

This study impacts practice through its use of a mixed methods approach that yields both veracity and utility. Veracity emerges, using triangulated methodology, through predictive determinants to ascertain variations within populations coupled with the expressed meanings emerging from the as-lived experience of those concerned. Observations of agents' *situated action* grounded with interviews of agents' observations is imperative since the meaning of technological innovations emerges from the interactions and interrelations through which agents get work done (Dourish, 2004; Suchman et al., 1999). Utility reflects the time required to gather data relative to its value. The information gained from this study's approach can be used to design appropriate interventions for specific populations relative to the design, rollout, and on-going support of technological innovations to effectively achieve adoption and integration.

This study informs practice through the integration of: (a) Rogers' normal adoption curve as a retrospective reflection of successful adoptions, (b) the variations in individuals' perceptions of the determinants for acceptance and use of technology, and (c) the factors affecting individual adoption and social diffusion. Often practitioners assume that the entire population will simply follow lead adopters through the adoption cycle. However, social systems exhibit dynamism with substantial variations among populations relative to the adoption and diffusion of an innovation. Variations among populations relative to the meanings they ascribe to the innovation may lead to rejection or resistance towards the innovation. Furthermore, change agents may garner more resources and energy for the design, rollout, and support of technology in ways informed by this research.

This study contributes to practice through a more nuanced understanding of the digital divide as a continuum of access, use, and resultant outcomes. This is especially important in the 21st century where the skills required for work are highly dependent on technology use. Meaningful use is critical for access to and generation of capital in its various forms (e.g., social, cultural, etc.).

Leaders must develop deeper awareness and understanding that (a) adoption requires understanding variations within populations as well as the interchange between persons, work, technology, and social context and (b) their leadership actions should be aligned with this knowledge regarding adoption. This study supports higher education institutions that are learning how to continuously improve the design, rollout, and support of learner technology in ways that engage learners, and reminds practitioners that on-going persistent use requires on-going support.

Contribution to Policy

This study deepens and extends the research knowledge that should be used to inform policy: (a) supports a nuanced view of the digital divide, (b) promotes understanding of variations in the determinants for acceptance and use of technological innovations within segments of a population, and (c) encourages effective targeted interventions that decrease inequity gaps. This study also points to ways to work towards adoption that can result in deeper integration, lower costs, and shorter time to adoption.

This study encourages more participative design so educational technology better fits the intended population. Most importantly, this research reminds policy makers that variations exist within populations which, when acknowledged, can lead to change where all can participate in technological innovations that bring value to those concerned.

Research Questions

1. What is the strength of the determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) on student behavioral intention and use behavior regarding tablet technology use for academic purposes?
2. Is there a difference among each demographic construct (socioeconomic status, race/ethnicity, and gender) on the determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) for student behavioral intention and use behavior regarding tablet technology use for academic purposes?
3. Is there a difference over time among each demographic construct (socioeconomic status, race/ethnicity, and gender) on the

determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) for student behavioral intention and use behavior regarding tablet technology use for academic purposes?

4. What are the facilitating conditions and associated meanings related to the acceptance and use of tablet technology relative to the demographic constructs of socioeconomic status and race/ethnicity?
5. What are the performance conditions and associated meanings related to the acceptance and use of tablet technology relative to the demographic constructs of socioeconomic status and race/ethnicity?

Definition of Terms

This study uses the terms **technological innovation**, **technology,** and **innovation** synonymously within the context of diffusion and acceptance, and uses the terms **acceptance and use, behavioral intention** and **use behavior**, and **adoption** synonymously within the context of acceptance and use.

Access: Access is herein defined as available use of digital computing devices, applications and Internet broadband with the distinction regarding the quality of such access in the discussion on equity (Selwyn, 2004).

Adoption: A decision to make full use of an innovation as the best course of action available (Rogers, 1983).

Agent and Agency: There are several uses of these terms herein. The definition depends upon the research stream: For diffusion research, an agent refers to the protagonist who introduces an innovation (Rogers, 1983). For acceptance and use research, an agent intentionally influences one's functioning and life circumstances (Bandura, 2006). For equity discussions, critical theory

suggests that reliance on independent agency disadvantages working class Americans (Fiske & Markus, 2012).

Attitude: An individual's positive or negative feeling about performing the target behavior (e.g., using a system).

Behavioral intention: The degree to which a person has formulated conscious plans to perform or not perform some specified future behavior (Venkatesh et al., 2003).

Computer self-efficacy: The degree to which an individual believes that he or she has the ability to perform a specific task/job using a computer.

Context: Context is used in this study in the following ways: (a) the situation or group of conditions that exist where and when something occurs ("Context", Merriam-Webster online, n.d.), (b) within diffusion research, the organizational requirements for adoption such as voluntariness or certain attributes of the technology such as complexity (Fichman, 2000; Rogers, 2003); and (c) within Human Computer Interaction research, the interactions and interrelations of persons, technology, and work (Dourish, 2004).

Diffusion: The process by which an innovation is communicated through channels, over time, within a social system (Rogers, 1983).

Efficacy: The belief that a person has the ability to produce a desired effect through a specific behavior (Bandura, 1986). Efficacy is herein used to describe a person's belief in their ability to produce a desired effect through a specific interaction with technology.

Effort expectancy: The expected degree of ease associated with a user's use of technology (Venkatesh et al., 2003).

Experience: Experience is herein defined as previous use of technology with the distinction regarding the meaningfulness of such experience in the discussion on equity (Selwyn, 2004).

Facilitating conditions: The expected degree to which an individual believes resources and support exist to help the user perform the desired activity (Venkatesh et al., 2003, 2012).

First generation student: Student for whom neither parent has earned a bachelor's degree (Engle & Tinto, 2008).

Hedonic motivation: The perceptual construct, conceptualized as perceived enjoyment, that reflects the fun or pleasure derived from using a technology (Venkatesh et al., 2012).

Information and communication technology (ICT): A set of devices, applications, contents, and communications that encompass technology used in the support of educational institutions, teaching, and learning (Oye, Iahad, & Rahim, 2014; Selwyn, 2004).

Innovation: An idea, practice, or object that is perceived as new by an individual or other unit of adoption (Rogers, 2003).

Performance expectancy: The degree to which an individual believes that using the technology will help him or her perform certain activities (Venkatesh et al., 2003, 2012).

Price value: The consumers' cognitive tradeoff between perceived benefits and associated costs for use (Venkatesh et al., 2012).

Segment: A subgroup of a population for whom, relative to a technological innovation, perceptions significantly differ and associated meanings substantially vary relative to peers within the population.

Social influence: The degree to which an individual perceives that important others think that he/she should use a particular technology (Venkatesh et al., 2003, 2012).

Socioeconomic status or condition: First generation student was used as a proxy for socioeconomic condition. This study made a distinction on the level of socioeconomic condition between first generation student as well as range within middle-class based upon the quality, age and attributes of a student's assemblage of technologies. For example, a student with a new laptop, new tablet, and new smartphone is more likely to be classified herein at a higher level of socioeconomic condition.

Tablet: A tablet, from an Information Communication and Technology artifact perspective, is a portable personal computer with a touch screen as its primary input device (EDUCAUSE, 2014).

Voluntariness: The extent to which potential adopters perceive the adoption decision to be non-mandatory (Venkatesh et al., 2003).

Delimitations

This study focused on undergraduate students' acceptance and use of tablet technology for academic purposes at a Hispanic-serving, Asian American and Native American Pacific Islander-serving, 4-year public university. The adoption context is a blend of consumer (voluntary) and organizational (mandatory). The organization and students exist within the early stages of the diffusion of tablet technology use for academic purposes within higher education.

Summary

A mismatch exists between demand for technological innovation by students, faculty and institutions of higher education in the 21st century and the

capability of these agents to design, implement, adopt, and diffuse technological innovations. Different levels of access to and use of technology compound this problem and may further increase inequities. The purpose of this study was to investigate variations within student populations relative to the acceptance and use of tablet technology for academic purposes at a 4-year, public university and to explore these differences from students' perspectives, lived-experiences, and socially constructed meanings. Successfully understanding such variations supports effective design and implementation of technology in ways that lead to faster and less expensive adoption and diffusion of technological innovations. This study synthesized the four research streams of diffusion of technological innovations, acceptance and use of technology, information systems implementation, and the research on design and implementation with and for persons. This study contributes to research, practice, and policy through its integrative theoretical frame and mixed method design.

Chapter 2 provides a review of the literature focusing on five areas that provide a foundation for this study: technology and education in the 21st century; four foundational research streams; tablet technology as the technological innovation; the characteristics, preferences and technology use behaviors of students as the prospective adopters; and an exploration of the socioeconomic, gender, and ethnic differences affecting the adoption of technological innovations. The four foundational research streams presented within the review of literature informed the theoretical frame and the design of this study. These four research streams include the diffusion of innovations, the acceptance and use of technological innovations, information systems implementation, and the design and implementation with and for persons.

Chapter 3 describes the methodology of the study including the purpose of the study and research questions, the research design, participants and sampling method, instrumentation, and data collection and analysis procedures, as well as the limitations of the study. Chapter 4 presents the findings and analysis of the data collected related to the research questions gathered through both quantitative and qualitative methods. Chapter 5 presents a summary of findings and conclusions of the study, discussion related to the literature, and explores implications for practice and policy as well as future research.

CHAPTER 2: REVIEW OF THE LITERATURE

Introduction

Effective acceptance, use and diffusion of technological innovations are a necessity for higher education institutions that seek to continually improve the quality of learning experiences, access, and equity (Daniel, Kanwar, Uvalic-Trumbic, 2009). Technology-enabled environments for curriculum, assessments, and learning are increasingly dependent on technological innovations to meet student expectations, contain costs, and deliver at scale to a diverse population (Kirshstein & Wellman, 2012; Mehaffy, 2012). Students will soon enter higher education institutions with K-12 and home technology experiences that are at least a decade newer than the current higher education environment (Dahlstrom et al., 2012; Project Tomorrow, 2013). Higher education institutions need to prepare students with 21st century competencies, which include the ability to quickly and effectively adopt technological innovations not yet imagined (Hart Research Associates, 2013; Holtzman & Kraft, 2011; Partnership for 21st Century Skills, 2006; Rosenberg, Heimler, & Morote, 2012). Furthermore, the rate at which technological innovations are emerging has increased, and the time frame for adoption has shortened (DeGusta, 2012; McGrath, 2013). And yet, the theory and practices for effective adoption of technological innovations are not commonly understood. Innovations, whether successful or not, can increase societal inequities especially within public, higher education institutions. The review of literature for this study focuses on the adoption of technological innovations pertinent to institutions of higher education.

The review of literature focuses on five areas that provide a foundation for this study: technology and education in the 21st century; the four foundational

research streams; tablet technology as the technological innovation; the characteristics, preferences and technology use behaviors of students as the prospective adopters; and an exploration of the socioeconomic, gender, and ethnic differences affecting the adoption of technological innovations. The four foundational research streams presented within the review of literature informed the theoretical frame and the design of the study. These four research streams include the diffusion of innovations, the acceptance and use of technology, information systems implementation, and design and implementation with and for persons. The diffusion of technological innovations, the first research stream, emerged from Everett Rogers' (2003) seminal work, *The Diffusion of Technological Innovations*. This study examines this research stream by exploring diffusion as individuals' adoption decisions over time within a social context, moving to critiques of diffusion research, and examining models of organizational diffusion. The acceptance and use or adoption research stream includes the Theory of Reasoned Action, Theory of Planned Behavior, Social Cognitive Theory, and the Technology Acceptance Model. The adoption research stream culminates in the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). The review of literature then briefly explores the importance of context, both the adoption context and type of technology, and the context's effect on adoption and diffusion. The third research stream, information systems (I.S.) implementation research, explores adoption and diffusion within industry, higher education, and K-12, and expounds on the enablers and barriers (or factors) affecting adoption. Design and implementation with and for persons, the fourth research steam, focuses on the importance of stakeholder participation, design practices, and human computer interaction within practice and research

related to adoption and diffusion of innovations. Each research stream contributes and supports aspects of the researcher's theoretical frame.

The literature review culminates in the explication of a theoretical frame that (a) acknowledges the social dynamics pertaining to diffusion as proposed by Rogers' Diffusion of Technological Innovations (2003); (b) predicts populations' acceptance and use of technological innovations using the Unified Theory of Acceptance and Use of Technological Innovation (Venkatesh et al., 2003); (c) guides implementations based upon the research on factors from information systems implementation research, and (d) incorporates the relevant practice from the research on design and implementation with and for persons to articulate the voices of those concerned. This research integrates the four research streams and proposes a model of inquiry that distinguishes variations within and between populations as articulated by those populations.

Technology and Education in the 21st century

The pervasive impact of technological change on modern society is broadly understood (Berger, 1986; Friedman, 2006; Reich, 1991). The rate of change is accelerating as well as its form (Friedman, 2006; Katz, 2008; Reich, 1991). These changes lead to significant transformations within industries, society, and economies around the globe (California Department of Education [CDE], 2014; Friedman, 2006; Reich, 1991). Most people, within most societies and economies, find their lives substantially altered due to these technological changes (Friedman, 2006; Reich, 1991). In fact, Berger and Reich contended that knowledge work is the new work.

People's socioeconomic mobility and economic well-being are influenced by their ability to meaningfully understand and intentionally choose to use technology (Reich, 1991; Selwyn, 2004). The Partnership for 21st Century Skills

(2006) surveyed over 400 employers across the U.S. to determine requisite competencies for employment and concluded that information media and technology skills were a core set of critical 21st century outcomes. In fact, technology so transforms work that much future work may be difficult to describe from today's perspective (Manyika et al., 2013). Today's students will have experienced multiple technological iterations and innovations before they complete their formal school education (CDE, 2014). The Bureau of Labor Statistics (2012) indicated that by the time today's students are 38 years old they will have on average 10-14 jobs, and many students will experience jobs that do not yet exist. Therefore, technological adoption competency, the ability to accept and use the next new technology, becomes a key capability in the 21st century (Selwyn, 2004). As a result, Selwyn developed the concept of a new form of capital, namely, technology capital.

Technology, within higher education, supports people, systems, and infrastructure that enable 21st century learning experiences (Katz, 2008). DeMillo (2011) described three drivers transforming higher education with the most significant of the three being technology, and attributed the impact of technology on higher education to the growth-driven law of the Internet era that describes the annual doubling of capability and capacity for equal costs. Mehaffy (2012) discussed challenges facing higher education and observed that these changes are driven primarily by rapid technological changes. Higher education both combats and embraces this rapid technological change (Katz, 2008). Yet, Daniel et al. (2009) and Porto (2013) argued that the effective use of technology is the only way to achieve the necessary scale to meet the growing demands of higher education within the triple constraints of the iron triangle of cost, equity, and access. Similarly, Christensen, Horn, Caldera, and Soares (2011) contended that

innovations in technology are disruptive to current ways of delivering education. Changing circumstances have shifted the mandate of higher education to how to make quality postsecondary education affordable. Christensen et al. argued that the only way to effectively extend access is to manage innovations effectively including the use of disruptive innovations that rely on technology. Hill (2012), in his analysis of online delivery models for education, demonstrated the dramatic shifts in higher education resulting from such disruptive technologies.

The student population within higher education will not be static relative to acceptance and use of technology for academic purposes. The pipeline of students emerging from K-12 is shaped by system responses to employer expectations, disruptive innovations, and students' use of technology in and out of school. The use of technology will continue to grow in relevance and with a potential increase in its resultant impact as it supports education systems and accelerates student learning (CDE, 2014).

The Common Core State Standards were developed as a response to the need for enhanced career readiness for all students (Project Tomorrow, 2013). The drivers for increased use of technology in K-12 education were: (a) the Common Core State Standards, which changed how digital tools and resources support the standards; (b) teachers, administrators, and parents who are more technologically proficient and dependent upon Internet connectivity and online collaborative learning environments; (c) lack of funding, which is prompting the use of more innovative ways to leverage technology; (d) digital tools that are transcending the classroom and connecting school and home; and (e) employer demand for better skilled employees (Project Tomorrow, 2013). National Governors Association Center for Best Practices & Council of Chief State School Officers (2010) referenced at least five technology competencies within the

Common Core State Standards. The National Education Technology Standards for Teachers (International Society for Technology in Education [ISTE] 2008) listed technology competencies as critical 21st century skills.

Students exist within contexts where adoption is mandatory with educational institutions acting as source agencies. They also exist within consumer contexts where adoption is voluntary. Madden, Lenhart, Duggan, Cortesi, and Gasser (2013) conducted a nationally representative phone survey of 802 parents and their teens to determine cell phone and Internet access use by teens. The findings revealed that 23% of the participants have a tablet computer, 37% have a smartphone, and 78% have a cell phone (margin of error ±4.5%). These use patterns will continue to grow as students are exposed to technology in K-12 education (Project Tomorrow, 2013). Johnson et al. (2013) projected a time frame of 1 year or less for time-to-adoption of mobile learning within K-12 in the U.S.

Important to the review of the research streams is first a review of the definition of ICT, literally defined as "information and communication technologies", it is a "cluster" (Rogers, 2003) or "a bundle of material and cultural properties" (Orlikowski & Iacono, 2001) "having meaning within their interactions and interrelationships to their everyday use by agents" (Suchman et al. 1999). Technology, including "tablet" technology, is therefore not an abstract notion but a "social fact" for which meaning is negotiated within a specific *context* (Dourish, 2004). The bundle or cluster herein termed "tablet" technology shall include its use as tool, proxy, and ensemble (Orlikowski & Iacono, 2001) and intentionally include "tablet" as a social fact emerging from students' interactions and interrelations with this bundle. Tablet technology emerges as socially constructed meanings of a particular 'situated action' (Dourish, 2004; Suchman et

al., 1999). These meanings emerge from "interactions and interrelations to their everyday use by agents" (Suchman et al., 1999).

Foundational Research Streams

Diffusion of Innovations

> Many technologists believe that advantageous innovations will sell themselves, that the obvious benefits of a new idea will be widely realized by potential adopters, and that the innovation will diffuse rapidly. Seldom is this the case. (Rogers, 2003, p. 1)

Diffusion research provides insights into how, over time, individuals within a social system decide whether to adopt a technological innovation and how information about this technological innovation is conveyed (Rogers, 1983, 2003; Straub, 2009). Diffusion research seeks to understand why some adopt early, others later, and some not at all (Rogers, Singhal, & Quinlan, 2009). Diffusion scholars explore research related to areas such as (a) how adopters differ; (b) how attributes of an innovation as perceived by respondents affect adoption; and (c) why the S-shaped diffusion curve of cumulative adopters and the resultant bell-shaped distribution of adopters undergo an acceleration in adoption after adoption reaches critical mass (Rogers, 1983).

Classical diffusion research can be traced to Gabriel Tarde (1903), who in his book, *The Laws of Imitation*, articulated the S-shaped curve of adoption (Rogers et al., 2009). Rogers (1983) credited Bryce Ryan and Neal Gross for moving diffusion research forward with their 1943 investigation of the diffusion of hybrid seed corn among Iowa farmers. Early diffusion research was ethnographic and became quantitative with the emergence of inferential statistical analysis within agricultural research (Rogers et al., 2009). In 1962, Everett M. Rogers published the Diffusion of Innovations with the final edition published in 2003. Rogers' initial research in 1957 was an analysis of the diffusion of agricultural

innovations in a rural county in Iowa. Rogers reflected on his initial research and postulated that diffusion was a general process not bound by the type of innovation, the specific adopters, or by place or culture. Rogers' expansive body of research includes specific studies conducted by Rogers as well as reviews and synthesis of the growing body of diffusion research, which, in 1962 included 405 publications and in 1983 over 3,085 publications. In his first edition of *Diffusion of Innovations* (1962), Rogers observed that most diffusion research examined agriculture diffusion and included the S-shaped curve for the rate of adoption over time, different channels of communication used at various stages in the innovation-decision process, and common attributes of adopters. Rogers developed a theoretical framework that describes the dynamics of diffusion and includes an operational definition of diffusion and its components, the innovation-development process, the innovation-decision process, attributes of innovations and their rate of adoption, the adopter categories, characteristics of diffusion networks, and the innovation process within organizations. Subsequent research included empirical replications or extensions of the theory, examined the history of diffusion research, and critiqued diffusion theory or its results (Rogers, 2003).

Rogers (2003) defined diffusion as "the process in which an innovation is communicated through certain channels over time among the members of a social system" (p. 5). The four main elements of this operational definition are: (a) innovation, (b) communicated over certain channels, (c) over time, and (d) among members of a social system. An innovation is an idea, practice, or object perceived as new by a unit of adoption (Bandura, 1986; Rogers; 1983). Rogers (2003) recognized that most diffusion research studied new ideas that were technological innovations, and therefore, used the words, innovation and technology, as synonyms. Rogers (2003) defined technology as a "design for

instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a desired outcome" (p. 13). Rogers (1983) differentiated two aspects of technology, namely, the hardware aspect consisting of the tool in which the technology is embodied and the software aspect consisting of the information base for the tool or the way it is used. The innovation may have boundary conditions, which overlap or encompass other technologies. In this case, diffusion research is more challenging since there is a technology cluster, or more than one technology has elements perceived as being closely related (Rogers, 1983, 2003). However, change agents can use this cluster effect to promote several innovations together rather than requiring recipients to treat each innovation separately (Rogers, 1983).

Rogers (1983, 2003) identified key characteristics of innovations, as perceived by the receiver of communications, which help explain the respective rates of adoption. Rogers (1983) aimed to define characteristics that would be mutually exclusive and universally relevant. These characteristics represent independent variables that explain the dependent variable, namely, the rate of adoption of innovations. The characteristics of an innovation that contribute to the rate of adoption include: relative advantage, compatibility, complexity, trialability, and observability (Rogers, 1983). Rogers defined relative advantage as the degree to which an individual perceives an innovation, based upon the individual's self-defined criteria or utility set, to be better than its predecessor. He conceptualized relative advantage to include economic factors such as profitability, initial cost, savings in time and effort as well as non-economic factors such as social status. Rogers defined compatibility as the degree to which an individual perceives an innovation as being consistent with the individual's existing values, past experiences, and perceived needs. Complexity is defined as the degree to which

an individual perceives the innovation to be difficult to understand and use. Trialability refers to the degree to which an individual can experiment with an innovation on a limited basis (Rogers, 1983, 2003). Lastly, Rogers (2003) defined observability as the degree to which the results of an innovation are visible to others. Rogers (2003) found that these five characteristics of innovations determine most of the variance in the rate of adoption over time, between 49 to 87 percent.

Rogers (1983, 2003) listed other factors that determine the rate of adoption: the type of innovation-decision (optional, collective, authority), the nature of the communication channels (mass media, interpersonal), the nature of the social system (e.g., norms, degree of network interconnectedness), the degree of the change agent's promotion efforts, and the indirect influence through the behavior of other members of the social system. Greenhalgh et al. (2004) studied the diffusion of innovations in service organizations and articulated several attributes from the research that extend beyond Rogers' set of attributes, namely, fuzzy boundaries (where the soft periphery is more complex), risk, task issues, and the knowledge required to use the technology. Greenhalgh et al. also posited a systems view of adoption wherein the individual adoption decision often occurs within a larger system that includes components such as the outer context, system antecedents, system readiness, and the implementation process.

The second element of Rogers' operational definition of diffusion is communication over certain channels. Innovation is a special type of communication in that the messages are concerned with new ideas. However, unlike the diffusion of news, the diffusion of innovations focuses on awareness, perceptual changes, decision-making, and integration (Rogers et al., 2009). For example, Rogers described an initiative by the Egyptian government and USAID

to pipe sanitary water to villagers living in the Nile River delta. Villages refused the sanitary water and continued to use the canal water even though it was contaminated. Rogers noted that Belasco, circa 1989, was able to ascertain through interviews with female water gatherers why the government's initiative was failing. Rogers (2003) reported that it is essential to take "into account the people's perceptions of an innovation" to overcome the technologists' pro-innovation bias (p. 109).

Rogers (1983, 2003) also contended that the newness of an innovation can lead to a degree of uncertainty. This "uncertainty is the degree to which a number of alternatives are perceived with respect to the occurrence of an event and the relative probability of these alternatives. Uncertainty implies a lack of predictability, of structure, of information" and communication can lead to reduction in uncertainty (Rogers, 2003, p. 6). Communication is an interpersonal process in which people create and share information with each other to reach a mutual understanding (Rogers, 1983). A communication channel is the means by which a message is transmitted and received between individuals. Mass market channels are means of broadcasting a message to many people. Interpersonal channels involve person-to-person communication and are more effective in persuading an individual to accept a new idea if the channel links persons who are similar such as similarities in socioeconomic condition or level of education (Rogers, 2003).

Most people depend on a subjective evaluation of an innovation often communicated to them from other individuals like themselves who have previously adopted the innovation. This communication is more effective when individuals are homiphilous, which means they share common interests, beliefs, or lived spaces. However, most diffusion requires exogenous communication of new

ideas and this is more likely to occur between people who are heterophilous or do not share personal and social characteristics (Rogers, 2003). Over time, the diffusion of the innovation changes the norms of the system toward the innovation and the new idea may become incorporated into the normal routines of the system (Rogers, 1983).

The third element of Rogers' operational definition of diffusion is over time. The time variable is used to measure diffusion in the innovation-decision process of an individual or an organization. The time dimension is also used to categorize adopters according to their relative time to adopt (Rogers, 2003). Rogers (2003) indicated that often the innovation is widely diffused before research is conducted; therefore the data gathered is based on the respondents' recall. Fichman (1992) and Rogers (2003) suggested that a major weakness of diffusion studies is an over reliance on retrospective measures.

The innovation-decision process is the process through which a decision-making unit, typically an individual, goes from initial knowledge about an innovation to forming a perspective toward the innovation, to a decision to adopt or reject, to implementation, and then to confirmation or rejection of the decision (Rogers, 1983). The innovation-decision process is also an information gathering and evaluation process where an individual uses information to decrease uncertainty about the innovation (Rogers, 2003). Agarwal, Ahuja, Carter, and Gans (1998) defined the innovation adoption process as one involving information gathering and uncertainty reduction. Dourish (2004) defined adoption as the meaning emerging from interaction with the technology where such meaning cannot be removed from the context or its social world. Rogers (1983, 2003) postulated five main steps in the innovation-decision process: knowledge, persuasion, decision, implementation, and confirmation. Knowledge occurs when

the decision-making unit learns of the innovation's existence and basic function. Persuasion occurs when the decision-making unit forms a favorable or unfavorable opinion regarding the innovation. Decision occurs when the decision-making unit engages in behaviors that either reject or adopt the innovation. Implementation occurs when the decision-making unit engages in use of the innovation. Confirmation occurs when the decision-making unit seeks social reinforcement for the decision during which the decision-making unit can choose discontinuance of the innovation or confirm adoption. Re-invention is the degree to which the use of an innovation changed from the initial information about the innovation's use and this re-invention can serve to confirm adoption (Rogers, 1983). The decision-making unit in this process may be an individual, organization, or community (Rogers, 2003).

Rogers (1983, 2003) operationalized the term innovativeness as the degree to which a decision-making unit is earlier in adopting an innovation than other decision-making units, and proposed that members of a social system be classified into five categories based on their individual rate of adoption: innovators, early adopters, early majority, late majority, and laggards. Given a normal adoption cycle, Rogers (1983) determined that a bell-shaped distribution could represent the cumulative adoption of these adopter categories as illustrated in Figure 3. Rogers distinguished these respective categories, or "Ideal Types," based on numerous diffusion studies. From a critical theory perspective, it is important to note the pro-innovation bias in these categories, a bias Rogers (2003) himself later criticized. Rogers et al. (2009) asserted that most diffusion research continues to exhibit this pro-innovation bias.

The final element of Rogers' operational definition of diffusion is members of a social system. Straub (2009) defined a social system as the context, culture,

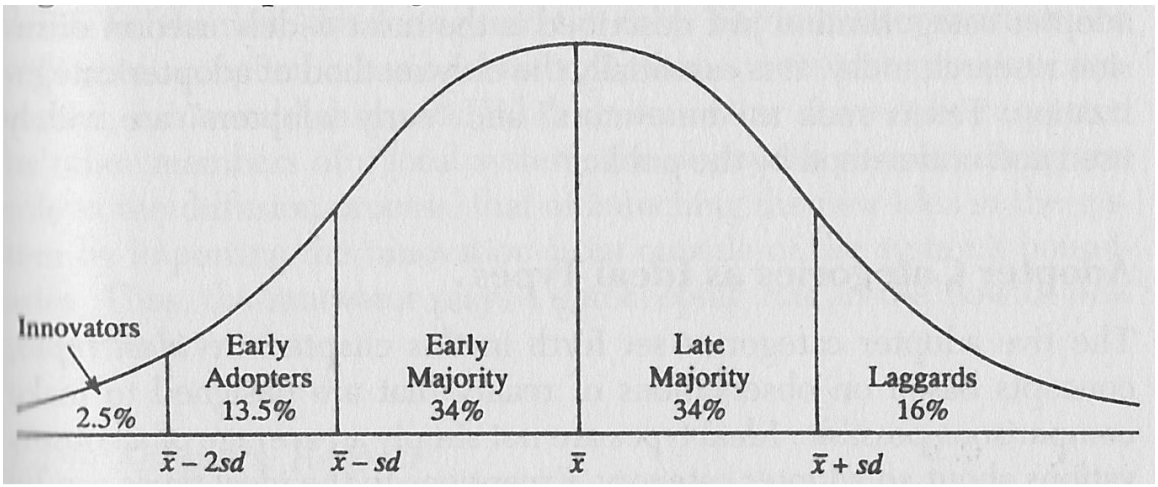


Figure 3. Adopter categories across adoption life cycle.
Adopter categories based upon standard deviations within the normal distribution of the adoption curve. The adoption curve is typically a normal distribution due to cumulatively increasing influences upon individuals to adopt resulting from the activation of peer networks. From Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York, NY: Simon and Schuster. Reprinted with permission.

and environment in which the individual exists and interacts. Rogers (1983) defined a social system as a set of interrelated units engaged in joint problem solving and the structure of this social system as the patterned arrangements of these units in the system. Given that diffusion occurs within a social system, Rogers asserted that the social structure of the system can affect the innovation's diffusion in many ways: the boundary within which an innovation diffuses, the roles of opinion leaders and change agents, the effect of norms on diffusion, the types of innovation decisions, and the consequences of innovation. The compatibility of an individual's values, beliefs, and experiences with an innovation, which are socially constructed, affect the adoption rate of the innovation for the individual (Rogers, 2003). Rogers (1983) also found that research related to educational technology conformed to the general theory of diffusion.

The acceptance and use of educational technology by students is highly correlated to adoption of educational technology by faculty given the social influence of faculty to affect student behavior (Margaryan et al., 2011). Dooley (1999), in a review of research related to the adoption of educational technology, found that a key predictor for school innovativeness was the educational cost per student. Sahin (2006) conducted a review of the research to determine the factors determining adoption. The findings indicated that attitude, training, support, access, and age were significant factors determining adoption. Sahin (2006) reviewed Rogers' (1983) three types of knowledge (awareness-knowledge, how-to-knowledge, and principles-knowledge) that reduce uncertainty related to an innovation. Sahin's review of research regarding diffusion of innovations within education revealed that (a) faculty may not have knowledge on how to use technology within teaching, (b) faculty may lack the knowledge of why and how to integrate technology in the classroom, and (c) faculty require more support during the implementation stage of a new technology.

Sahin and Thompson (2006) conducted a study to explore adoption of instructional computer use by faculty at a University in Turkey. The survey instrument used constructs from Rogers' theory of diffusion and then differentiated the level of instructional computer use and the level of computer expertise. The survey was distributed to 157 full-time faculty, yielding a 74.5% response rate. The study, using canonical correlation, found several factors that affect faculty adoption of instructional computer use including computer expertise, computer access, attitude toward computer use, and support for computer use, as well as correlations to Rogers' determinants of adoption. Faculty indicated higher levels of proficiency with personal computer technology but lower levels of proficiency relative to instructional technology. Study findings demonstrated the

importance of administrative support and faculty development to build knowledge and strengthen competency relative to educational technology. Findings also indicated divergent levels of adoption for various technologies by each individual (Sahin & Thompson, 2006). Similarly, in Neufeld's (2013) study conducted to investigate students' preferences for and proficiencies with technology, findings revealed that high school students at a college prep high school exhibited higher levels of adoption with personal productivity applications and lower levels of adoption with more complex or analytical software.

Jacobsen (1998) conducted a study to determine faculty's innovativeness in their use of technology for teaching and learning. The survey was administered to 76 faculty members across disciplines at two major North American universities. Survey items included information about use of technology for teaching, technology use patterns, general self-efficacy, and changes to teaching and learning, as well as incentives and barriers. Findings revealed three faculty adoption patterns: (a) use of computers for one purpose may encourage enthusiasm for further computer use, (b) mainstream faculty may be limited adopters due to lack of technical support and training, and (c) colleague supported training is a viable way to encourage diffusion (Jacobsen, 1998). Jacobsen argued that adoption of technology within higher education has mostly been limited to early adopters who are different than the early majority. Jacobsen concluded that early adopters are more willing to experiment, self-sufficient, and interested in technology itself whereas early majority faculty are more concerned about addressing teaching and learning problems, see ease of use as critical, and want technology that is proven and reliable.

Critiques of diffusion theory include analysis of the context in which a technological innovation is introduced; the effect of the type of technology on the

diffusion process; and refinements to the factors influencing adoption (Fichman, 1992; Greenhalgh et al., 2004). Based on meta-analysis of diffusion studies, Fichman (1992) and Greenhalgh et al. found that target technologies and social contexts determine which aspects of classical diffusion theory are applicable and identified where refinements in the theory are needed for both theoretical and applied research. Classical diffusion research assumed that individuals were adopting innovation for independent use while technologies may be subject to network externalities and interwoven with organizational practices (Fichman, 1992). Fichman (2000) argued that Rogers' adoption categories would not be applicable if another measure of adoption was considered such as aggregated adoption, internal diffusion, routinization, or assimilation. Rogers (2003) found a source agency bias in the use of diffusion theory during the Cold War as a means of modernizing developing nations in ways aligned with source agency goals. Greenhalgh et al. found later economic development studies reflected a broader system that included political, technological, and ideological contexts. These economic development studies attended to the appropriateness of a specific technology for a specific situation while appreciating the agenic response of the intended adopters (Greenhalgh et al.). Fichman (1992) articulated the differences between "type 1" and "type 2" technologies where the latter require high levels of knowledge or have significant user interdependencies. Fichman (1992) found that the generalizations of classical diffusion studies were upheld for individual adoptions of type 1 technologies. Bandura (1986) argued that diffusion's temporal analysis might yield misleading results if an individuals' adoption is not measuredly similarly for the time and amount of the initial exposure to the time and extent of the adoption.

Various methods have been used for data collection to study diffusion, however, recent research has moved to the use of surveys. Ethnographic methods can increase understanding of social dynamics. Alternative methods such as ethnography, interviews, and participant observations should supplement the dominant quantitative methodologies (Rogers et al., 2009). The influential study of Pfizer's tetracycline diffusion showed the importance of observed actual adoption, in this case, records of doctors' prescriptions (Rogers et al., 2009). Rogers also recommended that alternative research designs be used that gather data during the diffusion process; methods which include the use of archival records, longitudinal panel studies, and field experiments. Research should take into account the users' contexts and avoid a pro-technology and pro-adoption bias (Rogers, 2003; Rogers et al., 2009).

Source agency bias, pro-technology bias, and pro-adoption bias may result in outcomes that are not in the interests of the adopters (Rogers et al., 2009). Dutton, Rogers and Jun (1987) conducted a study to explore the diffusion of personal computers in the United States and examine the social impacts that occurred as a result of this diffusion. Dutton et al. recommended further examination of the gender gaps and socioeconomic inequality resulting from the diffusion of personal computers. Rogers (2003) later observed a shift in diffusion research away from source agency, pro-technology bias to a respect for respondent agency and wisdom.

Rogers (2003) and Sahin (2006) claimed that a distinctive problem with the diffusion of innovations is that it requires that innovations be communicated between heterophilous individuals while most communication occurs within homiphilous interactions. In this context, heterophily is the degree to which pairs of individuals who interact are different in key attributes (e.g., occupation,

education, race/ethnicity, etc.); while homophily is its opposite. Rogers (1983, 2003), while categorizing respondents based on innovativeness, acknowledged that variations exist among respondents. In education, the population of teachers and students is heterogeneous and exhibits variations relative to adoption (Dooley, 1999). Dooley argued that emphasis should be on understanding differences among teachers relative their level of concerns and level of use in order to design appropriate interventions. Similarly, Jacobsen's (1998) study on teacher adoption of educational technology explained that slow adoption resulted from administrator's understanding of the differences between faculty members who readily adopt technology for teaching and those members who do not.

Diffusion theory is critical to understanding adoption and diffusion. Adoption is a sub-process and inseparable from diffusion. However, diffusion theory, while retrospective in its description of adoption, does not provide a prescriptive diagnostic framework for adoption (Straub, 2009). Nonetheless, the diffusion of innovations theory is integral to this study's theoretical frame because it identifies the social dynamics of diffusion that act as determinants in adoption and shape the socially constructed meaning of an innovation.

Acceptance and Use of Technological Innovations

Diffusion and adoption theories consider different aspects of behavioral change and distinct scopes of the change process (Straub, 2009). Diffusion theory describes how an innovation spreads through a social system. Adoption, or acceptance, theory examines individuals' perceptions, norms, and beliefs as well as their choices relative to a particular technological innovation (Rogers, 1983; Straub, 2009). Adoption is a sub-process and inseparable from diffusion (Straub, 2009). Adoption may be operationally termed *acceptance* and the terms are synonymous herein. The goal of adoption research is to understand the relevant

determinants for behavior relative to a particular innovation, improve predictability of behavior based on the determinants, and understand variations in populations relative to the determinants. However, understanding and controlling factors that lead to adoption does not guarantee adoption since contextual factors can lead to non-adoption (Rogers, 1983; Straub, 2009).

Adoption theory examines the individual's beliefs and the choices made relative to a particular innovation. The metrics of adoption or acceptance theory are behavioral intention and actual change. Affective, cognitive, and contextual factors are predictors of behavioral change (Straub, 2009). Adoption research provides a tool to increase understanding of populations relative to a technological innovation, improve predictive insights into a population's determinants of acceptance and use of an innovation, and appreciate the variations within and between populations based on perspectives relative to a technological innovation.

Acceptance and use: foundational theories and models. Several acceptance and use theories and models inform the theoretical frame: Social Cognitive Theory, Theory of Reasoned Action, Concerned Based Adoption Model, Theory of Acceptance Model, and the Unified Theory of Acceptance and Use of Technology. Rogers' theory of diffusion is a general theory pertinent to numerous contexts, populations, and technologies albeit with appropriate adjustments as required by the context, population, and technology (Fichman, 2000). Subsequent to Rogers' diffusion research, adoption research specific to information technology explored alternative theories emerging from disciplines such as social psychology (Agarwal et al., 1998).

Information technology adoption is a special research stream that considers design, implementation, adoption, and diffusion specific to information systems technologies. Early diffusion studies, given the retrospective social analysis as

well as credence offered to technology and social systems, appeared to limit the agency of the intended adopters based on a behaviorist perspective (Rogers et al., 2009). The common themes that emerged from adoption theories are the perspectives of potential adopters, the predictive nature of the independent variables, and identification of behavioral intention and behavior as dependent variables (Rogers et al., 2009).

The theory of reasoned action (TRA) seeks to provide consistency in research between attitudes and behaviors relative to the acceptance of technology innovations (Fishbein & Ajzen, 1975). The TRA operationalizes two constructs, namely, principles of compatibility and behavioral intention. The TRA posited that an individual's attitudes toward a behavior and the surrounding subjective norms influence behavioral intention (Fishbein & Ajzen, 1975). Oye et al. (2014) criticized the TRA for not considering social factors. Ajzen (1991) subsequently developed the theory of planned behavior (TPB) by adding the construct of perceived behavioral control to the existing constructs within TRA, namely, behavioral beliefs and normative beliefs. This extension of TRA was necessary to deal with contexts in which the adopter has limited volitional control (Ajzen, 1991).

Ajzen (1991) built on Bandura's concept of self-efficacy identifying the impact of perceived behavioral control on intentions and actions. Bandura (1986) defined self-efficacy as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances ... judgments of what one can do with whatever skills one possesses" (p. 391). The TPB, depicted in Figure 4, articulates the strong relationship between behavior and core beliefs about consequences of behavior, expectations of others regarding the behavior, and the perceived behavioral control (Ajzen, 1991; Oye et al., 2014).

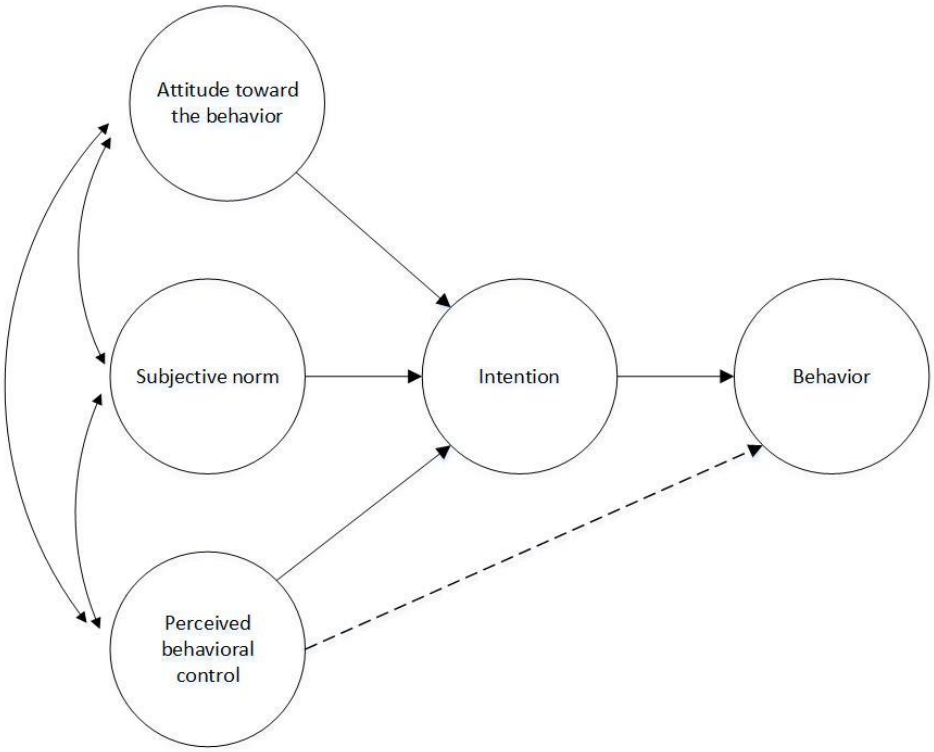


Figure 4. Theory of Planned Behavior
Determinants of intention include attitude toward the behavior, subjective norm, and perceived behavioral control. Intention and perceived behavioral control determine behavior. From Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50(2), 179-211. Adapted with permission.

Ajzen (1991) analyzed data from 12 studies, circa 1984 to 1990, using TRA constructs to investigate the predictive power of intention and perceived behavioral control on behavior. The analysis showed a strong predictive power with an *R* between .20 and .78 and an average of .51. The behaviors studied included weight loss, problem drinking, voting, and class attendance. Ajzen analyzed data from 16 studies using constructs from the theory of planned behavior to determine the strength of those constructs. The findings revealed strong predictive power of intention and perceived behavioral control on behavior with an *R* between .43 to .94 and an average of .71. Based on data analysis from the 16 studies, Ajzen, found that personal considerations tended to have a stronger

influence than perceived social pressure and that previous experience plays a role in behavioral intention. Ajzen concluded that learning about the unique factors inducing one person to engage in a behavior occurs at the level of beliefs and these beliefs provide keys to behavioral interventions.

Subsequently, Concerns Theory research findings indicated that teachers' differing perceptions and needs are important considerations when developing and delivering interventions (Dooley, 1999). Hall (1973) defined concerns as the composite representation of a person's beliefs, feelings, and considerations relative to a specific issue or task. Each person perceives and mentally contends with an innovation differently (Dooley, 1999). These deep-seated beliefs and identity structures lead to resistance to change and/or acceptance of innovations (Straub, 2009).

Hall (1973) described the Concerns-Based Adoption Model (CBAM) for adoption of innovations within educational contexts as a process wherein each user demonstrates successively higher quality use of the innovation. CBAM is used to address change implementation on a systems level and consists of three diagnostic dimensions combining three major perspectives: (a) systems thinking, (b) diffusion, and (c) organization development. The Concerns-Based Adoption Model consists of three diagnostic dimensions: stages of concern, levels of use, and innovation configuration (Hall, 1973; Straub, 2009). Hall defined six principles necessary for innovation to occur: (a) change is a process, not an event; (b) change is accomplished by individuals; (c) change is a highly personal experience; (d) change involves developmental growth; (e) change is best understood in operational terms; and (e) the focus of facilitation should be on individuals, innovations and context (Hall, 1973). Hall argued that sensitivity to

the concerns of users could lead to educational adoption at a high quality level of use.

Attention to adopters and their social cognitive processes also exists within Bandura's Social Cognitive Theory (1986, 2001). Social Cognitive Theory posits that learning occurs in a social context with a dynamic interchange between the person, the person's environment, and the person's behavior (Bandura, 2001). Bandura (2001) asserted that human agency is characterized by several core features including the temporal extension of agency through intentionality and forethought, self-regulation, and self-reflectiveness about one's meaning and purpose while elevating personal agency. Bandura (2001) contended that this agency operates within a broad network of socio-structural influences and identified three modes of agency: direct personal agency, proxy agency, and collective agency. Bandura (1986) explained human functioning in terms of a "triadic reciprocity in which behavior, cognitive and other personal factors, and environmental variables all operate as interacting determinants of each other" (p. 18). This conceptualization of the interactions between personal and environmental factors and behavior is a foundational concept in adoption research (Sahin & Thompson, 2006). Bandura (1986) asserted that people by nature have the core capabilities of symbolizing, forethought, vicarious experience, self-regulation, and self-reflection. Straub (2009) suggested that the most salient aspects of Social Cognitive Theory for understanding adoption are self-regulation, attitude and belief development, and affect. Bandura (1986) distinguished two separable processes in the adoption process: (a) acquisition of knowledge regarding the innovation and (b) the adoption of that innovation in practice; and each process is governed by different determinants.

Furthermore, Bandura (1986) found direct and symbolic modeling as the key vehicle for transmitting information about an innovation and its use. Adoptive behaviors are governed by incentive influences, economic social recognition, skills and knowledge required, amenability to brief trial, and the resources required for adoption. However, forecasting adoption and diffusion is challenging given the many uncertainties involved (Bandura, 1986). Bandura (2001) asserted that humans' functional consciousness involves "purposive accessing and deliberative processing of information for selecting, constructing, regulating, and evaluating courses of action" (p. 3). Bandura's (1986) contribution to acceptance theories is the rich framework for understanding the formation and ongoing changes in personal perspectives, beliefs, norms and choices. Bandura's concept of self-efficacy, similar to Ajzen's (1991) concept of perceived behavioral control, influences choice, preparation, and effort expended for a given behavior as well as thought patterns and emotional reactions (Bandura, 1986).

Davis' (1989) Technology Acceptance Model (TAM), depicted in Figure 5, builds on Bandura's (1982) self-efficacy theory and Beach and Mitchell's (1978) behavioral decision theory. Davis designed the model to predict information technology acceptance and use within an organizational context. Davis conducted a study to develop and validate scales for the variables of perceived ease of use and perceived usefulness, hypothesized to be fundamental determinants of user acceptance. A questionnaire, using 10-item scales, was administered to 120 users from IBM Canada's Toronto Development Laboratory asking participants to rate the ease of use and usefulness of two information systems (PROFS electronic email and XEDIT file editor). Davis hypothesized that the use of an innovation is predicted by behavioral intention, which is predicted by two characteristics of the

innovation, namely, perceived ease of use and perceived usefulness as illustrated in Figure 5.

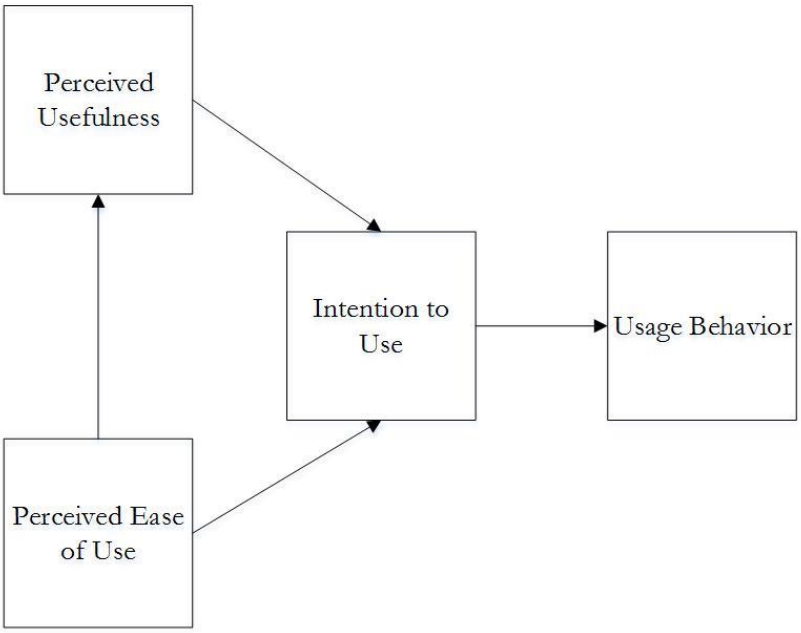


Figure 5. Technology Acceptance Model
Perceived Usefulness and Perceived Ease of Use determine Intention to Use which determines Usage Behavior. From Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly 13(3), 319-340. Adapted with permission.

Results revealed that perceived usefulness was significantly correlated with current usage (r=.63, Study 1) and self-predicted future usage (r=.85, Study 2). Similarly, perceived ease of use was significantly correlated with current usage (r=.45, Study 1) and self-predicted future usage (r=.59, Study 2). Davis tested the validity of the TAM against data from previous studies and found that the technology acceptance model, with its constructs of ease of use and usefulness, was capable of predicting adoption success in 30% to 40% of the cases (Davis, 1989). Davis concluded that perceived ease of use might be a determinant of perceived usefulness as opposed to a direct determinant of usage. Davis (1989) found that perceived self-efficacy and perceived instrumentality governed

perceived ease of use. The technology acceptance model was criticized for not acknowledging differences within a population or the constraints limiting chosen behaviors (Agarwal & Prasad, 1999). This model also did not account for prior experience and other variables such as gender and age that could affect attitudes about technology (Straub, 2009).

Subsequently, Venkatesh and Davis (2000) extended the technology acceptance model (TAM2) to include cognitive instrumental and social influence processes. Venkatesh and Davis conducted four longitudinal field studies to validate TAM2 within organizational contexts. In the interest of ecological validity, Venkatesh and Davis selected diverse research sites mirroring the target situation, namely, where the innovation was to be introduced, so that the findings could be generalized. Studies 1 through 4 respectively included 48 supervisors at a manufacturing company, 50 financial services personnel from a large financial service firm, 51 employees with various roles in a small accounting firm, and 51 employees of a small international investment firm. Two of the four studies included mandatory adoption of an innovation. The survey instrument used items from previous research. In each study, the survey was administered over four time-periods: after initial training, 1 month after implementation, 3 months after implementation, and 5 months after implementation. The model was consistent across all four organizations and results revealed the first three points of measurement accounted for 40%-60% of variance in perceived usefulness and 34%-52% of the variance in usage intentions. Both social influence and cognitive instrumental processes significantly affected user acceptance. Venkatesh and Davis concluded that social influence is more effective over time than mandatory approaches to introducing new technology. Recommendations included designing systems to match intended use. However, the model did not include variables

such as training and support, factors that Venkatesh later conceptualized as "facilitating conditions" (Oye et al., 2014; Venkatesh et al., 2003).

Unified Theory of Acceptance and Use of Technology. Venkatesh and Davis (2000) continued their research of acceptance and use of technology within organizational contexts with the aim of reviewing and synthesizing research in order to move towards a unified theory. Venkatesh et al. (2003) conducted a study for the purpose of (a) reviewing the eight dominant user acceptance models with their extensions, (b) empirically comparing these models, (c) formulating a unified model that integrates components of the eight models, and (d) empirically validating the model (Venkatesh et al., 2003). The study explored eight models: theory of reasoned action, technology acceptance model, motivational model, theory of planned behavior, a theory that combined the theory of reasoned action and the theory of planned behavior, model of personal computer utilization, diffusion of innovations theory, and social cognitive theory. Table 1 presents the eight models and the core constructs for each model (Venkatesh et al., 2003).

Venkatesh et al. (2003) condensed the 32 variables or core constructs from the eight models reflected in Table 1 into four determinants of behavior intention and use behavior as well as four moderating variables which impact the strength of the four determinants as illustrated in Figure 6, a graphical representation of these determinants. The four determinants were performance expectancy, effort expectancy, social influence, and facilitating conditions, and the four moderating variables were gender, age, experience, and voluntariness of use. The two-staged dependent variables were behavioral intention and use behavior. Findings revealed three determinants (performance expectancy, effort expectancy, and social influence) predicted behavioral intention. Behavioral intention and

Table 1

Eight User Acceptance Models with Core Constructs

Model	Core Constructs for Each Model
Theory of Reasoned Action (TRA)	• Attitude Toward Behavior • Subjective Norm
Technology Acceptance Model (TAM)	• Perceived Usefulness • Perceived Ease of Use • Subjective Norm
Motivational Model (MM)	• Extrinsic Motivation • Intrinsic Motivation
Theory of Planned Behavior (TPB)	• Attitude Toward Behavior • Perceived Behavioral Control • Subjective Norm
Combined TAM and TPB (C-TAM-TPB)	• Attitude Toward Behavior • Perceived Behavioral Control • Perceived Usefulness • Subjective Norm
Model of PC Utilization (MPCU)	• Affect Towards Use • Complexity • Facilitating Conditions • Job-Fit • Long-Term Consequences • Social Factors
Innovation Diffusion Theory (IDT)	• Compatibility • Ease of Use • Image • Relative Advantage • Results Demonstrability • Visibility • Voluntariness of Use
Social Cognitive Theory	• Affect • Anxiety • Outcome Expectations – Performance • Outcome Expectations – Personal • Self-Efficacy

Source: Venkatesh et al. (*2003)*

facilitating conditions predicted use behavior. Performance expectancy was the degree to which the individual believed that using the innovation would help him or her attain gains in job performance. Performance expectancy encompassed five of the constructs from the eight models: perceived usefulness, extrinsic motivation, job-fit, relative advantage, and outcome expectations. Effort expectancy was the perceived degree of ease associated with the innovation. Effort expectancy encompassed two constructs from the eight models: perceived ease of use and complexity. Social influence was the degree to which the individual perceived that others important to him/her think that he/she should use the innovation. Social influence encompassed three constructs from the eight models: subjective norm, social factors, and image. Facilitating conditions was the degree to which the individual believed that organizational and technical support would be accessible. Facilitating conditions encompassed three constructs from the eight models: perceived behavioral control, facilitating conditions, and compatibility (Venkatesh et al., 2003). Based on the assumption that aspects of facilitating conditions such as training and support are freely available within organizational contexts, the researchers hypothesized that facilitating conditions influence behavioral intention, but not technology use (Venkatesh et al., 2012).

Venkatesh et al. (2003) conducted longitudinal field studies at four companies where a technological innovation was introduced into the workplace. The contexts of these studies were heterogeneous in (a) the voluntariness of adopters with regard to the innovation (two were mandatory and two were voluntary) and (b) the industries represented. The researchers were once again interested in ecological validity and selected target situations where an innovation was to be introduced. The studies were titled 1a, 1b, 2a, and 2b and included 54 personnel within product development at an entertainment company, 65 sales

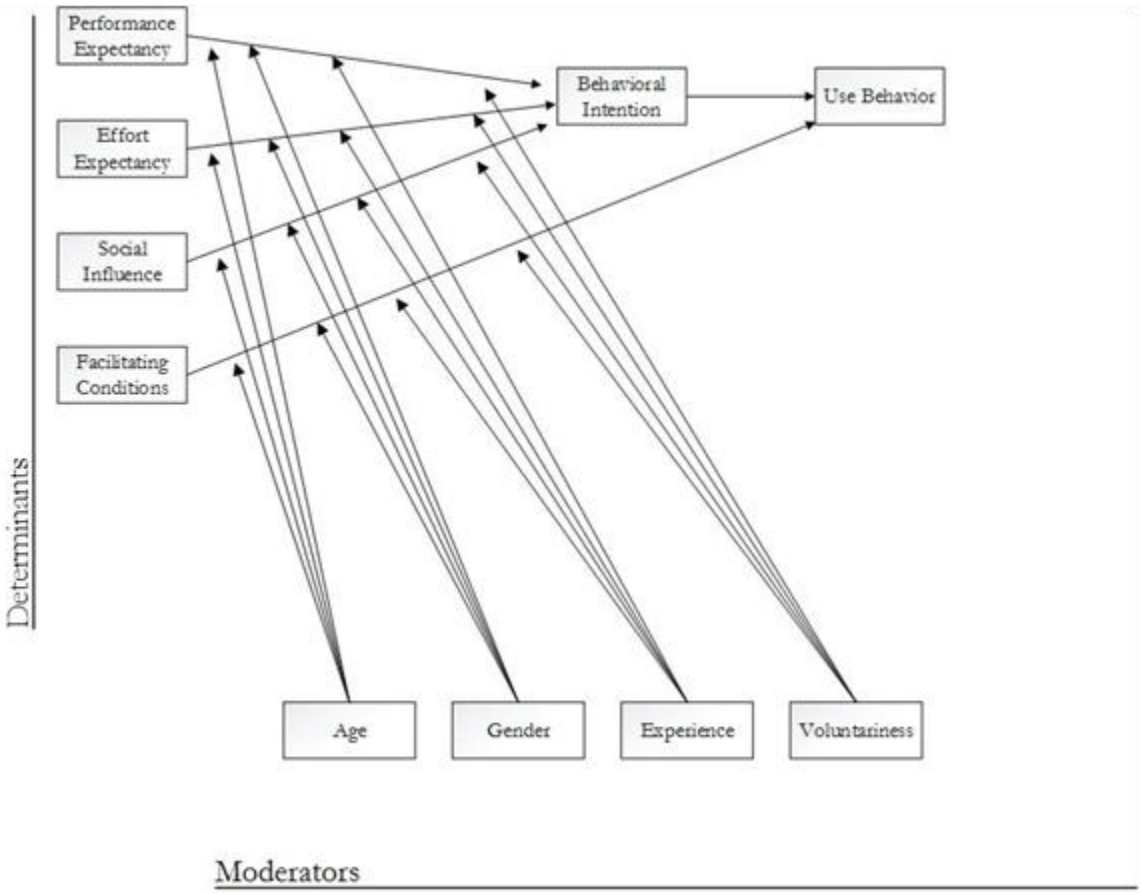


Figure 6. Unified Theory of Acceptance and Use of Technology. UTAUT showing determinants for behavioral intention and use behavior within organizational contexts. The determinants of Behavioral Intention include Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions. The determinants of Use Behavior include Facilitating Conditions and Behavioral Intention. The strength of each determinant is moderated Age, Gender, Experience and Voluntariness. From Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425-478. Adapted with permission.

personnel from a telecommunication service firm, 58 account managers with a banking firm, and 38 accounting personnel from a public administration organization, respectively. The survey instrument used items validated from previous research and was adapted for the specific technology and organizational context. In each study, the survey was administered three times: after initial training, 1 month after implementation, and three months after implementation. The survey instrument included constructs from the eight models.

Findings revealed high perceptions of voluntariness in studies 1a and 1b, with 1a occurring in the entertainment sector and 1b occurring in the telecommunication services sectors, and very low in studies 2a and 2b, with 2a occurring in the banking sector and 2b occurring in the public sector. Given the bi-modal distribution in the data relative to voluntariness, the researchers created two data sets for analysis (1a and 1b; 2a and 2b). A partial least squares was used to determine convergent and discriminant validity of the measures. The test of the model only examined the direct effects on intention rather than interrelationships among determinants of intention. Hence, indirect paths did not impact the explained variance (R^2). Findings indicated that the eight models explained variance in intention ranging from 17% to 42%. A key difference was revealed for the social influence construct, which was stronger in its relation to intention in the studies where the innovation was mandated.

Venkatesh et al. (2003) formulated the UTAUT that incorporated the components of the eight models into three direct determinants of intention to use (performance expectancy, effort expectancy, and social influence), two direct determinants of usage behavior (behavioral intention and facilitating conditions), and four moderating variables (experience, voluntariness, gender and age). The resultant UTAUT outperformed the original eight models in its prediction of

behavioral intention (adjusted R^2 of .69). The post-training data (T1) was pooled across studies (N=215) to measure the seven direct determinants of intention. Findings indicated that the performance expectancy construct was the strongest predictor of behavioral intention and was significant within both voluntary and mandated settings. Results also revealed that effort expectancy was significant for both voluntary and mandated settings. However, effort expectancy was only significant during the initial period and diminished thereafter. Effort-oriented constructs are expected to be more significant in early stages of adoption and become overshadowed by performance expectancy in later stages (Davis, 1989; Venkatesh et al., 2003). Social influence constructs were significant for the mandated context, however, not significant for the voluntary context. Data from these four studies validated the UTAUT model (Venkatesh et al., 2003).

Two additional studies, Studies 3 and 4, were conducted to validate the UTAUT and test for external validity. Studies 3 and 4 included data collection from two organizations, 80 research personnel within a financial services firm and 53 customer service personnel at a retail electronics firm, respectively. The context for study 3 was voluntary use and mandatory use for study 4. Results revealed that the new UTAUT model continued to outperform the previous eight models in predicting behavioral intention and use behavior (adjusted R^2 of .70.). Venkatesh et al. (2003) asserted that the UTAUT model provides a "useful tool … to assess the likelihood of success for new technology introductions and helps them understand drivers of acceptance in order to proactively design interventions (including training, marketing, etc.) targeted at populations of users that may be less inclined to adopt and use new systems" (p. 426).

The UTAUT model has been applied in different research contexts and the theory extended with varying sets of constructs. Williams, Rana, Dwivedi, and

Lal (2011) analyzed 450 citations of Venkatesh et al.'s (2003) original study of UTAUT to investigate use and adaptations of the theory. Of these citations, only 43 actually used the theory or its constructs in an empirical study. Analysis revealed that the studies referred to over 43 different target technological innovations such as mobile banking (Zhou, Lu, & Wang, 2010), social media (Mandal & McQueen, 2012), e-recruitment (Eckhardt, Laumer, & Weitzel, 2009), health/hospital information systems (Hennington & Janz, 2007), and text messaging (Baron, Patterson, & Harris, 2006), and indicated the use of external variables (such as anxiety, attainment value, attitude, computer self-efficacy, credibility, efficacy, experience, gender, income, experience, objective norm, perceived ease of use, perceived risk, perceived usefulness, risk, task technology fit, trust, and utility value) combined with the UTAUT constructs. Of the external variables, attainment value, utility value, trust, attitude, perceived ease of use, perceived usefulness, computer self-efficacy, gender, perceived risk, income, and experience indicated the strongest influence on behavioral intention within these studies. Results further revealed application of the model within different social and organizational contexts (Williams et al., 2011).

Critique of the UTAUT focused on discussions about the theory behind certain constructs, recommendations to extend the theory, and examinations of underlying assumptions. Straub (2009) argued that attitudes towards computers, self-efficacy and computer anxiety, all represented within the effort expectancy construct, seemed contradictory to the value social cognitive theory puts on these constructs. Brevik (2005) argued that the UTAUT constructs explain success measures of the different research streams in terms of user acceptance, but do not explain the interaction between these measures. Brevik also suggested that the UTUAT would benefit from the insights of cognitive dissonance theory and

expectation-disconfirmation theory. Subsequently, Venkatesh, Thong, Chan, Hu, and Brown (2011) explored users' post-adoption behaviors using expectation-confirmation theory (ECT), also known as the expectation-confirmation model, to better understand continued information system usage. The original UTAUT model assumed that facilitating conditions, specifically, training and support, would be freely available within an organizational context (Venkatesh et al., 2012). However, this assumption often is not correct within many educational organizations where educators often feel training and support are not readily available (Butler & Sellbom, 2002; Hutchison & Reinking, 2010; Singh & Hardaker, 2014). Similarly, students are less likely to turn to institutional support services (Dahlstrom et al., 2012) despite students' need for support in the use of technology to perform academic tasks (Gros et al., 2012). Numerous studies (Marchewka & Kostiwa, 2014; Moran, Hawkes, & El Gayar, 2010; Oye et al., 2014; Tan, 2013; Van Schaik, 2009) have used the UTAUT to research technological adoption within an educational context. These studies examined UTAUT in relation to both faculty and student populations as well as innovations such as mobile devices, online courses, virtual learning environments, learning management systems, placement tests, and tablet computers. Anderson, Schwager, and Kerns (2006) studied faculty acceptance of tablet PCs in a college of business at a large U.S. university using UTAUT as a prescriptive tool to assess user acceptance. Study results validated the UTAUT and revealed that the most salient drivers for acceptance in this context were performance expectancy and voluntariness. Faculty were mainly concerned with the results of use, the voluntariness of faculty use, and administrators providing training and support (Anderson et al., 2006).

Oye et al. (2014) conducted a study using UTAUT to understand behavioral intention of Adamawa State University (Nigeria) faculty's acceptance and use of Information and Communications Technology (ICT) in their workplace. A survey, based on Venkatesh et al.'s (2003) constructs, was administered to 100 faculty proportionately distributed across the university's colleges and schools. Results revealed that the four determinants of performance expectancy, effort expectancy, social influence, and facilitating conditions had a significant positive influence on behavioral intention to accept and use ICT, with effort expectancy and social influence showing the most strength. Van Schaik (2009) used the UTAUT model to explore acceptance and use of websites used by students. The study included 118 undergraduate psychology students from Teesside University who participated in the survey as part of a course requirement. The data affirmed the relevance of UTAUT, within this context, to predict behavioral intentions from the determinants. Van Schaik (2009) concluded that intrinsic motivation had an effect on performance expectancy mediated by effort expectancy.

Moran (2006) studied the acceptance and use of tablet PCs at a university in the United States. A survey instrument was designed based on Venkatesh et al.'s constructs (2003) as well as the constructs of self-efficacy and anxiety. The survey was administered 1 time to 365 students with 263 students responding. This sample size was larger than that required by PLS-Graph (software for analysis of data using partial least squares). Moran selected this population because they had been using tablet PCs for a semester, and most of the participants were in computer science courses. Moran acknowledged that the results were skewed towards tablet PC adoption since the students self-selected a computer science program with a tablet PC program. Moran used partial least squares to determine goodness of fit and factor loading indicators. Findings revealed

relevance of UTUAT for the acceptance and use of tablet PCs within the university context (Moran, 2006).

UTAUT was designed for organizational contexts (Venkatesh et al., 2003), but expanded to include additional constructs for consumer contexts (Venkatesh et al., 2012). Venkatesh et al. (2012) theorized consumer adoption using three additional constructs: hedonic motivation, price value, and habit. Hedonic motivation is the enjoyment or pleasure from using a technology. The moderating factor of voluntariness was eliminated since it was not pertinent to a consumer choice context. Consumers are responsible, in a consumer context, for the costs of their decision to adopt an innovation; the price value construct is the consumers' cognitive tradeoff between perceived benefits and associated costs for use. Habit is a perceptual construct that reflects results of prior experience. The Unified Theory of Acceptance and Use of Technology 2 (Venkatesh et al., 2012) is illustrated in Figure 7, a graphical representation of the determinants and moderators.

Venkatesh et al. (2012) conducted a study of mobile Internet acceptance and use in Hong Kong using a two-stage survey. The 1,512 respondents were all mobile Internet users. Findings showed significant effects for performance expectancy, effort expectancy, and social influence on behavioral intention; and both behavioral intention and facilitating conditions had significant effects on use. Results showed UTAUT2 explained 56%-74% of the variance in behavioral intention and 40%-52% of the variance in technology use. The findings indicated that habit complemented facilitating conditions as a determinant of use during the initial stage of the survey, however, as experience with the technology increased, habit was a less significant factor relative to use. Findings revealed that habit is a critical factor predicting technology use within a consumer context. Findings

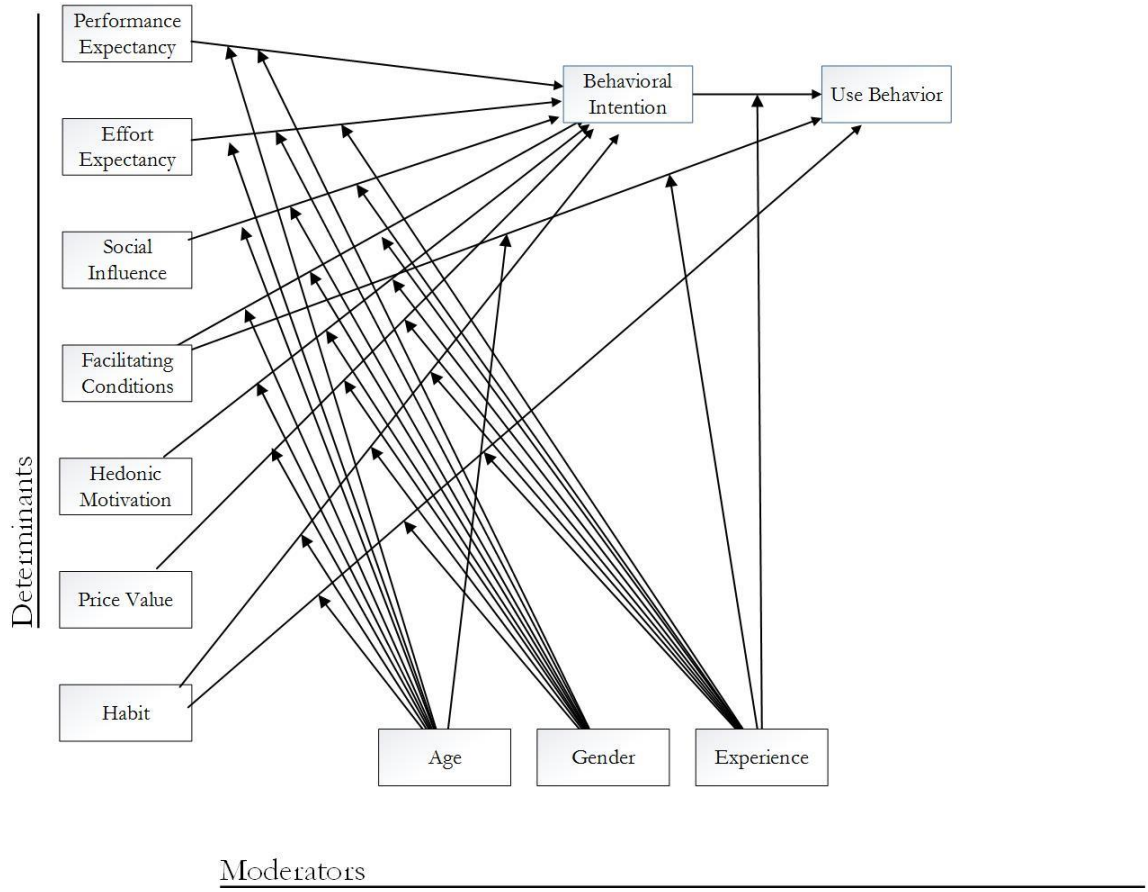


Figure 7. Unified Theory of Acceptance and Use of Technology 2
Unified Theory of Acceptance and Use of Technology 2 includes determinants of behavioral intention and use behavior within consumer context. The determinants of Behavioral Intention include Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Hedonic Motivation, Price Value and Habit. The determinants of Use Behavior include Facilitating Conditions, Behavioral Intention, and Habit. The strength of each determinant is moderated by Age, Gender, and Experience. From Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS Quarterly, 36*(1), 157-178. Adapted with permission.

revealed facilitating conditions influenced both behavioral intention and use behavior, whereas in the UTAUT study, which occurred within an organizational context, facilitating conditions only influenced use behavior (Venkatesh et al., 2003, 2012).

UTAUT2 does not include socioeconomic status as a moderating factor; however, socioeconomic status may influence performance expectancy, facilitating conditions, and price value. For example, a person may perceive the price value trade-off differently depending on their socioeconomic status (Venkatesh et al., 2012).

Adoption: systems, contexts and technology types. Systems context (Greenhalgh et al., 2004) and adoption context (Fichman, 1992, 2000) are important considerations for applied research related to the adoption and diffusion of innovations. Venkatesh et al. (2012) noted that applying theories to a specific context is important to understand phenomenon and extend theories.

For organizational contexts, Rogers (2003) suggested a separate set of independent variables related to the diffusion of innovations. These variables consist of the individual leader's attitude toward change, the internal characteristics of the organizational structure (i.e., centralization, complexity, formalization, interconnectedness, and organizational slack), and external characteristics of the organization, namely, system openness (Rogers, 2003). Fichman (1992) argued that classical diffusion research looked at adoption by individuals making autonomous choices about whether to adopt personal-use innovations that do not require extensive specialized knowledge prior to adoption. Subsequent research (Brevik, 2005; Davis, 1989; Fichman, 1992; Venkatesh & Davis, 2000) included individual adoption with strong managerial influence within

organizations for technologies where adopter interdependencies exist. Fichman (1992) conducted a review of adoption, diffusion, and assimilation literature to explore which models, based on the research, were most relevant to varying technological, social, and situational contexts. Fichman (1992) categorized adoption contexts relative to the type of study, voluntariness of adoption, and type of technology. Fichman (1992) separated adopter studies from macro diffusion studies, and classified technologies as type I, in which use was independent and knowledge requirement was low, and type II, in which use was interdependent and knowledge requirement was high. Fichman (1992) reviewed the research stream related to organizational adoption including Kwon and Zmud's (1987) five contextual factors for adopter innovativeness (user community characteristics, organizational characteristics, technology characteristics, task characteristics, and environmental factors) and Robertson and Gatignon's (1986) competitive effects for macro diffusion. Fichman (1992) distinguished the context often found in classical diffusion studies, where the focus was on individual adopters within social systems, compared to the context of diffusion within organizations, where knowledge barriers are high. Fichman (1992) described the difference between these contexts as a shift from adopter willingness to adopter ability to adopt (1992). Fichman's (2000) research revealed that information systems adoption studies produced the strongest results when the context included individual adoption with independent-use technologies. Given the absence of a singular theory of innovation, Fichman (2000) suggested that researchers should develop theories tailored to specific classes of technologies and/or to particular adoption contexts.

Similarly, Greenhalgh et al. (2004) referred to systems' contexts as pertinent to the specific adoption context. Greenhalgh et al. contended that

systems contexts, with their various subcomponents, determine the adoption, diffusion, and implementation of innovations. Fichman (1992), Venkatesh et al. (2003), Venkatesh et al. (2012) and others who have researched diffusion and adoption within various contexts noted the changes needed in theory to adapt to the given contexts. Fichman (1992) suggested that information systems diffusion research diverges from classical diffusion assumptions due to the characteristics of the technology (user interdependencies and knowledge barriers) and the locus of adoption (individual versus organization). Venkatesh et al. (2011) conducted a longitudinal study of individuals using a government web site and SmartID cards in Hong Kong. The purpose of the study was to examine the continuance of use of a technology innovation after the initial adoption of the technology. Participants included 1,263 respondents to the SmartID card survey and 1,896 respondents to the government web site survey. Findings revealed that trust was an important construct within the e-government context. This study once again affirmed the importance of context to determine which factors affect a person's use of technology (Venkatesh et al., 2011).

Information Systems Implementation

The information systems (I.S.) implementation research stream examines the factors that help or hinder adoption, diffusion, and dissemination of technological innovations within organizations. Systems implementation initiatives present significant challenges (Standish Group, 2013). Effective implementation leads to substantial gain while implementation failure negatively affects people, resources and brand (Standish Group, 2013; Vaughan, 2001). The classic barometer of I.S. implementations is the annual Chaos Report first published by the Standish Group in 1994. This report communicated an annual I.S. project success rate of 39% in 2012 (Standish Group, 2013). The investment

of financial, human resource, and organizational capital in educational technology suffers when implementations do not go well (Burke, Kenney, Kott, & Pflueger, 2001; Vaughan, 2001). Furthermore, the degree of implementation effectiveness affects the adoption and diffusion of innovations for students (Butler & Sellbom, 2002; Keengwe, Kidd, & Kyei-Blankson, 2008; Singh & Hardaker, 2014). I.S. implementation research studies (Burke, et al., 2001; Greenhalgh et. al., 2004; Vaughan, 2001) have revealed factors that affect implementation outcomes. These factors, which appear in implementations across industry, also pertain to education (Butler & Sellbom, 2002; Covington et al., 2005; Dennison, 2014; Vaughan, 2001).

Greenhalgh et al. (2004) conducted a study of diffusion within service organizations analyzing 213 empirical and 282 non-empirical studies using narrative synthesis techniques. Findings were ranked based on the strength of the evidence within the studies using the World Health Organization's Health Evidence Network criteria. Greenhalgh et al. developed a conceptual model for considering the determinants for adoption, diffusion, and dissemination. The factors emerging from the studies were grouped into aspects of this conceptual model, which included the innovation itself, system antecedents for innovation, system readiness for innovation, the adopter, the adoption/assimilation process, the outer context, and linkages between these aspects during the design and implementation process. The factors identified within the innovation aspect included fuzzy boundaries or the soft-periphery of the organizational structure and systems required to achieve full implementation, risk or the uncertainty of the expected outcome, the task issues or the innovation's relevance to performance of the user's work, and the knowledge required to use the innovation. The aspect of system antecedents for innovation included factors such as structural determinants

for innovation, absorptive capacity for new knowledge, and the receptiveness of the context for change. The aspect of system readiness for innovation included factors such as innovation-system fit and support and advocacy as well as dedicated time and resources. The implementation and assimilation process aspect included factors such as routinization, required appropriate organizational structure, leadership, funding, intra-organizational communication, feedback loops, and the adaptation and reinvention of the technological innovation within the given context. The factors for the adopter aspect were needs, motivation, values, goals, skills, styles, and social networks. Informal inter-organizational networks, intentional spread strategies, the broader environment, and political directives were factors related to the outer context aspect of the model. Additionally, the model included linkages between the components of the model during design and implementation processes and factors such as shared meaning and mission, user involvement, communication, training, and project management support. Greenhalgh et al. (2004) concluded that an innovation's attributes are neither immutable nor stable - a point also articulated by Venkatesh et al. in 2012. Study findings revealed that interaction among the innovation, the intended adopter(s), and the particular context determined the rates of adoption (Greenhalgh et al., 2004).

Similarly, the Standish Chaos Report identified several factors critical to effective information systems implementation: user involvement, skilled resources, project management expertise, clear business objectives, emotional maturity, execution, tools and infrastructure (Standish Group, 2013). Since 1985, the Standish Group, a group of industry analysts and advisors, has collected case information on real-life IT infrastructure and software projects (Standish Group, 2013). The criteria used by the Standish Group were criticized by Eveleens and

Verhoef (2010) who noted that the Standish Group classified projects as *success*, *failure,* or *challenged* rather than using a more nuanced classification. In addition, the impact of project failures is found in published project failures, which reveal the fiscal, reputational, and operational impacts to organizations (Kanaracus, 2013; IT Cortex, 2014).

Further support for implementation factors is found in the work of Nah, Zuckweiler and Lee-Shang Lau (2003). Nah et al. reviewed the literature and identified 11 critical success factors for implementation of enterprise resource planning (ERP) systems. Fifty-four respondents to the study's survey, all CIOs from Fortune 1000 companies, identified the top five factors of the 11 critical success factors: top management support, project champions, implementation teamwork and composition, project management, and change management culture and program. The factors identified by Nah et al. as well as the Standish Group (2013) correlate with higher degrees of information implementation success.

Additionally, Vaughan (2001), a project manager within higher education, reviewed implementation literature and identified several factors important to information systems implementation within higher education: user involvement and participation, resistance and commitment, risks and planning, and the interaction of the organization with technology. Vaughan concluded that the most likely factor to increase the success of an information systems implementation is participation by those concerned.

Neufeld, Dong, and Higgins (2007) explored the relationship of charismatic or transformational leadership relative to the determinants identified by Venkatesh et al. (2003). In a study of information systems implementations, Neufeld et al. explored the leadership factor, specifically leadership effects on project implementation successes. Participants included 209 survey respondents at six

manufacturing companies with 18 to 42 respondents per I.T. project. Findings revealed that transformational leadership contributed to a greater percentage of project successes, assuming all other factors were constant. Findings also revealed that users who perceived their project champion as exhibiting charismatic leadership, based on Bass and Avolio's Multifactor Leadership Questionnaire, were more likely to perceive the target innovation with higher performance expectancy, effort expectancy, social influence, and facilitating conditions. Neufeld et al. concluded that charismatic leadership influences behavioral intention and, directly and indirectly, use.

Information systems implementation research within educational settings reflects similar factors as the general research on information systems implementation with certain factors appearing to be more pertinent to the educational context (Cox et al., 2000; Dooley, 1999; Vaughan, 2001). Dooley sought to understand the adoption and diffusion process within an educational context and developed a model of the diffusion process that included contextual factors, concerns about the innovation, and the individual stage of the innovation-decision process. Dooley studied the dynamics of diffusion in three schools in Texas, each with similar funding available for technology and each expected to be at similar stage in the diffusion process. A snowball sample technique was used to select participants at each school who represented high, medium, and low adopters of educational technology. Results revealed several factors related to the adoption of educational technology including technical support, professional development, and innovation overload. However, Dooley argued that the biggest impediment to innovation was the system itself – teachers reflected their educational experience. Dooley recommended that technology be evaluated for effectiveness, extensiveness, and endurance.

Cox et al. (2000) conducted a study to investigate what motivates teachers in K-12 to use ICT and sustain ICT use during their teaching. Data sources included documents, questionnaires, and teacher reports dating from 1992 to 1998 through the MirandaNet project as well as teacher interviews. The survey, based primarily upon Davis' Technology Acceptance Model, explored ICT experiences, expertise and use in teaching; teacher's attitudes to the value of ICT for teaching and learning; and the training teachers had received. The survey, completed by 82 educators across three educator networks, was followed by focus group interviews with 20 of the educators who had completed the survey. Findings revealed that what motivated teachers was their desire to make learning more interesting and engaging (Cox et al., 2000).

Singh and Hardaker (2014) conducted an extensive literature review to identify the factors that enable or constrain adoption and diffusion of e-Learning within higher education. Study findings revealed that technological innovation within higher education is often geared towards technically literate and innovate staff – a strategy that reduces the likelihood of mainstream adoption of instructional technology. Singh and Hardaker recommended that innovation research recognize the complexity and multiple dimensions of social reality with a perspective that includes adoption, diffusion, and the situational context. In addition, change agents should recognize the social dimensions of ICT adoption and diffusion within education including alignment with professional goals, interests and needs; patterns of work; sources of support; and social networks. Singh and Hardaker emphasized drawing on diverse motivators without imposing constraints that assume a single solution fits all eventualities.

Birch and Burnett (2009) conducted a study to analyze institutional, individual, and pedagogical factors that affect how faculty members develop e-

learning environments for distance education. A qualitative study was conducted at the University in Queensland, Australia, which was undergoing a major transformation of its distance learning program to e-learning content and delivery. In-depth, semi-structured interviews were conducted with 14 faculty members (four pioneers, six early adopters, and four non-adopters) and four instructional designers. Three themes emerged from the study: institutional barriers (e.g., lack of clear direction), individual inhibitors (e.g., lack of time, negative impact on workload), and pedagogical concerns (e.g., clear education technology integration plan). Birch and Burnett recommended that institutions should encourage and support faculty use of e-learning content and delivery, the design of inclusive curriculum, and effective infrastructure and support to mitigate barriers to adoption.

Covington et al. (2005) conducted a case study to examine the transition of faculty to online teaching. The case centered on the English department at North Carolina State University, which was faced with a large-scale transition of courses from traditional to online delivery. Covington et al. noted that faculty and administration worked together to provide the necessary resources, peer support and professional development since faculty resistance and lack of training could impede the institution's aims. The study, conducted over a 2-year period, examined the success factors critical to the initiative's successful outcome of 95% of courses being delivered online within 2 years. Findings revealed that implementation outcomes were realized when there was collaboration between administrators and faculty, peer support, and professional development as well as adequate resources were provided (Covington et al., 2005).

Butler and Sellbom (2002) conducted a study to identify the factors that affect faculty adoption of instructional technology. A questionnaire was

distributed to 410 faculty members in the College of Science and Humanities at Ball State University, Indiana. The sample population, 125 respondents, was congruent with the population in terms of gender, tenure status, and department. Findings revealed that the factors affecting adoption were reliability of the technology, knowledge of how to use the technology, perception that the technology improves learning, and difficulty in using the technology. Butler and Sellbom (2002) recommended that institutions of higher education improve the reliability of technologies, simplify the effort required to learn a new technology, help faculty determine if learning to use the technology is worthwhile, and improve institutional supports.

Keengwe et al. (2008) explored factors affecting the ICT adoption process to determine the implications for faculty development and technology leadership. The study was conducted at a U.S. mid-southern public university with 25 participants selected using a snowball sampling technique. Respondents submitted narratives and the researchers used content and narrative analysis to determine emergent themes. Results identified several factors affecting the ICT adoption process: organizational support, leadership, training and development, and resources (Keengwe et al., 2008).

Dennison (2014), acknowledging the pressures on higher education to innovate with technology, conducted a study within the university system of Georgia to investigate critical success factors relative to technology innovation, adoption, and diffusion. Dennison distributed a survey, based upon David Garson and Shannon Schelin's study, to 2,091 faculty members and IT leaders who belonged to one of two statewide IT leadership groups. Four hundred and five individuals responded to the survey. Respondents provided open-ended responses to a prompt regarding the top five critical success factors for technological

innovation, adoption, and diffusion. Dennison, through manual coding, identified emergent patterns and themes resulting in the top 17 rank-ordered critical success factors, of which the top five were: professional development and training, executive and administrative level support, skilled technical support, stakeholder involvement, and skill level and commitment of faculty/students.

Design and Implementation with and for Persons

Adoption of innovations occurs *by* and diffusion occurs *through* persons. Information systems implementation research articulates factors affecting adoption by individuals. The adoption and diffusion of innovations research streams also acknowledge the degrees of variations within populations. Yet, research from both diffusion of innovations and information systems implementation research reveals an absence of adopter participation in the design and implementation of innovations (Covington et al., 2005; Dennison, 2014; Rogers, 2003; Standish Group, 2013).

Where are notable disciplines, research traditions, and emerging practices that support the inclusion, involvement, and participation of person(s) within the adoption and diffusion of technological innovations? The discipline of participative design and the emergent domain of design thinking share the theme of design and implementation with and for persons. Understanding variations among person(s) within populations to improve the design, implementation, and support for technological innovations is important (Holmlid, 2009; Nielsen, 2012; Venkatesh et al., 2003; Wolff & Seffah, 2011).

Participative design. The discipline of participative design exists in fields as diverse as human computer interaction, social services, economic development, and learning experiences (Holmlid, 2009). Participative design is defined as design wherein stakeholders participate in the design process through user

involvement and where design outcomes result in innovations that fit the use and needs of stakeholders (Holmlid, 2009; Kumar, 2013). This approach emerged from Scandinavia as *cooperative design* (Holmlid, 2009), within computer science as *user-centered design* (Carroll, 2013) and *situated action* (Suchman et al., 1999) and *context* (Dourish, 2004), within service industries as *client-centered design* (Novotná, Urbanoski, & Rush, 2011; Von Pischke, 2002), and within industry as *design thinking* (Kumar, 2013). Holmlid (2009) explored the participatory or cooperative design discourse and identified three salient themes: user involvement, cooperation, and emancipation.

Carroll (2013) described the origins and undergirding theories of human computer interaction (HCI). Cognitive science emerged at the end of the 1970s incorporating disciplines such as cognitive psychology, cognitive anthropology, and linguistics. Early works in this field include Brooks' (1975) discussion of human interactions within design collaboration and iterative prototyping and Carroll's work (1997) which focused on usability and user-centered design. Carroll (2013) described the opportune nexus that emerged with the maturation of this cognitive science coupled with the need to shape the (personal) computer for persons. Human computer interaction practices emerged in the 1980s focused on human factors engineering; moving beyond the desktop to the design of devices, software, user experiences, and service design (Carroll, 2013). Carroll (2013) argued for "understanding and better empowering users" to "ensure that human values and human priorities are advanced and not diminished through new technology" (p. 15). Suchman et al. (1999) also contributed to HCI through studies on the interaction of people interacting with technology within a workplace as they sought to do their work. Human factors engineering continued to evolve and guided design for both products and services (Goodwin, 2011). Nielsen

(2012) advanced the on-going maturation of user-centered design in the practice of web usability and user experience (UX) design practices. Dourish (2004) moved theory beyond the traditional workplace to address context as people interact with mobile devices and interrelate with cloud-based services. Dourish recommended an open approach to participant design where users are active participants in the emergence of new ways of working. Soloway, Guzdial, and Hay (1994) argued that human computer interface should turn its attention in the 21st century to learned-centered design.

Participatory design principles have been used to improve products and services in numerous contexts including social services and economic development as well as learning environments and experiences. These principles have influenced the design of place and service within health care and behavioral health (Novotná et al., 2011). For example, organizations have included behavioral health clients in the design of facilities and services (Kings View Behavioral Health Systems, 2014). Similarly, economic development has shifted from an agency perspective to a client perspective in the design of programs, products, and services (Von Pischke, 2002; Rogers, 2003). A case study reviewing the Mennonite Economic Development Associates' Mbeya Oxenization Program (Mennonite Economic Development Associates, 2014) reflected this client perspective in economic development. The Mbeya Oxenization Program upgraded the productivity of the maize sector in the Mbeya Region of Tanzania by using ox-driven plows and cultivation that fit the region and its clients rather than importing technology that would not fit this context. The adoption of this technological innovation required the development of manufacturing and repair infrastructure with successful diffusion leading to for-profit firms emerging to

sustain the ongoing use of this technology (Mennonite Economic Development Associates, 2014).

Similarly, Von Pischke (2002) described a shift from product-centered to client-centered design in financial services, and identified three such innovations in finance: lengthening term structure, reducing transaction costs, and refining valuation processes. These shifts in theory and practice demonstrate the importance of a participant perspective in the design and implementation of technological innovations (Holmlid, 2009; Mennonite Economic Development Associates, 2014; Von Pischke, 2002).

Participatory or human centered design has emerged within education, which may be reflected in student-centered approaches to services, curriculum, and instruction (Palaigeorgiou, Triantafyllakos, & Tsinako, 2011). Palaigeorgiou et al. (2011) conducted a case study on the participatory design of a web-learning environment and demonstrated the value of student participation in the design of their web-learning environment. The study included 117 undergraduate students who participated in 25 participatory sessions. Students identified 773 needs demonstrating their refined views about technology requirements for the next generation of e-learning. Students articulated a vision of a web-learning platform that was evolutionary rather than revolutionary with their primary focus on the advancement of the form and content of the learning material (Palaigeorgiou et al., 2011).

Critical theory (Freire, 2000; Valenzuela, 2010), social constructivist theory, and brain science (Medina, 2014) have also contributed to the shift to student-centered approaches. The emergence of student-centered approaches may also be a reflection of economic and industry pressures such as educational providers seeking to achieve scale and educational institutions seeking to redefine

the delivery of educational services to better meet the needs of students (Christensen et al., 2011; DeMillo, 2011; Mehaffy, 2012). Research relative to participatory design in education appears limited and practice within the educational context is varied. Halverson and Shapiro (2012) contended that technological innovation within education demonstrates patterns of adoption that result from differing cultures of use, namely, schools adopt technologies in accountability cultures, and learners adopt technologies in participatory cultures.

Design thinking. Design thinking, an emergent way of thinking and practice, also reflects the value of participatory design. Design thinking combines understanding the context of a problem, empathy with the people within the context, creativity and collaboration in the design of solutions, and the implementations of the solutions (Hasso Plattner Institute of Design at Stanford, 2013; Kumar, 2013; Stickdorn & Schneider, 2011). In the 1980s human-centered design emerged, and in the 1990s design theory influenced practice within design firms such as IDEO, a global design firm that uses a human-centered, design-based approach to design products and services for organizations. Tim Brown, CEO of IDEO and a seminal contributor to design thinking, stated that the goal of design thinking is matching needs with what is technologically feasible. In the 2000s, design thinking began to include services as well as products leading to service design thinking (Stickdorn & Schneider, 2011).

Stickdorn and Schneider (2011) articulated five principles of service design thinking in their collaborative work with 23 authors from the global service design community: service design thinking is user-centered, co-creative, sequencing, evidencing, and holistic. Stickdorn and Schneider indicated that user perspective and participation in the design process is important. Kumar (2013), a design practitioner with Doblin Inc. and currently faculty with the IIT Institute of Design,

identified four principles for repeatable innovation success (build innovation around experiences, think of innovation as systems, cultivate an innovation culture, and adopt a disciplined innovation process) and seven modes of activity within a design process. The design innovation process, like any creative process, moves between modes of activity flowing along one axis from real to abstract and along the other from understanding to making. Kumar identified these seven modes of activity as sense intent, know context, know people, frame insights, explore concepts, frame solutions, and realize offerings. The Institute of Design at Stanford (or d.school) proposes seven mindsets within design thinking: show don't tell, focus on human values, craft clarity, be mindful of process, embrace experimentation, bias toward action, and radical collaboration, and five modes of activity: empathize, define, ideate, prototype, and test (Hasso Plattner Institute of Design at Stanford, 2013). Most design thinking emphasizes the radical importance of collaboration with stakeholders and the principle that improvements require a shift in culture more than practice (Gobble, 2014).

Tablet Technology: Taxonomy, Genesis, Trends and Device Use in Education

A technological innovation has attributes related to its hardware and software (Rogers, 2003). The definition of a tablet, from the hardware perspective, is a portable personal computer with a touch screen as its primary input device (EDUCAUSE, 2014). A tablet does not have the compute capacity of a laptop; however, both a laptop and a tablet may have a detachable keyboard. The definition of a tablet, from the software perspective, includes the user experience and user functions provided by the operating system, applications, and available media. Tablet devices are also part of at least two clusters of technological innovations. The first cluster is the cloud computing services made

available through tablet devices including services such as iCloud, Office 365, and Google. The second cluster may include pedagogical changes experienced by students who enroll in a course where tablet use is required for academic purposes, if the faculty has redesigned the course to fit users of tablet computers. Against these technology-as-artifact perspectives, "tablet" is also a social fact emerging from students' interactions and interrelations to their everyday use of this technology bundle within academic contexts (Suchman et al., 1999).

Tablets as a computer device category are not new. What is new is the latest generation of tablets and their use for academic purposes (Dahlstrom et al., 2012; EDUCAUSE Center for Applied Research, 2012; Karsenti & Fievez, 2013; Pearson Foundation, 2012, 2014). GRID systems released the first commercially available tablet-like computer in 1989. Apple launched the Newton in 1993 with low levels of adoption. Palm introduced the Palm Pilot in 1996. The Palm Pilot was widely adopted with diffusion occurring through industrial use and as the traveling companion of Internet mavericks. Microsoft released the Tablet PC in 2002, and in 2009 the first Android tablet was released. In 2010, Apple successfully launched the iPad (Centre for Computing History, 2014; History of Computing Project, 2014).

The Online Publishers Association surveyed 2,540 Internet users between the ages of 8 and 64 in March 2012. Results revealed that 31% of Internet users in the U.S. owned a tablet with 51% owning an iPad and 52% an Android-based tablet (Moscaritolo, 2012). In 2012, shipments of tablet displays surpassed laptop displays – a proxy for actual shipments of tablets versus laptops (Crothers, 2012). Worldwide shipments for tablets are projected to increase with tablets based on the Android operating system growing the fastest (Gartner, 2014). Table 2 presents

the worldwide device shipments by operating systems for 2013 as well as projections for 2014 and 2015.

Table 2

Worldwide Device Shipments by Operating Systems (*Millions of Units)*

Operating System	2013 Actual *N*	2014 Projected *N*	2015 Projected *N*
Android	898,944	1,168,282	1,370,893
Windows	326,060	333,419	373,694
iOS/Mac OS	236,200	271,115	301,349
Others	873,195	660,112	545,817
Total	2,334,000	2,432,927	2,591,753

Equipment designers are learning from customers and positioning themselves to better secure market share. Understanding of usage and preferences leads to changes in the traditional categories of computer, laptop, tablet, smartphone, and phone. These categories now include slates, hybrids, phablets, and laplets. The slate is a tablet where the keyboard is optional. The hybrid has a dedicated keyboard. Phablets are phones with larger screens. Laplets or 2-in-1s are a combination of laptop and tablet with a detachable keyboard and more processing power (Chang, 2012). Ranjit Atwal, research director at Gartner, noted that "tablet substitution of notebooks will start to dissipate from this year onwards as consumers and businesses align the right device with the right usage pattern" (Gartner, 2014, p. 1).

Moving from devices to their use within education, teaching and operational experts consistently point to 1:1 learning as an optimal way to customize education for each student for two primary reasons: (a) to improve learning outcomes and (b) to boost the operational efficiency and cost-

effectiveness of teachers, staff, and administration. By definition, 1:1 computing refers to the level of teacher and student access to technology. Numerous 1:1 computing initiatives have been initiated across K-20 schools, institutions, and systems (Argueta, Huff, Tingen, & Corn, 2011; Ehrlich, Sporte, & Sebring, 2013). Holcomb (2009) reported 1:1 initiatives in Georgia, Florida, Kansas, Louisiana, Maine, Massachusetts, Michigan, Missouri, New Hampshire, Pennsylvania, and South Dakota. Bebell and O'Dwyer (2010) reviewed four empirical studies of K-12 1:1 computing programs to examine evidence of outcomes for 1:1 compute initiatives, and results revealed that technology access and use is required before any educational impacts can be realized.

A 1:1 Learning Technology Initiative was launched in North Carolina in 2008 that included eight Early College high schools and ten traditional high schools involving 9,500 students and 600 school staff (Argueta et al., 2011). Every student and teacher in these schools received a laptop. The overall goal of the initiative was to use the technology to increase student achievement, improve learning practices, and better prepare students with 21st century skills (Argueta et al., 2011). The initiative intentionally rolled out laptops to schools in three cohorts, each with staggered starting years (cohort 1 in year 1, cohort 2 in year 2, cohort 3 in year 3). The Friday Institute for Educational Innovation studied this initiative from several different perspectives. Based on this multi-year study, a report to the North Carolina legislature indicated that teacher and student engagement increased and was a key benefit of the 1:1 effort. The findings also revealed that more active, reflective, collaborative, and project-based learning took place after technology debuted in the classroom (Corn, Huff, Halstead, & Patel, 2011).

El-Gayar and Moran (2006) conducted a study of a 1:1 initiative within higher education using the UTAUT model to explore the acceptance and use of tablet technology by students in a small Midwestern university located in South Dakota. The university required all first and second year students to lease a wireless tablet computer. The purpose of the study was to identify both aspects that contributed to adoption and support structures that facilitated student acceptance and use. Findings indicated that the UTAUT model was relevant to understanding students' adoption of tablet computers. Students in a discretionary use environment (e.g., juniors and seniors) perceived the tablet in ways similar to students in the mandatory environment (e.g., freshmen and sophomores). Similarly, Seton Hall, previously a 1:1 laptop university, is carefully transitioning to tablet slates while ensuring that the tablets have the necessary compute power to meet the needs of faculty, staff, and students (Samsung, Case Study: Seton Hall University, 2014).

Karsenti and Fievez (2013) conducted another study of tablets in education focused on the use of iPads in 18 K-12 schools in Quebec, Canada. Survey participants included 6,057 students and 302 teachers regarding the uses, benefits, and challenges of iPad use. The researchers concluded that tablet technology has a significant cognitive potential to engage students in effective personalized learning and that tablet technology, when effectively integrated with curriculum, can make a meaningful contribution to educational outcomes (Karsenti & Fievez, 2013).

Students' Characteristics, Preferences, and Use

Students are the prospective adopters of tablet technology for academic purposes and the agents within educational technology adoption decisions and diffusion processes. As such, understanding students' characteristics, preferences, and use behaviors is critical to understanding adoption and diffusion within higher

education. Students' perspectives, values, and use patterns can inform and shape effective design, implementation, and supports for the adoption of technological innovations. Understanding students begins with appreciation of students as a generation and as agents within the interchange of work, technology, and social systems. This understanding increases through awareness of the variations in students' technology preferences and their exhibited patterns of use (Oblinger & Oblinger, 2005; Pearson Foundation, 2014).

Students as a Generation and as Agents

Current undergraduate students, as part of the generation born after 1988, may be characterized as significantly different from previous generations. This group of students is referred to as the Net Generation (Tapscott, 1999), Millennials (Oblinger & Oblinger, 2005), and Digital Natives (Prensky, 2001). Research on this group of students provides insights into the shared and special attributes of this generation. These narratives often assume that this generation's extensive use of technology makes them expert in their use of technology and uniquely enables them to transfer knowledge to subsequent innovations (Prensky, 2001; Tapscott, 1999). However, the focus on the specialness of this generation may not account for their access to technology, their agency relative to technology, the heterogeneity within this generation, and the attributes this generation shares with other generations (Bennett, Maton, & Kervin, 2008; Jones & Czerniewicz, 2010). The belief in the transferability of experience within technology can lead to incorrect assumptions about student acceptance and use of technological innovations (Bennett et al., 2008).

Tapscott (1999) and Prensky (2001) were pivotal in the reconceptualization of the millennial generation's special knowledge and learning styles, which resulted from this generation's interactions within a technology-laden context.

Tapscott studied thousands of "Net Generation" aged youth using an interview protocol. Findings revealed that this generation used computer technology naturally and easily. Tapscott argued that technology fundamentally shaped this generation's learning preferences or styles, and argued that these students were so immersed in technology throughout their lives that they are more adept at technology than prior generations. Prensky (2001) argued that a significant discontinuity has occurred between the millennial generation of students and previous generations. Prensky (2001), building on neuroplasticity and social malleability research, argued that the volume of the millennial generation's interaction with their ubiquitous technological environment has fundamentally altered their information processing in ways different from their predecessors.

Prensky (2010) shifted the focus from defining the uniqueness of millennial generation to a focus on the context from which students emerge, packed with demands for students' attention and the increasing velocity of the technology innovation cycle. Prensky (2010) also acknowledged the diversity of students' interests and passions as well as the equity gaps that might exist within educational contexts.

This conceptualization of the specialness of the millennial generation can diminish their agency, homogenize the population, and make significant assumptions about the transferability of technology use (Margaryan et al. 2011). Margaryan et al. explored the nature and extent of students' use of digital technologies for learning and socializing and investigated differences among generations. Margaryan et al. used a mixed methods approach and participants included students and staff from two UK universities with one of the universities, established after 1992, representing a higher proportion of students from less advantaged socioeconomic backgrounds; 80 survey respondents from each

university and eight participants were interviewed. Findings revealed that (a) students used a limited set of technology tools; (b) technology adoption was influenced by familiarity, cost, and immediacy concerns; and (c) technology use was influenced by the interchange between instructor and student within a course, technical requirements of the discipline, and the value the tool provided within a given context. In particular, the researchers contended that the "digital native" concept is too simplistic to describe students' use of technologies.

Jones and Czerniewicz (2010) contended that the use of the digital native theory, namely, that difference exists between young people and previous generations, persists despite research refuting this notion. Jones and Czerniewicz characterized the "digital natives / net generation" theories to include the following propositions: (a) young people who grew up with devices and the Internet have developed a natural aptitude and more competence in relation to new technologies, and (b) older people are less likely to adopt new technologies and cannot achieve the same level of competency with technology as their younger counterparts. Jones and Czerniewicz contended that this theoretical perspective adheres to technological determinism where education must adapt to this altered generation rather than opening up the possibility of shaping the technology and allowing for student agency. As an alternative perspective, Jones and Czerniewicz presented models such as Bourdieu's interrelated concepts of field, habitus, and capital. Jones and Czerniewicz's salient contribution was student agency within an adoption decision and within the diffusion process.

Similarly, Gros et al. (2012) questioned the fundamental assumption that frequent use of technologies implies that users can transfer digital skills to learning activities. Gros et al. reviewed empirical studies regarding the millennial generation's use of technology for learning and found that the millennial

generation student use of technology does not translate to better use of technology to support learning. Gros et al. administered a survey to 1,042 randomly selected university students representing two different groups: face-to-face university and online university. The survey was followed by three focus groups. Findings revealed that students had a basic set of technological abilities that did not transfer into high skill levels in the use of other technologies. Gros et al. recommended moving the discussion beyond characteristics of a population to a conversation about the implications of learning in a digitalized domain, and decreased the credence given to the notion that expertise with a given technology will automatically transfer to the next technology. Gros et al. supported Prensky's (2010) argument that the rapidly evolving digital context will affect anyone within this digital vortex. However, Gros et al. noted that students' competence with technology does not translate into proficiency with technology for academic purposes.

Oblinger (2003) described the digital shift among students, whether millennials or mature, as a function of a social context infused with information technology. Oblinger and Oblinger (2005) suggested that the exposure to and pervasiveness of IT is what defines the "Net Generation" more than age. Subsequently, individuals exposed more to computers will process information differently in such areas as the ability to read visual images, visual-spatial skills, inductive discovery, intentional deployment, and fast response time (Oblinger & Oblinger, 2005). Oblinger recommended that universities engage learners in a dialogue to better understand the learners' perspectives.

Roberts (2005), also a member of the millennial generation, conducted a study to understand the millennial generation's view on technology and learning. Roberts conducted individual and focus groups interviews as well as random

polling at the University of Pittsburgh-Johnstown in 2004. Roberts suggested that broad characterizations regarding a generation might improve understanding of student behaviors, attitudes, and expectations. Roberts also articulated the important role faculty play in shaping students' decisions for adoption and use of technology.

Students' Technology Preferences and Use

Harris Interactive (Pearson Foundation, 2014), EDUCAUSE Center for Advanced Research (Dahlstrom et al., 2012), and Project Tomorrow (2013) measured the perceptions of students relative to the use of technology for academic purposes. Harris Interactive, a leading market research firm, conducted a study to investigate student use of mobile technology for learning (Pearson Foundation, 2014). The Pearson Student Mobile Device Survey was administered to 1,288 students enrolled at 2-year colleges, 4-year colleges, universities, and graduate schools throughout the U.S. Findings revealed that 81% of college students agree that tablets will transform the way students learn and 74% agree that tablets make learning more fun. Only 45% of students used a tablet regularly with 89% of students using a laptop. Study findings indicated that laptops were still the most commonly used device for schoolwork (Pearson Foundation, 2014).

Dahlstrom et al. (2012), on behalf of EDUCAUSE Center for Applied Research (ECAR), conducted a study of undergraduate students and information technology to better understand how students experience technology and the ways in which innovations impact a student's relationship with information technology. An annual survey provided baseline measures about the technologies students prefer for learning, their capabilities with these technologies, and their view of the technology's impact on learning. Survey responses were collected from more than 112,000 undergraduate students representing more than 250 higher education

institutions. The results showed that 86% of students own laptops with a higher level of laptop use among students at a 4-year university. Results revealed more community college students owning desktops. Findings indicated that 15% of students own a tablet with 67% of these students using the tablet for academic purposes. In addition, 62% of students owned a smartphone. Longitudinal analysis revealed diminishing use of desktop computers, leveling of laptop ownership, and increasing ownership of smartphones and tablets. Study findings revealed the recurring importance of support for students in the use of technology as well as the influential role faculty have in students' adoption of mobile technology for academic purposes. Dahlstrom et al. (2012) recommended that faculty guide students in their use of technology for academic purposes.

Delcore and Mullooly (2013) conducted a study to explore *I.T. use as tool use* at a Hispanic-serving and an Asian American and Native American Pacific Islander-serving, 4-year public university in central California. The study was delimited to student use of technology using a tool/task orientation given the campus' desire to understand how students accomplish their I.T. related tasks. The ethnographic study was conducted over an eight-month period with 183 hours of observation and 393 intercept interviews. A photo diary interview protocol with 48 participants was also used. Themes and patterns emerged from the data that led to differentiating work types (school-related and non-school-related) and activity types (production and consumption). The results indicated that laptops and smartphones were important for school-related work; however, tablets were rare and problematic for school-related work. The researchers concluded that production-oriented devices such as desktops and laptops might influence academic success more so than other device types (Delcore & Mullooly, 2013).

Current K-12 students are the pipeline of students who will enter higher education institutions within the next decade. Therefore, it is important to understand this emerging population's preferences and use of technology (Project Tomorrow, 2013). Project Tomorrow conducted a study to understand the spectrum of students' activities and aspirations for digital learning. The study intentionally sought to answer three research questions: How are K-12 students currently using digital tools and resources to support schoolwork activities? How are K-12 students currently using digital tools and resources to enable out of school time learning activities? What are K-12 students' aspirations for using digital tools and resources within innovative learning environments? Recognizing the diversity within the population, the demographic data included grade, gender, Title 1 designation, and community type. The surveyed population included 325,279 students representing 9,000 schools and 2,700 K-12 school districts. Findings indicated that students rated their own technology competencies along a broad continuum. Results revealed differences among K-12 students in their use of and aspiration for technology used to support learning. Student-initiated technology use varied with females leading the way in the use of socially based tools. A proliferation of mobile devices were found at many schools designated Title I where tablets were provided for students. Students from lower socioeconomic environments attributed greater value to tablet use than students from higher socioeconomic environments. Findings also revealed that not all K-12 students had Internet access, and the researchers concluded that this presents a serious equity challenge. This study refuted the notion that all students are naturally tech-savvy and know how to use digital tools to support learning. Project Tomorrow concluded that teachers are key to driving student use of technology, and recommended that focus be placed on how technology can be

used to improve student learning rather than placing focus on extraordinary student technology use.

Equity and Differences in Adoption of Innovations

Research shows that the "Digital Divide" is related to access to technology, adoption and meaningful use of technology, and resultant outcomes (Warschauer & Matuchniak, 2010). Researchers (Friedman, 2006; Reich, 1991; Warschauer & Matuchniak, 2010) contended that the development and diffusion of information and communication technologies has a profound effect on life in the 21st century. The skills required for the 21st century include the ability to meaningfully use and integrate technology (Partnership for 21st Century Skills, 2006; Rosenberg et al., 2012). The skills to meaningfully use and integrate technology align with the symbolic analysis role identified by Reich (1991). Reich categorized 21st century work into routine-production, in-person service, and symbolic analysis. Reich found, based on labor statistics, that the symbolic analyst roles within the economy receive a disproportionate and rising share of the wealth in the United States. Critical to symbolic analysis is the daily use of new media or ICT to identify, solve, and broker problems. Effective access to technology, at home and in school, and high-level use of technology is critical for preparation and access to these symbolic analysis roles (Warschauer & Matuchniak, 2010). Adoption of technological innovations can lead to increased wealth as well as fiscal and social capital (Rogers, 1983; Sun & Metros, 2011; Warschauer & Matuchniak, 2010). Warschauer and Matuchniak found a strong relationship between access, adoption, and use of technology to generate wealth, power, and knowledge. Access to technology requires capital regardless of its form, and technology capital generates further meaningful use of technology (Warschauer & Matuchniak, 2010). This

technology capital has a strong relationship with the accumulation of fiscal and social capital (Reich, 1991).

Warschauer and Matuchniak (2010) conducted a review of students' access to computing across time using seven national reports issued from 1995 to 2008. The National Telecommunications and Information Administration (NTIA) issued the reports that were based on the Current Population Surveys of approximately 50,000 U.S. households. Results revealed that the largest gaps, in availability of Internet access at home, occurred where there were differences in income and educational attainment. Home Internet access was 95.5% for households earning more than $150,000 and 24.6% for households earning less than $10,000. Warschauer and Matuchniak recommended a broader perspective than a "digital divide" and this perspective begins with access and includes use and outcomes.

Warschauer, Knobel, and Stone (2004), in a qualitative study, compared availability of, access to, and use of new technologies among eight high schools in California, which included schools from low and high socioeconomic areas. Participants included 64 teachers, as well as the students in these teachers' classrooms. Data were collected through 115 hours of observation, teacher interviews, student questionnaires and interviews, and artifacts related to technology policy and use. Findings revealed that high socioeconomic area schools tended to invest more in professional development, support staff, and communication to improve access to and use of technology (Warschauer et al., 2004).

Sun and Metros (2011), in a review of the relevant literature, explored the relationship of technology use, academic performance, and socioeconomic status. Analysis showed that race and socioeconomic status negatively affect access to technology. Conversely, Rogers (1983) articulated the positive relationship

between the adoption of a technological innovation and the resultant socioeconomic status and educational attainment. Subsequently, Warschauer and Matuchniak (2010) advocated for an understanding of access that explores how access is supported and constrained by socio-cultural and technological factors. Warschauer and Matuchniak found differences in rates of Internet access based on race/ethnicity. Warschauer and Matuchniak referenced data from the National Telecommunication and Information Administration's 2008 national survey that indicated Internet access among Hispanics at 43.4% while access for Whites was 67%.

Lopez et al. (2013) expanded this understanding of differences among ethnicities, specifically for Latinos relative to Whites and Blacks, with an exploration of technology adoption of social media, digital technology, and mobile technology. Lopez et al. categorized Whites and Blacks as the non-Hispanic group within these respective populations. Lopez et al. analyzed data from the Pew Hispanic Center's 2012 National Survey of Latinos. The national phone survey included a randomly selected, nationally representative sample of 1,765 Latino adults contacted via cellular and landline phones. Findings indicated that the gap in access to the Internet has decreased between Latinos and Whites. Latinos were similar to other Whites and Blacks when it came to owning a smartphone and accessing the Internet from a mobile device. However, results revealed a gap between the Latino (72%) and Black (70%) population and the White population (83%) regarding ownership of desktop or laptop computers. Three demographic factors correlated with technology adoption: age, level of educational attainment, and annual family income.

Similarly, Dupagne and Salwen (2005) explored communication technology adoption and race/ethnicity to determine if systematic patterns of

ethnic variations exist in communication technology adoption. The researchers' national telephone survey in 1999 included 486 adults, randomly sampled, with a response rate of 41%. Researchers viewed race/ethnicity as a complex construct with multiple dimensions and defined race/ethnicity as White (not Hispanic), Black (not Hispanic), and Hispanic. Results revealed significant differences between ethnicities, controlling for socioeconomic variables, in the adoption of four out of the thirteen technologies included in the study, namely: CD player, camcorder, cellular phone, and Internet usage. The study did not find significance for lesser adoption related to race/ethnicity. Dupagne and Salwen concluded that cultural variables may mediate the relationship between race/ethnicity and the adoption of communication technologies.

Research findings (EDUCAUSE Center for Advanced Research, 2012; Mayall, 2002, 2008; Venkatesh, 2003) indicated mixed results when investigating gender and determinants for technology acceptance and use. Venkatesh et al. (2003) found higher perceived performance expectancy and lower perceived facilitating conditions for males, which were moderated by the time of second and third phase administration of the survey. Mayall (2002) examined gender differences for technology self-efficacy and academic self-efficacy among 231 high school students within the United States. Participants completed a questionnaire measuring technology self-efficacy and academic self-efficacy before and after participating in the GlobalEd project. The GlobalEd Project was a classroom-based, problem-based simulation that used socially based communication technologies. Results revealed significantly higher levels of technology self-efficacy for males both pre and post-test ($p<0.05$) than females, and females indicated significantly higher levels of academic self-efficacy pre and post-test ($p<0.50$) than males.

In contrast, Mayall (2008) investigated technology self-efficacy and gender differences of 248 middle school students enrolled in a technology intensive curriculum using a pre/post survey based on the Computer Self-Efficacy instrument created by Cassidy and Eachus (2002). Results revealed no significant gender differences for self-efficacy. Similarly, Bain and Rice (2006) investigated gender effects on students' attitudes towards and use of technology using the Computer Survey in a mixed methods study of 59 sixth graders. No significant differences were indicated for attitudes towards the use of technology between genders. However, findings from Project Tomorrow's Speak Up 2013 study revealed that females outpaced males in self-initiated schoolwork assistance using socially based tools.

Regardless of the demographic constructs used to measure the gaps in access to ICT, the framing of these gaps as the "digital divide" have limited the discussion to a dichotomous access distinction and/or resulted in digitally constrained solutions (Selwyn, 2004; Warschauer & Matuchniak, 2010). Warschauer and Matuchniak went beyond access in the home to include the condition of access to technology (e.g., slower Internet, less powerful computer…) and access in schools, and asserted that sociotechnical factors support or constrain the use of computers and the Internet in schools in ways that effect equity. Similar conclusions emerged from Porter and Donthu (2006) who explored the effect of perceived access barriers and demographic factors (age, education, race, and income) on the acceptance of Internet usage. A survey was administered to 614 participants using a convenience sample of real consumers. Findings revealed that (a) attitude toward Internet usage was positively correlated with Internet usage and (b) perceived ease of use and usefulness were related more to attitude toward Internet usage than access barriers. Furthermore, findings indicated that particular

beliefs about a technology affected diverse segments of the population differently. The study demonstrated that it is possible to ascertain which perceptions matter to which demographic groups and that interventions can thereby effectively be adapted to these groups (Porter & Donthu, 2006). Selwyn criticized the concept of the digital divide after examining the relevant research and offered a framework of access, use, and meaningful use informed by Bourdieu's concept of forms of capital. Selwyn argued that access is non-dichotomous and that context and condition are relevant to classifying levels of access. Selwyn operationalized the term "ICT" to reflect the convergence of technologies beyond information technologies to now include computers, telecommunications, and broadcasting while emphasizing the communicative and networking capacity of information technologies. Given the importance of symbolic analysts in modern economies and the critical nature of their use of computational technology (Reich, 1991), the definition of ICT should also include the "computational" capacity of information technologies (Selwyn, 2004). Selwyn articulated the need to define *digital*, within the digital divide discourse, as inclusive of the devices, information, resources, applications, and the services an individual accesses using new technologies. This distinction went beyond counting physical artifacts to determining the disparities in the context of ICT access. Selwyn found that inhibiters such as time, cost, quality of the technology, and the environment in which it is used can constrain ICT access and use. Furthermore, access to a technology is of no use without the knowledge, skills, and support to use the technology effectively. Selwyn contended that ICT access does not by default lead to ICT use, and the diffusion curve is reflective of successful adoption and not of the diffusions where adoption does not occur for a portion of the population (Selwyn, 2004).

Selwyn (2004) articulated meaningful use as use where the individual concerned has a degree of control and choice over the technology and associated experience. Selwyn conceptualized a mediating role emerging from the various forms of capital (economic, cultural, and social) and suggested that these forms of capital constrain or energize acceptance, use, and meaningful use of technology. Selwyn introduced and defined the concept of technological capital as enabling individuals to move from consumer of a product to producer or distributor of their own technological innovation.

Summary

This review of the literature is the foundation for this study's theoretical frame and guides this study's methodology and research design. The research streams reviewed are complementary and inform the theoretical frame.

The diffusion of innovation stream provided a model for diffusion and a description of the adoption decision process. The model provided insights into the social dynamics of adoption and diffusion, and distinguished between the social dynamics particular to specific contexts (e.g., organizational). The model assumed adoption was successful. The model was retrospective and not predictive. However, the research relative to this stream provided rich descriptions of adoption and rejection grounded in people's personal beliefs, social norms, and interpersonal dynamics.

The acceptance and use research stream built upon social cognitive theory's assertion that beliefs, when articulated, were strong predictors of behavior. This research stream included the development of five theories: Theory of Reasoned Action, Theory of Planned Behavior, Social Cognitive Theory, the Technology Acceptance Model, and the Unified Theory of Acceptance and Use of Technology. These models improved the ability to predict behavioral intention

and use behavior. The determinants and moderating factors articulated by Venkatesh et al. (2003) in the UTAUT and Venkatesh et al. (2012) in the UTAUT2 provide salient constructs to understand variations within populations and design interventions in the design, implementation, and supports for people considering adoption of a technology innovation.

Context changes everything. Both diffusion and adoption models require changes to their constructs based upon the situational context and the technology type. Technology types were characterized as being more complex, requiring more collaboration, and requiring more knowledge. Situational contexts included mandatory and voluntary adoption as well as organizational and consumer contexts. Lastly, context is contained within larger systems where components interact with and factors affect adoption and diffusion. One such set of factors can be found in the implementation of the information system. The determinants for adoption and conditions for diffusion may be strongly inclined towards successful adoption and diffusion. However, factors in the implementation of the information system may hinder and/or help adoption and diffusion. These critical success factors were identified and shown to be significant in the adoption decision and diffusion process. Effective training and support for prospective adopters leads to increased perceptual belief in facilitating conditions and potentially the promotion of the adopter's experience with the technology in a way that furthers diffusion.

Diffusion and adoption research consider persons as key predictors of adoption, agents of adoption, and the most salient means of reducing uncertainty to further diffusion. The information systems implementation research frequently identifies involvement of prospective adopters as critical to successful implementations. The literature review presented approaches to the design and

implementation of technology with and for persons by exploring the mindsets and practices of participatory design and design thinking.

Tablet technology, the target technology in this adoption and diffusion study, was defined and characterized as a cluster technology (Rogers, 2003). Additionally, the review considered the development of this technology, its diffusion within education, and trends in its use and ongoing development.

The capstone of this review is the population of students. The literature review showed changing and conflicting perspectives regarding this generation of students. The research revealed increasing adoption and use of technology. However, this use was not generally congruent with educational use. Furthermore, student's expertise with technology outside of the educational domain did not correspond to a transfer of said expertise to educational use. This generation of students exists within an environment where technology is ubiquitous and so their expectations and preferences reflect these interactions with their environment.

Lastly, the imperative of equity within the 21st century requires developing technology capital and proficiency as part of requisite 21st century skills. Technology skills, including the ability to adopt and integrate innovations, influence a person's social and economic capital. The review of literature explained that equity is more than just access, which when measured effectively, is often inequitable. Rather equity includes meaningful access and use.

Two themes that emerged from and across the research streams were: (a) technological competency is critical to 21st century skills and a person's well-being in the global economy and local society and (b) North American culture's bias towards technology may lead to overstating its value and/or a technology bias when introducing a technological innovation. Critical success factors emerged from each of the four research streams that can inform practice as well as guide

the design and implementation of a technological innovation. Diffusion and adoption research articulated variation within populations providing recommendations for appropriate interventions that built upon the knowledge of these variations. Technology implementations can differentiate design and implementations in ways aligned with participative design and congruent with UTAUT's predictive signals.

The research streams reviewed in this study were deliberately chosen to cultivate a holistic understanding of adoption, diffusion, and integration of technological innovations for persons within education contexts. This holistic frame (a) respects the interchange among persons, work, technology, and social systems, (b) understands segments (and their representative personas) within populations relative to their perceptions of the determinants for acceptance and use of an innovation, (c) appreciates stakeholder concerns and capabilities, (d) collaboratively designs the technology, implementation, and on-going supports, and (e) seeks to honor people with agency in ways that minimize inequity.

Chapter 3 describes the methodology of the study including the purpose of the study and research questions; the research design, participants and sampling method; instrumentation; and the data collection and analysis procedures. Chapter 4 presents the findings and analysis of the data collected related to the research questions gathered through both quantitative and qualitative methods. Chapter 5 presents a summary of findings and conclusions of the study, discussion related to the literature, implications for policy and practice, limitations of the study, and recommendations for subsequent research.

CHAPTER 3: METHODOLOGY

This chapter describes the methodology that was used to explore variations within students' beliefs regarding the acceptance and use of tablet technology for academic purposes at a 4-year, public university. The strengths of the UTAUT determinants were examined within this particular context. This study explored students' perceptions regarding a technological innovation from these students' experiences during a nascent moment of innovation. This chapter begins with the purpose of the study and research questions. Next, the research design and the rationale driving this design is explained, followed by the sampling approach identifying selected participants and instrumentation. The chapter concludes with a description of the data collection and analysis procedures.

Purpose of the Study

This study investigated variations among student populations relative to the acceptance and use of tablet technology for academic purposes at a 4-year, public university. More specifically, this study explored variations in students' perceptions of the determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) for behavioral intention and use behavior relative to the demographic constructs of socioeconomic status, race/ethnicity and gender. Additionally, this study explored the strength of the determinants for behavioral intention and use behavior as well as the effects of the moderating factors (self-efficacy, access, experience, socioeconomic status, race/ethnicity and gender). Lastly, this study explored differences directly from students' perspectives, lived-experiences, and socially constructed meanings.

Research Questions

1. What is the strength of the determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) on student behavioral intention and use behavior regarding tablet technology use for academic purposes?
2. Is there a difference among each demographic construct (socioeconomic status, race/ethnicity, and gender) on the determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) for student behavioral intention and use behavior regarding tablet technology use for academic purposes?
3. Is there a difference over time among each demographic construct (socioeconomic status, race/ethnicity, and gender) on the determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) for student behavioral intention and use behavior regarding tablet technology use for academic purposes?
4. What are the facilitating conditions and associated meanings related to the acceptance and use of tablet technology relative to the demographic constructs of socioeconomic status and race/ethnicity?
5. What are the performance conditions and associated meanings related to the acceptance and use of tablet technology relative to the demographic constructs of socioeconomic status and race/ethnicity?

Research Design

This study employed a non-experimental research design given the complexity and variations within social and educational systems (Bogdan &

Biklen, 2006). This study used a case study methodology in order to focus on a phenomenon within a particular context. Specifically, this study used an instrumental case study approach where the case is instrumental to understanding the phenomenon of adoption and diffusion (Bogdan & Biklen, 2006; Stake, 1995). Participants were engaged in a critical moment within a context of adoption and diffusion - before, during, and after the study. During this study participants participated in the adoption decision process as well as diffusion communication processes.

This study used mixed methods to increase understanding of the phenomena and better understand students' lived-experiences (Stake, 1995). This research design was guided by recommendations from diffusion research (Rogers, 2003); participative design (Hasso Plattner Institute of Design at Stanford, 2013; Kumar, 2013; Stickdorn & Schneider, 2011; Suchman et al., 1999); user-centered design (Draft International Standard, 2009); and user-experience research (Nielsen, 2012; Suchman et al., 1999). Rogers (2003) noted that diffusion research prior to the 1960s was based on ethno-methodologies while after 1960 it was based more on quantitative studies. Recently, the field turned to more diverse methods given its use within numerous disciplines as well as the post-modern shift in epistemology. The use of *qualitative* in addition to *quantitative* research methods is a response to the critiques of purely quantitative-based research on technology acceptance and diffusion. This mixed methods design recognized the epistemological necessity to move beyond identifying differences in sub-groups to methods that uncovered persons' perspectives and associated meanings. The use of multiple methods served to better understand the meaning of technology for students and attempted to move from an understanding of students as an "arithmetically calculable mass of human beings" (Webb, 1926, p. 41, as cited in

Bogdan & Biklen , p. 12) to persons with agenic behavior and peoples with variations in their motivations and behaviors (Bogdan & Biklen, 2006).

The *between methods* or combined methods approach (Jick, 1979) involved the collection, analysis, and interpretation of data from methods including a two-phase survey, photo diary with interviews, and focus group interviews. This use of multiple methods allowed the researcher greater access to understanding students' perceptions and behavior related to adoption and diffusion. The research followed Venkatesh et al.'s (2003) survey approach to explore the population's perceptions of the determinants for acceptance and use of a technological innovation, and used the constructs and multi-staged approach defined by Venkatesh et al. (2003) and Venkatesh et al. (2012). Venkatesh et al. (2003, 2012) also used other means (e.g., use logs) to track actual use relative to the determinants and the behavioral intention to use a technological innovation. To that end, this study used photo diary with interviews and focus group interviews to determine actual use behavior.

Only phenomenological methods such as photo diary interviews and focus group interviews facilitate understanding of the associated meanings emerging from students' interaction and interrelations within their everyday use of tablet technology for academic purposes. The phenomenological observations of agents and then grounding these observations in interviews were essential for understanding emergent meanings. Furthermore, those things most fundamental to the work and the intent of agents are often missed by the initial well-crafted inquiries of researchers (Suchman et al., 1999). Therefore, deductive analysis was coupled with inductive inquiry leaving the researcher open to what might otherwise be missed by a solely deductive approach. Quantitative analysis may

distinguish the relationships and differences among variables while inductive analysis colors within the resultant distinctions.

Also of importance is that diffusion research should happen concurrent with the diffusion process rather than retrospectively after adoption or non-adoption (Rogers, 2003). This research took place during the innovation moment for tablet technology within an institution of higher education. This diffusion research analyzed adoption at multiple points during the adoption process and moved beyond retrospective analysis (Rogers, 2003; Venkatesh et al., 2003). A two-phase survey was administered during the semester when the innovation cycle occurred, photo diaries were used in the middle of that same semester, and focus group interviews were conducted near the end of that same semester. Rogers (2003) criticized the pro-adoption, pro-technology bias of certain diffusion studies. Therefore, in being mindful of this tendency, this study sought, as an antidote, a modern economic development perspective that fosters an interchange between students, work, technology, and social systems in a way that seeks to understand students' concerns as well as social equity (Rogers, 2003; Selwyn, 2004).

This study used a collaborative research approach. The research team included a tenured faculty, post-doctoral professional, an undergraduate research assistant and a doctoral student. This research team collaborated on the scheduling and administration of the survey, the design of the photo diary and focus group protocols, as well as the coding of transcripts and the thematic analysis. The researchers studied the same phenomenon for different purposes and from different perspectives.

This study made extensive use of *triangulation* to confirm understanding, increase credence, and demonstrate commonality (Stake, 1995). Data source triangulation occurred in the survey item's use of different domains (e.g., home

work, classwork) relative to the same determinant construct as well as the photo diary's use of varying personal spaces. Investigator triangulation derived from the collaboration among the research team, especially during interpretive interactions with the data. Stake (1995) argued for a constructivist view of knowledge that claims description of the specific allows for effective generalizations. Additionally, Wynn and Williams (2012) provided principles, based upon critical realism, for use in case studies on information systems. Critical realism posits a causal explanation for a given phenomenon that is "inferred by explicitly identifying the means by which structural entities and contextual conditions interact to generate a given set of events" (Wynn & Williams, 2012, p. 787). Critical realism considers the subjective knowledge of social actors while acknowledging the "existence of independent structures that constrain and enable these actors to pursue certain actions in a particular setting" (Wynn & Williams, 2012, p. 788). This ontological confidence and epistemological humility guided this case study as it examined a specific phenomenon within a particular context by a particular population in order to better understand the phenomenon.

Population, Sample and Sampling Methods

This study explored variations among students relative to the determinants for acceptance and use of tablet technology for academic purposes. The instrumental case occurred within a 4-year public university that serves a diverse region of California. This university serves over 20,000 students within a large service area. The U.S. Department of Education (n.d.a.) has designated this university a Hispanic-Serving Institution and an Asian American and Native American Pacific Islander Serving Institution. The majority of undergraduates are from within the county where the university is located. The approximate ethnic distribution is listed in Table 3.

Table 3

Hispanic and White Distribution

Year	Hispanic (%)	White (%)
2005	30	38
2009	34	35
2013	41	26

The university launched an initiative during the fall of 2014 that included the use of tablets for academic purposes. During the fall of 2014, the university planned to have approximately 1,200 students in course sections where tablet use for academic purposes is required. Approximately 40 faculty members taught these courses and each of the faculty members participated in an intensive course redesign process during the summer of 2014.

The subjects of the study were undergraduate students aged 18 and older. Some participants were enrolled in a course requiring a tablet for academic purposes and others were not. The sample population for the survey was selected using criterion-based, cluster sampling wherein the criteria included a cross-section of undergraduate courses and the cluster was determined by course enrollment (Creswell, 1994; Creswell & Clark, 2007; Pedhazur & Schmelkin, 2013). The course sections included undergraduate courses on subjects such as history, English, business administration, political science, psychology, linguistics, mechanical engineering and computer science.

The population sample size was the next decision point. Kotrlik, and Higgins (2001) provided formulas and tables to determine sample size based on the type of variable, margin of error, and level of accuracy. Based on their statistical analysis and the population sizes with 1,200 students enrolled in the tablet initiative, the required sample size with categorical data (margin of error =

.05) is 306 (t=1.96). Based on an estimated undergraduate class of 6,530 students (i.e., 2 times 3,265 which was the number of freshman in 2013), the desired sample size for categorical data (margin of error = .05) is 367 (t=1.96). Therefore, the target sample size for the first phase of the survey should be at least 367 students. The actual sample size was 652 for phase 1 and 440 for phase 2.

A subsequent purposeful, stratified, criterion-based sampling technique was used to select participants for the photo diary and focus group interviews. Survey participants were asked during phase 1 of the survey if they were interested in participating in additional research, namely, the photo diary and focus group interviews. Participants were asked to provide contact information if they wished to participate. Individuals who responded affirmatively to participate in the photo diary and/or focus group interviews comprised the potential population for this portion of the study. This set of potential participants was then stratified by the demographic constructs of socioeconomic status and race/ethnicity. The research team sought to balance participation across four groups: Hispanic, White, first generation student, and not first generation student.

The intended sample size was 6 to 12 students as participants in the photo diary and 8 to 12 participants in the focus group interviews. These sample sizes were informed by, among others, a leading qualitative research design authority in the Nielsen Norman Group (Nielsen, 2012) who asserts that five subjects approximates testing's maximum cost/benefit ratio. The students for the photo diary study as well as the focus group interviews were comprised of distinct segments of the population. Those students who agreed to participate in this portion of the study were then stratified based upon socioeconomic status and race/ethnicity as the sample. The socioeconomic segment was comprised of two groups based upon student response to the survey item, *Are you the first person in*

your family to attend college? The race/ethnicity segment was comprised of two groups based upon student response as either "Hispanic" or "White" to the survey item regarding race/ethnicity. There were 11 students who agreed to participate and completed the photo diary interview portion of the study. Achieving size sufficient for effective group discussion as well as student availability resulted in two focus groups with six participants each and these two focus groups comprised a blend of the sub-groups.

A third focus group comprised two internal informants; staff who worked for the university as teaching assistants in courses that required use of tablets for academic purposes. One teaching assistant had two course sections with a total of 50 students while the other assistant served two course sections with 25 and 20 students respectively.

Instrumentation

Three instruments were used to collect data for this study: (a) two-phase electronic survey, (b) photo diary with interview, and (c) focus group interview.

Survey Design and Pilot Study

A survey was designed to gather data about students' perceptions of factors determining acceptance and use of technology as defined by Venkatesh et al. (2003, 2012). The determinants were performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value. Several moderating factors were explored: socioeconomic status (as determined by reported first generation student), race/ethnicity, gender, self-efficacy, access, and experience. The survey was created with items validated from and based on UTAUT constructs and adapted to this study's population, context, and technology. A two-phase online survey was created with phase 1 administered

during the initial introduction of the technological innovation and phase 2 administered subsequent to the introduction to the technological innovation. This practice of multi-phased surveys followed recommendations by Rogers (2003) and Venkatesh et al. (2003, 2012). Survey items were syntactically identical, however, the subjunctive tense was used to address participants without access to a tablet, and the present perfect tense was used to elicit perspectives of participants during the initial phase and subsequent phase of the survey.

The survey was administered electronically using responsive-design to address the various mobile devices available to students such as laptops, tablets, and smart phones. This responsive-design was necessary to ensure that the survey worked regardless of the students' brought-technology. The use of mobile web survey design has shown not to affect validity and reliability of survey responses (Peytchev & Hill, 2010). Survey construction was user-focused with survey questions using vocabulary likely to be understood by the majority of the survey respondents. According to Microsoft Word, the Flesch Reading Ease score was 62.1 and the Flesch-Kincaid Grade Level was 8.0.

The items related to the UTAUT constructs (performance expectancy, effort expectancy, social influence, facility conditions, price value, and hedonic motivation) were measured using a four point Likert scale with intervals of *Strongly Disagree*, *Disagree, Agree*, and *Strongly Agree* as well as the option to select, *Don't Know*. Responsive-design seeks to provide an effective user experience regardless of device used. A seven point Likert scale did not fit the responsive-design criteria for effectively fitting on mobile device. So this scale deliberately deviated from the 7-point Likert scale used by Venkatesh et al. (2003, 2012) in order to achieve a responsive-design for the student population who would use a mobile device to respond to the survey. The purpose of the rating

scale was to allow respondents to express the strength and direction of their preferences. No mid-point was used in the Likert scale so that respondents would not choose a neutral value. The absence of a mid-point is appropriate and does not affect the validity or reliability of the responses (Garland, 1991). Survey items were positioned proximate to items belonging to their respective UTAUT construct. This was a design decision so that respondents could differentiate the aspects of the specific construct prompted by the item (e.g., homework versus class work).

The survey items related to moderators included three demographic constructs (socioeconomic status, race/ethnicity, and gender), which were included near the end of the survey (to avoid bias, which might occur through the re-enforcement of student identifiers). The item requesting ethnic identity used the same categories as the U.S. Census Bureau (Census Bureau, 2013). However, within the survey the race/ethnicity categories were listed alphabetically rather than according to the sort order used by the U.S. Census Bureau. Also, selection of the Asian category allowed respondents to further identify their individual ethnic identity (e.g., Hmong). These categories may be insufficient to describe the diversity of populations, honor peoples' origins and identities, and continue to address equity. There is an on-going debate regarding these categories and also the potential that the Census Bureau may reconsider these categories in the 2020 census (Compton, Bentley, Ennis & Rastogi, 2013; Krogstad & Cohn, 2014; Prewitt, 2013). Nonetheless, these categories continue in use within higher education to evaluate responsiveness to diversity and the efficacy of equity programs (U.S. Department of Education, n.d.b.). These categories, although limited in their ability to reflect origin and identity, were used within this study to

identify variations within populations in the acceptance and use of technology, honor students' perspectives, and support the work on equity.

The demographic construct for socioeconomic level was based upon the survey item, *Are you the first person in your family to attend college?* Initially, low socioeconomic status was going to be determined by a student reporting either as a first generation student or having received free and reduced lunch in high school. Subsequent research into free and reduced lunch entitlements as well as conversations with research professionals revealed that free and reduced lunch may not be a reliable indicator of low socioeconomic status because (a) free and reduced lunch may be a stigma that limits self-reporting by students and (b) free and reduced lunch at some districts is available to all students regardless of socioeconomic status (U.S. Department of Agriculture, 2014a, 2014b; X. Fu, personal communication, March 6, 2015). A first generation student is a student for whom neither parent has earned a bachelor's degree (Engle & Tinto, 2008). This first generation student designation is often correlated with lower socioeconomic status (Engle & Tinto, 2008). This correlation may exist given that parental educational attainment is the most stable component among the tripartite components of socioeconomic status, along with parental occupation and income, and is highly correlated to income in the United States (Sirin, 2005). This designation is also more likely to be accurately reported (X. Fu, personal communication, March 6, 2015). Hence, first generation student was the sole indicator of socioeconomic status for purposes of this study.

The survey item on gender listed choices alphabetically and allowed respondents to identify their gender. The gender question was important since prior research shows males have a tendency to accept technological innovations more quickly, although this tendency recently appeared tempered relative to

females (Venkatesh et al., 2003). The gender construct in technology acceptance instruments may be syntactically sound but hermeneutically ambiguous. Is the gender construct about biological sex, sexual orientation, gender identity, or gender expression? In order to honor the survey respondents who might experience some ambiguity with this construct, the survey included additional choices of "Other" and "Prefer not to respond."

The survey concluded with items that invited students to participate in additional research including a photo diary with interview and a focus group interview. Table 4 depicts the constructs with the corresponding survey items. The Student Acceptance and Use Survey is included in Appendix A.

The second phase of the survey included a question to understand the student's motivation for enrolling in the tablet course. This question only appeared on the survey if the student previously responded in the affirmative to the question of whether the student was enrolled in a course that required use of a tablet for academic purposes. This item asked respondents to rank order the reasons why they agreed to enroll in a tablet course. The reason options included degree requirements, course fit schedule, specific faculty teaching course, friend's recommendation, course used tablet technology, and do not know.

The survey also included a hidden construct called *UserAgent* that determined the respondent's browser and operating system. These data were used to determine the devices used by respondents to complete the survey. These data represented the respondents' brought-device chosen to complete a web-based survey.

A pilot of the survey was administered to 30 students at the participating university in a course section not included in the actual study. The participants in the pilot study were asked to provide feedback regarding the format of the survey

Table 4

Survey Items Grouped by Determinant Factor

Performance Expectancy
• I think using a tablet would help me do work in class more quickly.
• I think using a tablet would allow me to be more efficient with homework (to work faster or get more homework done).
• I think using a tablet would be helpful during class.
• I think using a tablet would help me be more organized.
• If I had unlimited access to a tablet, I would use it for non-school activities whenever I could.
Effort Expectancy
• I think learning to use a tablet would be easy for me.
• I think it would be easy for me to develop the skills needed to use a tablet.
• I think homework would be easier to do if I used a tablet.
• I think checking on class assignments would be easier to do if I used a tablet.
• I think it would take me more time to do my homework if I used a tablet.
Social Influence
• I think my family believes I should use a tablet to do my school work.
• I think my friends believe I should use a tablet to do my school work.
• I think my teachers at this university believe I should use a tablet to do my school work.
• I think my classmates believe I should use a tablet to do my school work.
Facilitating Conditions
• If I needed help using a tablet, I would know how to get help.
• I think I could figure out what I would need to know to use a tablet.
• If I needed help using a tablet, I think I would know how to get help from the University Help Desk.
• If I needed assistance using a tablet, I think I would be able to get help from friends or family.
Experience
• Before I came to the university, I regularly used a computer or a tablet to do classwork in high school or at my previous college.
• Before I came to the university, every student had easy access to a computer or a tablet at the high school or previous college I attended.

items on their respective mobile devices and the clarity and readability of questions as well as student's general observations about the survey. Feedback from the pilot was used to make adjustments to the survey and administration process.

The reliability of the instrument was calculated using Cronbach's alpha following data collection. This measurement of internal consistency informed the level of homogeneity of items to determine whether item responses grouped together measure the same construct (Henson, 2001). The survey instrument was administered two times during the fall semester (phase 1 N = 652; phase 2 N = 440). The performance expectancy construct consisted of 3 items (α = .81) with two initial items dropped given low reliability, namely: *I think using a tablet would help me be more organized; If I had unlimited access to a tablet, I would use it for non-school activities whenever I could.* The effort expectancy construct consisted of 4 items (α = .71), the social influence construct consisted 4 items (α = .83), and the facilitating conditions construct consisted of 4 items (α = .83). The behavioral intention construct consisted 2 items (α = .77), and the use behavior construct consisted 3 items (α = .72). Each of these constructs has a Cronbach's alpha greater than .7 meeting internal consistency reliability expectations. Most of the construct's principal component loadings were .70 or higher. PCA loadings for performance expectancy were .866, .864, and .824; for effort expectancy .765, .773, .718, .698; for social influence.791, .866, .755, .844; for facilitating conditions .784, .710, .705, .566; for behavioral intention .903, .903; and for use behavior .833, .865, and .694.

Photo Diary (with interview) and Pilot Study

Several methods are available to explore behavioral intention to use a technological innovation and the actual use of that innovation. For ICT

innovations, researchers have used methods like server-based activity logs or client-side logs to track usage (Venkatesh et al., 2003). While these methods track usage, they cannot readily extract the personal meaning attached to the use behavior; therefore, many user-centered designs include specialized observations (e.g., click-stream analysis) combined with interviews (Nielson, 2012). Nonetheless, these methods would not provide access to all the times, places, and ways where students use tablets. On the other hand, photo diaries provide an effective means of learning from participant observation of behavior in situ without requiring the observer to be physically present in the day-to-day world of the participant (Gabridge, Gaskell, & Stout, 2008; Zimmerman & Wieder, 1977).

The purpose of the photo diary was to explore variations between and within populations relative to performance expectancy and facilitating conditions. The photo diary used a methodology from anthropology known as "cultural probes", which studies people in their own environment (Gabridge et al., 2008). This method generated insights into a group's behaviors that, through coding and analysis, bring a "larger pattern of behavior into sharper focus" (Gabridge et al., 2008, p. 512). The photo diary was a participant observation method that leveraged participants as researchers and allowed for observation in times and places that would prove difficult for direct observation. The photo diary acted as an observational log with pictures and annotations that later served as both stand-alone artifacts as well as the basis for interviews (Gabridge et al., 2008; Zimmerman & Wieder, 1977). The photo diary method also reduced the observer's effect on the participant's behavior and offered multiple means of learning from the participants structuring of meaning related to the subject of concern (Zimmerman & Wieder, 1977). Zimmerman and Wieder asserted that the product of photo diaries is "empirically warranted, theoretically relevant

description" (p. 492). The photo diary method served as an effective means of indirectly observing students' lived-experience, explicated through a subsequent interview, which resulted in relevant data.

A photo diary prompt was developed to guide what the participant saw as a relevant event for a photo diary entry (Appendix B). A photo diary interview script was developed to guide the subsequent interview with the participant following their completion of the photo diary (Appendix C). A pilot of the photo diary protocol was conducted with two students who were not actual participants in the study. Feedback from these participants was used to refine the prompts and interview questions.

Focus Group Interview

In addition to the survey and photo diaries, focus group interviews were used to explore the ways participants experienced and perceived performance expectancy and facilitating conditions related to tablet technology. Focus group interviews were structured group interviews that fostered dialogue among the participants regarding particular issues (Bogdan & Biklen, 2006). The focus group method elicited thoughts and feelings that might not readily emerge during individual interviews from this population (Bogdan & Biklen, 2006). Focus groups explicated the structures of meaning related to performance expectancy and facilitating conditions for these segments (Geertz, 1973).

A semi-structured interview protocol was developed with a list of questions to be explored and suggested prompts for following up key topics (Appendix D). According to Gall, Borg, and Gall (1996) a "semi structured interview involves asking a series of structured questions and then probing more deeply using open-form questions to obtain additional information" (p. 310).

Data Collection Procedures

Collection of Survey Data

In an effort to increase response rates, the electronic survey was administered during class sessions. The research team approached faculty of lower division undergraduate courses, and requested permission to administer the survey within their course sections. Faculty were informed that confirmation of participation included a commitment to participate in both parts of the two-phase survey. The course sections included the following subjects and number of sections: history (2), English (1), business administration (1), political science (2), psychology (2), linguistics, (2), engineering, and computer science (2). The research team scheduled a time with each faculty member to introduce and administer the survey during class time. Researchers introduced the survey to students using a pre-developed script that included a statement of informed consent (Appendix E). Students were offered an incentive for their participation in the survey, namely, a drawing opportunity for a limited number of $25 and $10 gift cards. During the administration of the surveys, students were allowed to use whichever Internet-connected mobile device they preferred and had available. The first item in the survey was a statement of informed consent that required students to acknowledge such consent (Appendix F).

Phase 2 of the survey included the same courses as phase 1. The set of students who responded to the survey in phase 1 might not be the exact same set of students responding to the survey during phase 2 (e.g., absence during one but not the other survey). However, 126 students' self-reported student IDs were matched for responses on both phase 1 and phase 2.

Photo Diary Data Collection Process

The research team contacted by email the students who agreed to participate in the photo diary (with interview), and participants were selected from a criterion-based, stratified sample. The research team then contacted participating students and provided them with additional information about the research, protocol, and prompt as well as support on the installation and use of the d.scout mobile application on their mobile device. Students were also provided with the consent form before the data collection process began (Appendix G).

The photo diary data collection process included collecting a set of participant-generated photos with student annotations of the photographs. These photos were evidence of the participating student's technology use patterns that explored issues of performance expectancy, facilitating conditions. and use behavior. Participants had 14 days to generate photographs and include corresponding annotations using the d.scout software. The participants were then interviewed to better understand their photos/journal entries. The photo diary interview recordings were then transcribed and reviewed for accuracy.

Focus Group Interview Data Collection Process

Focus groups, as structured group interviews, were used to foster interaction and discussion between members of the group to gather data regarding the subject of concern, namely, performance expectancy, effort expectancy, and use behavior. Six participants were selected for each of two focus group interviews. The researcher contacted the selected participants by email and phone, described the research, scheduled a time and place to meet for the focus group interview, and then contacted participants again to confirm participation. Students selected for the focus group interviews were informed at the beginning of the

focus group about the research and provided a consent form before proceeding with the research (Appendix H).

Focus group interviews took place in a conference room in an administrative section of the school of business at the participating university. Focus group interviews were scheduled based on availability of students and the facilitator. Each focus group interview was designed for 1 hour. At the conclusion of each focus group interview, a short debrief took place to make sure participants felt comfortable with the research and discussion. Focus group interview sessions were video-recorded and audio-recorded in order to facilitate recall. The researcher transcribed the sessions including the spoken communication, the perceptions of participants, and the interactions between participants.

The third focus group was comprised of two internal informants; staff who worked for the university as teaching assistants in courses that required use of tablets for academic purposes. The researcher transcribed the sessions including the spoken communication, the perceptions of participants, and the interactions between participants.

Data Analysis Procedures

Quantitative Analysis – Survey Data

Before the analysis could begin, the data had to be prepared. This included cleaning the data, eliminating invalid cases, and the creation of dummy dichotomous variables to decompose categorical variables into variables that fit regression analysis.

Regression analysis was performed to examine the relationship between the determinants (predictors) and behavioral use as well as use behavior. This

analysis informed the response to research question 1: What is the strength of the determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) on student behavioral intention and use behavior regarding tablet technology use for academic purposes?

Multiple regression and analysis of variance were used to inform the response to research question 2: Is there a difference among each demographic construct (socioeconomic status, race/ethnicity, and gender) on the determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) for student behavioral intention and use behavior regarding tablet technology use for academic purposes? Analysis included correlation analysis to explore relationships between the determinants and moderators. Then multiple regression analysis was used to determine the effects of the moderator categories upon the determinants including the direction and significance of these relationships. Lastly, ANOVA was used to determine if categories within the moderator variables had a significant effect upon the determinants.

Paired t-tests and multiple regression were used to respond to research question 3: Is there a difference over time among each demographic construct (socioeconomic status, race/ethnicity, and gender) on the determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) for student behavioral intention and use behavior regarding tablet technology use for academic purposes? The survey responses from phase 1 were matched with those from phase 2 where the student ID matched (n = 137). The analysis included paired t-tests to determine if there was variance at a significant level within the determinants between phase 1 and phase 2. Variables were computed to determine the difference in each

variable's means for phase 1 and phase 2 as well as the significance of this difference. Then, regression analysis was used to determine if there was a significant effect upon the variance in behavioral intention and use behavior based upon the variance in the determinants and moderators.

Qualitative Analysis - Photo Diary with Interviews and Focus Group Interviews

Qualitative research was also used in this study. The researcher began by reviewing the photos/annotations within each participant's photo diary stream and across photo diary streams. Similarly, the researcher reviewed the focus group interview conversations. The research team then met to develop a work plan for the analysis informed by the literature including Creswell's (1997) guidance on working through the data analysis spiral.

The artifacts and transcripts from the photo diary and focus group interviews were uploaded into Dedoose (2014). Dedoose is an online qualitative software service that facilitates qualitative data analysis. Next, the research team developed codes based upon the literature on acceptance and use of ICT as well as initial readings of the collected artifacts. These codes (Appendix I) were entered into Dedoose and used as the code set for closed coding of the data. The media within Dedoose was then separated into pertinent excerpts. The researcher and a research team colleague each coded two separate transcripts. These two individuals then performed evaluation of their coding applied to excerpts that the other had coded using Dedoose's "training" function. This produced inter-rater reliability scores and informed the research team where coding definitions and guidelines required greater clarity. The research team then met to validate the codes and coding practices. The research team worked in pairs to excerpt and code the remaining transcripts and also cross-validate coding of these excerpts.

Next, the research team worked in pairs to explore what meaning emerged from the data relative to their respective research questions. Lastly, the research team met to review their respective analysis and triangulate their respective interpretations through multiple researchers. Throughout this process, the analysis remained open to the data by using memos and adding codes where the data dictated. Following this work, the researcher revisited each of the separate transcripts to better understand the meaning emerging from the conversations with each person and group. The resultant themes were then validated across all of the transcripts to determine their valence within a given transcript as well as across the participants. This resulted in the final themes discussed in chapter 4.

Summary

This study investigated variations among student populations relative to the acceptance and use of tablet technology for academic purposes at a 4-year, public university. This study explored variations in individual's perceptions of the determinants for behavioral intention and use behavior (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) based on the demographic constructs of socioeconomic status, race/ethnicity and gender. Additionally, this study explored the strength of these determinants for behavioral intention and use behavior as well as the effects of the moderating factors (self-efficacy, access, experience, socioeconomic status, race/ethnicity and gender).

A mixed methods approach was used to determine the strength of the determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) on student behavioral intention and use behavior regarding tablet technology use for academic purposes.

Chapter 4 presents the findings and analysis of the data collected related to the research questions gathered through both quantitative and qualitative methods. Chapter 5 presents a summary of findings and conclusions of the study, discussion related to the literature, and recommendations for policy and practice as well as subsequent research.

CHAPTER 4: RESULTS

This chapter provides findings from the mixed methods instrumental case study, which explored variations in the acceptance and use of tablet technology by students at a 4-year, public university. This study explored variations in student perceptions of the determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) for behavioral intention and use behavior relative to the demographic constructs of socioeconomic status, race/ethnicity and gender. This study explored not only the strength of the determinants for behavioral intention and use behavior but also the effects of the moderating factors (socioeconomic status, race/ethnicity, gender, self-efficacy, access, and experience). These differences were directly investigated through students' perspectives, lived-experiences, and socially constructed meanings. The theoretical framework that provided the foundation for this study was a synthesis of four research streams: diffusion of technological innovations, acceptance and use of technology, information systems implementation, and the research on design and implementation with and for persons. This chapter presents a review of the methodology, results from the analysis of the survey data in response to research questions 1 through 3, and results from the thematic analysis of the photo diary and the focus group interviews in response to research questions 4 and 5. The chapter concludes with a summary of the major findings.

Review of Methodology

An instrumental, case study design and between mixed methods approach was used for this study that included a two-phase survey, photo diary with interviews, and focus group interviews. The survey approach was used to explore

the population's perceptions of the determinants for acceptance and use of a technological innovation. The photo diary with interviews and focus group interviews were used to determine actual use behavior and explore the associated meanings emerging from students' interaction and interrelations within their everyday use of tablet technology for academic purposes.

Data for this study were collected during the fall of 2014 and was co-incident with the formal and intentional introduction of tablet technology to 1,200 students for academic purposes within the university. Participants included (a) 1092 student responses combined from phase 1 and phase 2 of the survey, (b) 11 students in the photo diary with interviews, and (c) three focus groups with two focus groups comprised of six students each and one focus group comprised of two teacher assistants.

Findings from Quantitative Analysis

A survey was distributed in two phases (September and November) to students in the same set of course sections during a class period. Survey participants included undergraduate students aged 18 and older; some participants were enrolled in a course requiring a tablet for academic purposes and others were not. This section presents findings and analysis for the quantitative portion of this study, which includes demographic data and responses to research questions 1 through 3.

Demographic Survey Findings

The survey was conducted in two phases (phase 1 n=652; phase 2 n=440). Tables 5, 6, and 7, respectively represent participant responses regarding demographics; the categories for access, experience and efficacy; and the devices participants used to complete the survey.

The participants represent a diverse population as depicted in Table 5. The largest ethnic groups included those who self-reported as Hispanic and White. Three hundred and sixteen participants reported as being a *first generation student* and 142 participants reported *other* gender.

Table 5

Respondents' Self-Report of First Generation Student, Race/Ethnicity, and Gender

	Phase 1		Phase 2		Total
Demographic	*N*	%	*N*	%	*N*
First Generation Student					
No	459	70	317	72	776
Yes	193	30	123	28	316
Total	652		440		1092
Race/ethnicity					
American Indian	7	1.3	5	1.4	12
Asian	96	17.2	66	17.8	162
Black or African American	16	2.9	15	4.1	31
Hispanic. Latino or Spanish Origin	221	39.7	131	35.4	352
Native Hawaiian or Pacific Islander	11	2.0	7	1.9	18
White	187	33.6	133	35.9	320
Other	19	3.4	13	3.5	32
Total	557		370		927
Gender					
Female	319	49	199	45	518
Male	254	39	178	40	432
Other	79	12	63	14	142
Total	652		440		1092

Table 6 shows the frequency of participant responses to survey items related to the moderator categories of access, efficacy and experience.

Table 6

Respondent Responses to Survey Items Related to Access, Efficacy and Experience

	Phase 1		Phase 2		Total
Response to Moderator Categories	*N*	%	*N*	%	*N*
Access					
No	161	25	115	26	276
Yes	491	75	325	74	816
Efficacy					
I could figure it out on my own	331	56	242	62	573
I would need online help or training	73	12	48	12	121
Do not know	29	5	16	4	45
I would need someone available to help me by phone	30	5	21	5	51
I would need someone available to help me face-to-face	129	22	66	17	195
Experience					
Strongly Disagree	68	11	33	8	101
Disagree	162	27	89	23	251
Do not know	5	1	3	1	8
Agree	216	36	148	38	364
Strongly Agree	143	24	121	31	264

Access responses were relatively consistent between phase 1 and 2 with 25% responding *No* to access in phase 1 and 26% in phase 2. Efficacy increased between phase 1 and phase 2 for the response, *I could figure it out on my own*, and decreased for the response, *I would need someone available to help me face-to-face*. During phase 1, more students responded *Agree* (36%) or *Strongly Agree* (24%) than those who responded *Strongly Disagree* (11%) or *Disagree* (27%) to the survey item, *before I came to the university, I regularly used a computer or a tablet to do classwork in high school or at my previous college*.

Table 7 depicts the frequency for the types of devices participants used to respond to the survey. These data were automatically captured during the survey

using Qualtrics survey software's *UserAgent* function. This data represent the device participants brought to class and chose to use to complete the survey.

Table 7

Frequency for Types of Devices Students Used to Respond to Survey

	Phase 1		Phase 2		Total
Device	*N*	%	*N*	%	*N*
iPad	211	32	130	30	341
Android	162	25	116	26	278
Windows	120	18	81	18	201
iPhone	79	12	53	12	132
Apple	67	10	52	12	119
Other	13	2	8	2	21
Total	652	100	440	100	1092

The types of devices used to respond to the survey included smartphones (iPhone, Android), tablets (iPad, Android, other), and laptops (Windows, Apple). The iPad tablet was the most frequently used device (32% and 30%); the Android tablet the second most frequently used device (25% and 26%); and Windows tablets/laptops were the third most frequently used device (12% and 12%).

Findings for Research Question 1

Regression analysis was performed to examine the relationship between the determinants (predictors) and behavioral use as well as use behavior. This analysis informed the response to research question 1: What is the strength of the determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) on student behavioral intention and use behavior regarding tablet technology use for academic purposes?

The multiple regression model with the six determinants (performance expectancy, effort expectancy, facilitating conditions, social influence, hedonic motivation, and price value) explained 38% of the variance in behavioral

intention, $R^2 = .38$, $F(6,978) = 101.45$, $p < 001$. Results revealed significant positive coefficients for performance expectancy, effort expectancy, social influence, hedonic motivation, and price value; however, facilitating conditions did not contribute to the model. Table 8 depicts the coefficients for behavioral intention.

Table 8

Coefficients for Behavioral Intention

Variable	*β*	*β**	*T*
Performance Expectancy	.146	.114	3.225**
Effort Expectancy	.248	.144	3.969***
Social Influence	.164	.109	3.660***
Facilitating Conditions	.043	.022	.774
Hedonic Motivation	.344	.316	9.596***
Price Value	.103	.096	3.183**

Note. * p < .05; ** p < .01; *** p < .001

The multiple regression model with the three predictor variables of behavioral intention, facilitating conditions, and access, explained 44% of the variance in use behavior, $R^2 = .44$, $F(3,981) = 256.24$, $p < 001$. Behavioral intention and access revealed significant positive coefficients while facilitating conditions did not contribute to the model. Table 9 depicts the coefficients for use behavior.

Table 9

Coefficients for Use Behavior

Variable	*B*	*β**	*T*
Behavioral Intention	.324	.353	14.267***
Facilitating Conditions	-.026	-.014	-.569
Access	1.585	.546	22.793***

Note. * p < .05; ** p < .01; *** p < .001

Analysis revealed that 38% of variance in behavioral intention can be explained by the variance in the determinants for behavioral intention with significant positive coefficients for performance expectancy, effort expectancy, social influence, hedonic motivation, and price value. Similarly 44% of variance in use behavior can be explained by the variance in behavioral intention, facilitating conditions, and access with significant positive coefficients for behavioral intention and access.

Findings for Research Question 2

Is there a difference among each demographic construct (socioeconomic status, race/ethnicity, and gender) on the determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) for student behavioral intention and use behavior regarding tablet technology use for academic purposes? First, correlation analysis was used to explore the relationships between the moderators and determinants. Next, regression analysis was used to determine the effects of the moderator categories on the determinants including the direction and significance of these relationships. Lastly, ANOVA was used to determine if categories within the moderator variables had a significant effect on the determinants.

Table 10 presents a correlation matrix depicting relationships between *moderator variables* and determinants. Results revealed relationships between: *race/ethnicity* and performance expectancy, effort expectancy, social influence, and hedonic motivation; *gender* and performance expectancy, social influence, facilitating conditions, price value and use behavior; *first generation student* and performance expectancy, hedonic motivation, behavioral intention and use behavior; *access* and social influence, price value and use behavior; *efficacy* and performance expectancy, effort expectancy, facilitating conditions and use

behavior; and *experience* and effort expectancy, facilitating conditions and behavioral intention.

Table 10

Correlation for Moderator Variables relative to Determinants

		Determinant Variables							
Moderator Variables		Performance Expectancy	Effort Expectancy	Social Influence	Facilitating Conditions	Hedonic Motivation	Price Value	Behavioral Intention	Use Behavior
Ethnicity	*R*	-.10**	-.09**	-.08*	-.04	-.13***	-.12***	-.06	-.03
	N	1029	1015	1004	998	985	985	991	985
Gender	*R*	-.08*	.02	-.08**	.10**	-.05	-.09**	-.03	-.08*
	N	1029	1015	1004	998	985	985	991	985
First Generation Student	*R*	.067*	.014	.019	-.050	.099**	.032	.083**	.075*
	N	1029	1015	1004	998	985	985	991	985
Access	*R*	.03	.01	.16***	.04	.05	.19***	.04	.56***
	N	1029	1015	1004	998	985	985	991	985
Efficacy	*R*	-.07*	-.20***	.02	-.24***	-.03	.04	-.04	.10**
	N	985	985	985	985	985	985	985	985
Experience	*R*	.06	.08*	.05	.19***	.06	.05	.07*	.06
	N	988	988	988	988	985	985	988	985

* p < .05; ** p < .01; *** p < .001

Multiple linear regression analysis was conducted on each determinant (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) to ascertain if variations within the moderators predicted variations within the determinants. For each determinant, the results of the regression are shown with R^2, F-value, and p-value followed by a table with the selected regression model's beta coefficients, adjusted beta coefficients, t-values, and notations depicting the p-values.

Table 11 depicts the coefficients for performance expectancy. The regression model with first generation student, race/ethnicity, and gender predicted 4% of the variance in performance expectancy, $R^2 = .04$, $F(7,977) = 6.22$, $p <$

.001). Other gender students had a significantly lower response than female students for performance expectancy, almost 0.8 points on the survey scale of 1-5. Hispanic students were significantly more positive in their response than White students for their performance expectancy, while Asian and other race students were no different than White students. In other words, Hispanic students had the most positive response about the benefits they expect from tablets for academic use.

Table 11

Coefficients for Performance Expectancy

Variable	β	β*	*T*
Male students	.008	.004	.131
Other gender students	-.759	-.152	-4.515***
Not First Generation Student	-.057	-.029	-.852
First Generation Student Do Not Know	-.043	-.005	-.146
Hispanic students	.238	.127	3.137**
Asian students	.039	.016	.429
Other race students	.068	.025	.684

Note. * p < .05; ** p < .01; *** p < .001

Table 12 depicts the coefficients for effort expectancy. The regression model with first generation student, race/ethnicity, and gender predicted 4% of the variance in effort expectancy, $R^2 = .04$, $F(7, 977) = 5.00$, $p < .001$, and the model with race/ethnicity, gender, first generation student, access, experience and efficacy predicted 8% of the variance in effort expectancy, $R^2 = .08$, $F(10,974) = 8.38$, $p < .001$. Other gender students had a significantly lower response than female students for effort expectancy, about 0.34 points on the survey scale of 1-5. Asian students had a significantly lower response than White students. Reported efficacy resulted in a significant negative coefficient of .085. Hispanic students were significantly more positive in their response than White students for their

effort expectancy, while Asian and other race students were no different than White students. In other words, Hispanic students had the most positive response about the ease with which they associate tablet use for academic purposes.

Table 12

Coefficients for Effort Expectancy

Variable	*B*	*β**	*T*
Male students	.089	.064	1.960
Other gender students	-.358	-.095	-2.875**
Not First Generation Student	-.020	-.013	-.404
First Generation Student Do Not Know	-.224	-.032	-1.031
Hispanic students	.119	.085	2.122*
Asian students	-.148	-.080	-2.202*
Other race students	.051	.025	.696
Efficacy	-.085	-.197	-6.149***
Experience	.045	.090	2.902
Access	.046	.025	.795

Note. * p < .05; ** p < .01; *** p < .001

Table 13 depicts the coefficients for social influence. The regression model with first generation student, race/ethnicity, and gender predicted 3% of the variance in social influence, $R^2 = .03$, $F(7,977) = 4.27$, $p < .001$, and the model with first generation student, race/ethnicity, gender, access, experience and efficacy predicted 6% of the variance in social influence, $R^2 = .06$, $F(10,974) = 5.87$, $p < .001$. Reported experience resulted in a significant positive coefficient of 0.04 and reported access resulted in a significant positive coefficient of 0.31. Other gender students had a significantly lower response than female students for social influence, about 0.7 points on the survey scale of 1-5. In other words, other gender students had the lowest response about the belief that important others believe they should use tablets for academic purposes.

Table 13

Coefficients for Social Influence

Variable	*B*	*β**	*T*
Male students	.007	.005	.139
Other gender students	-.562	-.132	-3.926***
Not First Generation Student	.015	.009	.256
First Generation Student Do Not Know	.182	.023	.729
Hispanic students	.122	.076	1.887
Asian students	-.132	-.063	-1.709
Other race students	.157	.069	1.853
Efficacy	.000	-.001	-.023
Experience	.042	.073	2.324*
Access	.314	.150	4.766***

Note. * p < .05; ** p < .01; *** p < .001

Table 14 depicts the coefficients for facilitating conditions. The regression model with first generation student, race/ethnicity, and gender predicted 3% of the variance in facilitating conditions, $R^2 = .03$, $F(7,977) = 4.36$, $p < .001$, and the model with first generation student, race/ethnicity, gender, access, experience, and efficacy predicted 12% of the variance in facilitating conditions, $R^2 = .12$, $F(10,974) = 12.63$, $p < .001$. Reported efficacy had a significant negative correlation of -0.08. Reported experience had a significant positive correlation of 0.08. Reported access had a significant positive correlation of .12. Male students had a significantly higher response than female students for facilitating conditions, almost 0.13 points on the survey scale of 1-5. In other words, male students had the most positive response about the resources and support available to use tablets for academic purposes.

Table 14

Coefficients for Facilitating Conditions

Variable	*B*	*β**	*T*
Male students	.130	.107	3.350**
Other gender students	-.017	-.005	-.163
Not First Generation Student	.014	.011	.322
First Generation Student Do Not Know	-.308	-.051	-1.663
Hispanic students	.007	.006	.156
Asian students	-.096	-.060	-1.678
Other race students	-.093	-.053	-1.485
Efficacy	-.082	-.218	-6.948***
Experience	.084	.191	6.263***
Access	.122	.076	2.498*

Note. * p < .05; ** p < .01; *** p < .001

Table 15 depicts the coefficients for hedonic motivation. The regression model with first generation student, race/ethnicity, and gender predicted 5% of the variance in hedonic motivation, $R^2 = .05$, $F(7,977) = 7.41$, $p < .001$, and the model with first generation student, race/ethnicity, gender, access, experience and efficacy predicted 6% of the variance in hedonic motivation, $R^2 = .06$, $F(10,974) = 6.51$, $p < .001$. Other gender students had a significantly lower response than female students for hedonic motivation, about 0.7 points on the survey scale of 1-5. Reported experience resulted in a significant positive coefficient of .07. Hispanic students were significantly more positive in their response than White students for their hedonic motivation, while Asian and other race students were no different than White students. In other words, Hispanic students had the most positive response about fun or pleasure derived from using tablets for academic purposes.

Table 15

Coefficients for Hedonic Motivation

Variable	β	β*	*T*
Male students	.093	.042	1.280
Other gender students	-.722	-.122	-3.653***
Not First Generation Student	-.129	-.056	-1.653
First Generation Student Do Not Know	-.557	-.051	-1.617
Hispanic students	.416	.188	4.661***
Asian students	.201	.069	1.894
Other race students	.139	.044	1.192
Efficacy	-.037	-.054	-1.676
Experience	.066	.083	2.660**
Access	.163	.056	1.796

Note. * p < .05; ** p < .01; *** p < .001

Table 16 depicts the coefficients for price value. The regression model with first generation student, race/ethnicity, and gender predicted 3% of the variance in price value, $R^2 = .03$, $F(7,977) = 4.65$, $p < .001$, and the model with first generation student, race/ethnicity, gender, access, experience and efficacy predicted 7% of the variance in price value, $R^2 = .07$, $F(10,974) = 7.40$, $p < .001$. Other gender students had a significantly lower response than female students for price value, about 0.5 points on the survey scale of 1-5. Reported experience resulted in a significant positive coefficient of .06. Reported access resulted in a significant positive coefficient of .55. Hispanic students were significantly more positive in their response than White students for their price value, while Asian and other race students were no different than White students. In other words, Hispanic students had the most positive response about the cognitive tradeoff between perceived benefits and associated costs for use of tablets for academic purposes.

Table 16

Coefficients for Price Value

Variable	*B*	*β**	*T*
Male students	-.022	-.010	-.306
Other gender students	-.504	-.084	-2.515*
Not First Generation Student	.061	.026	.768
First Generation Student Do Not Know	-.603	-.054	-1.729
Hispanic students	.369	.164	4.078***
Asian students	.105	.035	.971
Other race students	.111	.034	.940
Efficacy	.002	.003	.097
Experience	.055	.068	2.183*
Access	.548	.186	5.936***

Note. * p < .05; ** p < .01; *** p < .001

The regression analysis showed that each of the determinants had a significant proportion of its variance that could be explained by the demographic constructs and/or all of the moderators. Male students had a significant positive correlation with facilitating conditions and hedonic motivation. Other gender students had a significant negative correlation with performance expectancy, effort expectancy, social influence, hedonic motivation and price value. Asian students had a significant negative correlation with effort expectancy. Reported efficacy had a significant negative correlation with effort expectancy and facilitating conditions. Reported access had a significant positive correlation with social influence, facilitating conditions and price value. Reported experience had a significant positive correlation with social influence, facilitating conditions, hedonic motivation and price value.

ANOVA was used to determine if there are different effects upon the determinants based on the categories within each moderator. Table 17 shows the results of the ANOVA analysis for the moderators relative to the determinants.

Table 17

ANOVA Results for Moderators relative to Determinants

Moderator Variables		Performance Expectancy	Effort Expectancy	Social Influence	Facilitating Conditions	Hedonic Motivation	Price Value	Behavioral Intention	Use Behavior
Ethnicity	*F*	6.47***	5.28**	4.77**	2.09	10.86***	7.62***	2.84*	2.48
	df	3,1025	3,1011	3,1000	3,994	3,981	3,981	3,987	3,981
Gender	*F*	4.97**	4.96**	6.14**	8.04***	9.99***	5.71**	1.45	3.14*
	df	2,1026	2,1012	2,1001	2,995	2,982	2,982	2,988	2,982
First Generation Student	*F*	4.60*	.21	.35	2.45	9.69**	.98	6.81**	5.54*
	df	1,1027	1,1013	1,1002	1,996	1,983	1,983	1,989	1,983
Access	*F*	1.10	.03	25.44***	1.47	2.67	37.08***	1.88	456.89***
	df	1,1027	1,1013	1,1002	1,996	1,983	1,983	1,989	1,983
Efficacy	*F*	3.04*	13.03***	2.18	18.13***	1.28	1.47	2.35	4.27**
	df	4,980	4,980	4,980	4,980	4,980	4,980	4,980	4,980
Experience	*F*	1.64	1.86	1.49	12.21***	1.10	1.37	1.42	1.78
	df	4,983	4,983	4,983	4,983	4,980	4,980	4,983	4,980

Note. * p < .05; ** p < .01; *** p < .001

Race/ethnicity was the first moderator analyzed. Table 18 provides bivariate analysis of determinants relative to categories of race/ethnicity. Analysis of variance showed the effect of race/ethnicity on performance expectancy as significant, $F(3,1025) = 6.47$, $p < .001$, with Hispanic ($M = 3.90$, $SD = .84$) reporting higher performance expectancy than White ($M = 3.62$, $SD = 1.02$). Analysis of variance showed the effect of race/ethnicity on effort expectancy as significant, $F(3,1011) = 5.28$, $p < .01$, with Hispanic ($M = 4.20$, $SD = .64$) reporting higher effort expectancy than White ($M = 4.12$, $SD = .76$). Analysis of variance showed the effect of race/ethnicity on social influence as significant, $F(3,1000) = 4.77$, $p < .01$, with Hispanic ($M = 3.33$, $SD = .71$) reporting slightly higher social influence than White ($M = 3.20$, $SD = .81$). Analysis of variance showed the effect of race/ethnicity on hedonic motivation as significant, $F(3,981)$

= 10.86, $p < .001$, with Hispanic ($M = 3.75$, $SD = .99$) reporting higher hedonic motivation than White ($M = 3.32$, $SD = 1.17$). Analysis of variance showed the effect of race/ethnicity on price value as significant, $F(3,981) = 7.62$, $p < .001$, with Hispanic ($M = 3.77$, $SD = 1.00$) reporting higher price value than White ($M = 3.42$, $SD = 1.17$). Analysis of variance showed the effect of race/ethnicity on behavioral intention as significant, $F(3,987) = 2.84$, $p < .05$, with Hispanic ($M = 3.44$, $SD = 1.15$) reporting higher behavioral intention than White ($M = 3.20$, $SD = 1.20$). Analysis of variance showed the effect of race/ethnicity on use behavior as not significant, $F(3,981) = 2.48$, p = n.s.; nor was the effect on facilitating conditions significant, $F(3,994) = 2.09$, p = n.s.

Table 18

Bivariate Analysis of Determinants relative to categories of Ethnicity

Race/ethnicity Categories		Performance Expectancy	Effort Expectancy	Social Influence	Facilitating Conditions	Hedonic Motivation	Price Value	Behavioral Intention	Use Behavior
Hispanic	*M*	3.90	4.20	3.33	4.13	3.75	3.77	3.44	2.70
	N	415	415	415	415	415	415	415	415
	SD	0.84	0.64	0.71	0.62	0.99	1.00	1.15	1.06
White	*M*	3.62	4.12	3.20	4.20	3.32	3.42	3.20	2.49
	N	265	265	265	265	265	265	265	265
	SD	1.02	0.76	0.81	0.60	1.17	1.17	1.20	1.12

Gender was the second moderator analyzed. Table 19 presents bivariate analysis of determinants relative to categories of gender. Analysis of variance showed the effect of gender on performance expectancy as significant, $F(2,1026) = 4.97$, $p < .01$, with other gender students ($M = 3.43$, $SD = 1.09$) reporting lower

performance expectancy than female students (M = 3.78, SD = .89) and male students (M = 3.75, SD = .93). Analysis of variance showed the effect of gender on effort expectancy as significant, $F(2,1012) = 4.96$, $p < .01$, with other gender students (M = 3.95, SD = .67) reporting lower effort expectancy than female students (M = 4.09, SD = .71) and male students (M = 4.19, SD = .66). Analysis of variance showed the effect of gender on social influence as significant, $F(2,1001) = 6.14$, $p < .01$, with other gender students (M = 2.88, SD = .71) reporting lower social influence than female students (M =3.27, SD = .76) and male students (M =3.23, SD = .82). Analysis of variance showed the effect of gender on facilitating conditions as significant, $F(2,995) = 8.04$, $p < .001$, with male students (M = 4.22, SD = .58) reporting higher facilitating conditions than female students (M =4.06, SD = .61) and other gender students (M = 4.13, SD = .67). Analysis of variance showed the effect of gender on hedonic motivation as significant, $F(2,982) = 9.99$, $p < .001$, with other gender students (M = 2.74, SD = 1.24) reporting lower hedonic motivation than female students (M =3.55, SD = 1.05) and male students (M =3.59, SD = 1.11). Analysis of variance showed the effect of gender on price value as significant, $F(2,982) = 5.71$, $p < .01$, with other gender students (M = 3.03, SD = 1.20) reporting lower price value than male students (M = 3.54, SD = 1.12) and female students (M = 3.65, SD = 1.09). Analysis of variance showed the effect of gender on use behavior as significant, $F(2,982) = 3.14$, $p < .05$, with other gender students (M = 2.32, SD = 1.12) reporting lower use behavior than male students (M = 2.54, SD = 1.13) and female students (M = 2.68, SD = 1.06). Analysis of variance showed the effect of gender on behavioral intention as not significant, $F(2,988) = 1.45$ $p <$ n.s.

Table 19

Bivariate Analysis of Determinants relative to categories of Gender

Gender Categories		Performance Expectancy	Effort Expectancy	Social Influence	Facilitating Conditions	Hedonic Motivation	Price Value	Behavioral Intention	Use Behavior
Female	*M*	3.78	4.09	3.27	4.06	3.55	3.65	3.34	2.68
	N	518	518	518	518	518	518	518	518
	SD	0.89	0.71	0.76	0.61	1.05	1.09	1.20	1.06
Male	*M*	3.75	4.19	3.23	4.22	3.59	3.54	3.33	2.54
	N	432	432	432	432	432	432	432	432
	SD	0.93	0.66	0.82	0.58	1.11	1.12	1.18	1.13
Other	*M*	3.43	3.95	2.88	4.13	2.74	3.03	3.01	2.32
	N	79	65	54	48	35	35	41	35
	SD	1.09	0.67	0.71	0.67	1.24	1.20	1.32	1.12

First generation student, for socioeconomic status, was the third moderator analyzed. Table 20 provides bivariate analysis of determinants relative to categories of first generation student. Analysis of variance showed the effect of first generation student on performance expectancy as significant, $F(1,1027) = 4.60$, $p < .05$, with first generation students ($M = 3.84$, $SD = .91$) reporting slightly higher than those who did not report as a first generation student ($M = 3.70$, $SD = .93$). Analysis of variance showed the effect of first generation student on hedonic motivation as significant, $F(1,983) = 9.69$, $p < .01$, with first generation students ($M = 3.70$, $SD = 1.07$) reporting higher than those who did not report as a first generation student ($M = 3.46$, $SD = 1.10$). Analysis of variance showed the effect of first generation student on behavioral intention as significant, $F(1,989) = 6.81$, $p < .01$, with first generation students ($M = 3.47$, $SD = 1.18$) reporting higher than those who did not report as a first generation student ($M = 3.25$, $SD = 1.20$). Analysis of variance showed the effect of first generation student on use behavior

as significant, $F(1,983) = 5.54$, $p < .05$, with first generation students ($M = 2.72$, $SD = 1.12$) reporting higher than those who did not report as a first generation student ($M = 2.55$, $SD = 1.08$). Analysis of variance showed the effect of first generation student as not significant with respect to effort expectancy, $F(1,1013) = .21$, $p <$ n.s.; social influence, $F(1,1002) = .35$, $p <$ n.s.; facilitating conditions, $F(1,996) = 2.45$, $p <$ n.s.; and price value, $F(1,983) = .98$, $p <$ n.s.

Table 20

Bivariate Analysis of Determinants relative to categories of First Generation Student

First Generation Student Categories		Performance Expectancy	Effort Expectancy	Social Influence	Facilitating Conditions	Hedonic Motivation	Price Value	Behavioral Intention	Use Behavior
No	*M*	3.70	4.12	3.23	4.16	3.46	3.55	3.25	2.55
	N	713	699	688	682	669	669	675	669
	SD	0.93	0.68	0.78	0.58	1.10	1.12	1.20	1.08
Yes	*M*	3.84	4.14	3.26	4.09	3.70	3.63	3.47	2.72
	N	316	316	316	316	316	316	316	316
	SD	0.91	0.72	0.81	0.66	1.07	1.10	1.18	1.12

Access was the fourth moderator analyzed. Table 21 provides bivariate analysis of determinants relative to categories of access. Access was determined by a yes response to the survey item, *I have regular access to a tablet*. Analysis of variance showed the effect of access on social influence as significant, $F(1,1002) = 25.44$, $p < .001$, where *yes* ($M = 3.26$, $SD = .81$) was slightly higher than *no* ($M = 3.23$, $SD = .78$). Analysis of variance showed the effect of access on price value as significant, $F(1,983) = 37.08$, $p < .001$, where *yes* ($M = 3.63$, $SD = 1.10$) was slightly higher than *no* ($M = 3.55$, $SD = 1.12$). Analysis of variance showed the effect of access on use behavior as significant, $F(1,983) = 456.89$, $p < .001$, where *yes* ($M = 2.72$, $SD = 1.12$) was higher than *no* ($M = 2.55$, $SD = 1.08$). Analysis of

variance showed the effect of access as not significant for performance expectancy, $F(1,1027) = 1.10$, $p <$ n.s.; effort expectancy, $F(1,1013) = .03$, $p <$ n.s.; facilitating conditions, $F(1,996) = 1.47$, $p <$ n.s.; hedonic motivation, $F(1,983) = 2.67$, $p <$ n.s.; and behavioral intention, $F(1,989) = 1.88$, $p <$ n.s..

Table 21

Bivariate Analysis of Determinants relative to categories of Access

Access Categories		Performance Expectancy	Effort Expectancy	Social Influence	Facilitating Conditions	Hedonic Motivation	Price Value	Behavioral Intention	Use Behavior
No	*M*	3.69	4.12	2.98	4.09	3.41	3.11	3.21	1.25
	N	213	199	188	182	169	169	175	169
	SD	.89	.67	.81	.64	1.13	1.20	1.24	.63
Yes	*M*	3.76	4.12	3.30	4.15	3.57	3.68	3.35	2.88
	N	816	816	816	816	816	816	816	816
	SD	.94	.70	.77	.60	1.09	1.07	1.18	.95

Efficacy was the fifth moderator analyzed. Table 22 provides bivariate analysis of determinants relative to categories of efficacy. Efficacy was determined by the response to the survey item, *If you encountered a challenge using a tablet, what is the level of help you would need to overcome the challenge?* Analysis of variance showed the effect of efficacy on performance expectancy as significant, $F(1,980) = 3.04$, $p < .05$, with the highest number of responses indicating *I would need someone available to help me by phone* ($M = 3.89$, $SD = .71$) and *I would need online help or training* ($M = 3.83$, $SD = .87$). Analysis of variance showed the effect of efficacy on effort expectancy as significant, $F(1,980) = 13.03$, $p < .001$, with the highest number of responses indicating *I could figure it out on my own* ($M = 4.23$, $SD = .65$) and *I would need someone available to help me by phone* ($M = 4.10$, $SD = .65$). Analysis of variance showed

the effect of efficacy on facilitating conditions as significant, $F(1,980) = 18.13$, $p < .001$, with the number of responses for *I could figure it out on my own* ($M = 4.26$, $SD = .55$) higher than the number of responses for *I would need someone available to help me face-to-face* ($M = 3.90$, $SD = .67$). Analysis of variance showed the effect of efficacy as not significant for social influence, $F(1,980) = 2.18$, $p <$ n.s.; hedonic motivation, $F(1,980) = 1.28$, $p <$ n.s.; price value, $F(1,980) = 1.47$, $p <$ n.s.; and behavioral intention, $F(1,980) = 2.35$, $p <$ n.s.

Table 22

Bivariate Analysis of Determinants relative to categories of Efficacy

Efficacy Categories		Performance Expectancy	Effort Expectancy	Social Influence	Facilitating Conditions	Hedonic Motivation	Price Value	Behavioral Intention	Use Behavior
I could figure it out on my own	*M*	3.78	4.23	3.21	4.26	3.56	3.53	3.33	2.52
	N	573	573	573	573	573	573	573	573
	SD	.95	.65	.81	.55	1.10	1.16	1.22	1.13
I would need online help or training	*M*	3.83	4.18	3.33	4.06	3.60	3.74	3.44	2.58
	N	121	121	121	121	121	121	121	121
	SD	.87	.61	.73	.62	1.05	1.01	1.22	1.10
Do not know	*M*	3.44	3.78	3.17	3.84	3.27	3.40	3.16	2.56
	N	45	45	45	45	45	45	45	45
	SD	.85	.70	.74	.57	1.16	1.10	1.14	.89
I would need someone available to help me by phone	*M*	3.89	4.10	3.51	4.04	3.69	3.73	3.66	3.12
	N	51	51	51	51	51	51	51	51
	SD	.71	.65	.72	.48	.99	.94	.99	1.11
I would need someone available to help me face-to-face	*M*	3.61	3.87	3.21	3.90	3.47	3.63	3.17	2.73
	N	195	195	195	195	195	195	195	195
	SD	.93	.80	.79	.67	1.10	1.06	1.15	1.01

Experience was the sixth moderator analyzed. Table 23 provides bivariate analysis of determinants relative to categories of experience. Experience was determined by the response to the survey item, *Before I came to the university, I*

regularly used a computer or a tablet to do classwork in high school or at my previous college. Analysis of variance showed the effect of experience on facilitating conditions as significant, $F(1,983) = 12.21$, $p < .001$, with the highest response indicating Strongly Agree ($M = 4.33$, $SD = .57$) and the lowest indicating Disagree ($M = 3.97$, $SD = .67$). Analysis of variance showed the effect of experience as not significant for performance expectancy, $F(1,983) = 1.64$, $p <$ n.s.; effort expectancy, $F(1,983) = 1.86$, $p <$ n.s.; social influence, $F(1,983) = 1.49$, $p <$ n.s.; hedonic motivation, $F(1,980) = 1.10$, $p <$ n.s.; price value, $F(1,980) = 1.37$, $p <$ n.s.; behavioral intention, $F(1,983) = 1.42$, $p <$ n.s.; and use behavior, $F(1,980) = 1.78$, $p <$ n.s.

Table 23

Bivariate Analysis of Determinants relative to categories of Experience

Experience Categories		Performance Expectancy	Effort Expectancy	Social Influence	Facilitating Conditions	Hedonic Motivation	Price Value	Behavioral Intention	Use Behavior
Strongly Disagree	*M*	3.52	4.03	3.17	4.07	3.50	3.62	3.22	2.59
	N	101	101	101	101	101	101	101	101
	SD	1.13	.83	.88	.64	1.31	1.17	1.30	1.10
Disagree	*M*	3.75	4.09	3.20	3.97	3.46	3.46	3.19	2.49
	N	251	251	251	251	250	250	251	250
	SD	.83	.69	.72	.67	1.06	1.02	1.07	.96
Do not know	*M*	3.75	4.00	3.69	4.03	3.38	3.38	3.44	3.17
	N	8	8	8	8	8	8	8	8
	SD	.90	.64	.72	.71	1.30	1.06	.90	1.17
Agree	*M*	3.77	4.11	3.23	4.13	3.53	3.57	3.36	2.60
	N	364	364	364	364	363	363	364	363
	SD	.88	.65	.71	.53	.99	1.06	1.17	1.05
Strongly Agree	*M*	3.78	4.21	3.30	4.33	3.65	3.68	3.42	2.71
	N	264	264	264	264	263	263	264	263
	SD	.99	.70	.91	.57	1.16	1.24	1.29	1.25

Regression analysis showed that a significant proportion of the variance in the determinant's variance was explained by the demographic constructs. For performance expectancy, other gender students had an inverse effect and Hispanic students a co-linear effect. For effort expectancy, other gender students, Asian students, and efficacy had an inverse effect while Hispanic students had a co-linear effect. For social influence, other gender students had an inverse effect while access and experience had a co-linear effect. For facilitating conditions, efficacy had an inverse effect while male students had a co-linear effect. For hedonic motivation, other gender students had an inverse effect while Hispanic students and those who reported experience had a co-linear effect. For price value, other gender students had an inverse effect while Hispanic students, reported experience, and reported access had a co-linear effect.

In addition, there was a significant effect upon the determinants by specific categories within the demographic constructs. Analysis of variance showed Hispanic students reporting higher performance expectancy, effort expectancy, social influence, hedonic motivation, price value and behavioral intention than White students. Other gender students reported lower than their peers on performance expectancy, effort expectancy, social influence, hedonic motivation, and use behavior while male students reported higher than their peers on facilitating conditions. First generation students reported higher than their peers on performance expectancy and use behavior while lower than their peers on hedonic motivation.

Findings for Research Question 3

Is there a difference over time among each demographic construct (socioeconomic status, race/ethnicity, and gender) on the determinants (performance expectancy, effort expectancy, social influence, facilitating

conditions, hedonic motivation, and price value) for student behavioral intention and use behavior regarding tablet technology use for academic purposes? Student ID numbers were used to match survey responses from phase 1 with survey responses from phase 2, which generated 137 matches (n=137). Analysis included paired t-tests to determine if there was variance at a significant level within the determinants between phase 1 and phase 2. The difference in each variable's means for phase 1 and phase 2 were computed. And lastly, regression analysis was used to determine if there was a significant effect upon the variance in behavioral intention and use behavior based upon the variance in the determinants and moderators.

Results of the paired t-tests are depicted in Table 24. Each of the paired values showed a significant positive correlation. However, only pair 1 (performance expectancy) and pair 4 (facilitating conditions) showed a difference at a significant level between phase 1 and phase 2. The paired samples t-test for performance expectancy revealed a negative correlation between the mean response within the cohort for phase 1 (M= 3.96, SD = .90) with those reported in in phase 2 (M = 3.79, SD = .95); $t(136) = -2.32$, $p < .05$. The results showed that performance expectancy decreased between phase 1 and phase 2. The paired samples t-test for facilitating conditions revealed a positive correlation between the mean response within the cohort for phase 1 (M= 4.19, SD = .62) with those reported in phase 2 (M = 4.29, SD = .53); $t(136) = 2.17$, $p < .05$. The results showed that facilitating conditions increased slightly between phase 1 and phase 2.

Next, regression analysis was performed for each pair to determine if the moderators (first generation student, race/ethnicity, gender, efficacy, experience, and access) had an effect on the variance in determinants over time. The moderators did not predict at a significant level the variance between phase 1

Table 24

Results from Paired T-Tests of Determinants between Phase 1 and Phase 2

	Phase 1		Phase 2		Correlation	Paired Sample Test	
Variable	*M*	*SD*	*M*	*SD*	*β*	*M*	*SD*
Performance Expectancy	3.959	.897	3.791	.951	.581***	.072	.847*
Effort Expectancy	4.204	.711	4.281	.688	.632***	.051	.600
Social Influence	3.312	.817	3.312	.807	.613***	.061	.715
Facilitating Conditions	4.192	.619	4.288	.533	.599***	.045	.522*
Hedonic Motivation	3.672	1.125	3.788	1.081	.674***	.076	.892
Price Value	3.745	1.085	3.635	1.162	.439***	.102	1.192
Behavioral Intention	3.423	1.241	3.416	1.300	.514***	.107	1.253
Use Behavior	2.662	1.057	2.742	1.132	.652***	.0782	.9151

Note. N = 137; * p < .05; ** p < .01; *** p < .001

and phase 2 for performance expectancy (R^2 = .08, F(9,127) = 1.182, p = n.s.), effort expectancy (R^2 = .06, F(9,127) = .87, p = n.s.), social influence (R^2 = .05, F(9,127) = .80, p = n.s.), facilitating condition (R^2 = .11, F(9,127) = 1.73, p = n.s.), hedonic motivation (R^2 = .06, F(9,127) = .90, p = n.s.), and price value (R^2 = .07, F(9,127) = 1.05, p = n.s.).

The demographic constructs and the change in determinants (difference in means between phase 2 and phase 1) were included in a regression analysis with change in behavioral intention (difference in means between phase 2 and 1) as the dependent variable. Table 25 depicts the coefficients for behavioral intention. The model with the six determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) accounted for 18% of the variance in behavioral intention over time, R^2 = .18, F(7,129) = 4.60, p < 001. The regression model that included the six determinants

and the three demographic constructs (socioeconomic status indicated by first generation student, race/ethnicity, gender) predicted 20% of the variance in behavioral intention over time, $R^2 = .20$, $F(12,124) = 2.63$, $p < 01$. The regression model that included the six determinants and three demographic constructs with the addition of the construct, *access,* predicted 24% of the variance in behavioral intention over time, $R^2 = .24$, $F(13,123) = 2.90$, $p < .01$, and also predicted a change in behavioral intention at a significant level for hedonic motivation and access.

Table 25

Coefficients for Behavioral Intention

Variable	*B*	*β**	*t*
Performance Expectancy	.077	.052	.505
Effort Expectancy	.309	.148	1.339
Social Influence	.003	.002	.018
Facilitating Conditions	.142	.059	.704
Hedonic Motivation	.337	.240	2.531*
Price Value	.076	.072	.833
Male students	-.265	-.104	-1.220
Other gender students	-.207	-.020	-.245
Not First Generation Student	-.228	-.085	-.932
Hispanic students	-.067	-.026	-.250
Asian students	-.405	-.127	-1.331
Other race students	-.161	-.041	-.445
Access	-.686	-.186	-2.284*

Note. * p < .05; ** p < .01; *** p < .001

The demographic constructs and access along with the change in determinants and behavioral intention (difference in means between phase 2 and 1) were included in a regression analysis with change in use behavior (difference in means between phase 2 and 1) as the dependent variable. Table 26 depicts the coefficients for use behavior. The model with the six determinants accounted for

22% of the variance in use behavior over time, $R^2 = .22$, $F(67,129) = 5.26$, $p < .001$. The model that included the determinants with the addition of the demographic constructs predicted 25% of the variance in use behavior over time, $R^2 = .25$, $F(13,123) = 3.11$, $p < 01$. Additionally, the model that included the six determinants, three demographic constructs, and the variable *access* explained 25% of the variance in use behavior, $R^2 = .25$, $F(14,122) = 2.92$, $p < .01$. This model also predicted a change in use behavior with a significant positive correlation for behavioral intention and hedonic motivation.

Table 26

Coefficients for Use Behavior

Variable	*B*	*β**	*T*
Behavioral Intention	.203	.278	3.100**
Performance Expectancy	.076	.071	.690
Effort Expectancy	-.144	-.095	-.857
Social Influence	-.001	-.001	-.006
Facilitating Conditions	.029	.016	.197
Hedonic Motivation	.209	.203	2.104*
Price Value	.125	.163	1.879
Male students	-.125	-.067	-.786
Other gender students	.352	.046	.574
Not First Generation Student	.144	.074	.808
Hispanic students	-.158	-.086	-.814
Asian students	-.047	-.020	-.209
Other race students	.124	.044	.471
Access	-.171	-.063	-.768

Note. * p < .05; ** p < .01; *** p < .001

Analysis revealed that differences over time did occur among the determinants. However, only performance expectancy and facilitating conditions showed a significant difference between phase 2 and phase 1 with a decrease in performance expectancy and an increase in facilitating conditions. Results revealed that the moderators did not predict a significant effect on the determinants over time. The regression model, which included the determinants, demographic constructs, and access, predicted 24% of the change in behavioral intention with both hedonic motivation and access revealing significant coefficients. The regression model, which included the determinants, behavioral intention, and demographic constructs, predicted 25% of the change in use behavior with both behavioral intention and hedonic motivation revealing significant coefficients.

Qualitative Analysis – Thematic Findings

The qualitative data included the artifacts, transcripts, and interactions with participants from the focus group and photo diary interviews. This data provided the inputs for the response to research questions 4 and 5 which explored the facilitating conditions and associated meanings and performance conditions and associated meanings related to the acceptance and use of tablet technology relative to the demographic constructs of socioeconomic status and race/ethnicity.

Participant Demographics

Table 27 depicts the demographic constructs for focus group participants. There were four first generation students in focus group 1 and none in focus group 2. For race/ethnicity, there were six participants who reported as Hispanic, six who reported as White, and two who reported as Hispanic and White. For gender, ten students reported female and four reported male.

Table 27

Demographic Constructs for Focus Group Participants

Group	Pseudonym	Role	First Generation Student	Ethnicity	Gender
Focus Group 1					
	Braden	Student	No	White	Male
	Diego	Student	Yes	Hispanic	Male
	Edna	Student	Yes	Hispanic	Female
	Hannah	Student	Yes	White	Female
	Imani	Student	No	Hispanic & White	Female
	Juanita	Student	Yes	Hispanic	Female
Focus Group 2					
	Angela	Student	No	Hispanic	Female
	Carmelo	Student	No	Hispanic	Male
	Evelyn	Student	No	Hispanic & White	Female
	Justina	Student	No	Hispanic	Female
	Shauna	Student	No	White	Female
	Trevor	Student	No	White	Male
Focus Group 3					
	Pat	Teacher Assistant	NA	White	Female
	Grace	Teacher Assistant	NA	White	Female

Table 28 depicts the demographic constructs for photo diary participants. There were two first generation students and nine who did not report as a first generation student. For race/ethnicity, there were five participants who reported as Hispanic, three who reported as White, and three who reported as Hispanic and White. For gender, four students reported female, six reported male, and one reported as *prefer not to answer*.

Table 28

Demographic Constructs for Photo Diary Participants

Pseudonym	Role	First Generation Student	Ethnicity	Gender
Angela	Student	No	Hispanic	Female
Antonio	Student	No	Hispanic	Male
Brooke	Student	No	Hispanic & White	Prefer Not to Answer
Braden	Student	No	White	Male
Chandler	Student	No	White	Male
Carlos	Student	No	Hispanic & White	Male
Evelyn	Student	No	Hispanic & White	Female
Jeanette	Student	No	Hispanic	Female
Javier	Student	Yes	Hispanic	Male
Jorge	Student	Yes	Hispanic	Male
Lily	Student	No	White	Female

Thematic Analysis

The transcripts and photo diary artifacts were read independent of each other to better understand the persons and their contexts. Next, the excerpts were grouped by code and examined across demographic moderators (first generation student, race/ethnicity, and gender) to answer research questions 4 and 5. The research team met to review these initial findings and discuss potential themes. Subsequently, the researcher examined each of the transcripts separately while being mindful of the participant and contexts. Thematic findings emerged from this reading and were discussed on numerous occasions with colleagues from the research team. These themes included *situatedness* of technology, new ways of practice, choice continuum and resourcefulness, naturally occurring segments, levels of responsiveness to students' brought-technology, expertise across social networks, and meaningful experience matters. The researcher examined these themes by reading the set of artifacts for the first generation student and

race/ethnicity segments. Lastly, the researcher examined the valence of the thematic findings across the participants to confirm the validity of these themes. Table 29 shows the valence by participant for each theme where a valence of 5 shows the theme appears heavily resonant and a valence of 3 shows the theme appears resonant. As qualitative data, this valence by theme matrix represents the presence and weight of a theme within the artifacts provided by the participants. The next step in the hermeneutic process is the interpretive presentation of the participant's experience.

Table 29

Valence of Themes across Photo Diary and Focus Group Participants

Sample	Pseudonym	*Situatedness* of Technology	New Ways of Practice	Choice Continuum and Resourcefulness	Naturally Occurring Segments	Responsiveness to Student's Brought-Technology	Expertise across Social Networks	Meaningful Experience Matters
FG1		5	3	3		5	5	3
FG2		5	3	3	3	3	5	5
FG3		5		5	3	5	3	3
PD	Angela	5	5	5	5		3	3
PD	Antonio	5	3	3	5	5	5	5
PD	Brooke		3	3	5		3	3
PD	Braden	5	5	3	5	5	5	5
PD	Chandler	5	3	5	5	5	5	5
PD	Carlos	5	3	3	3		5	5
PD	Evelyn	3	3	3	5	3	3	3
PD	Jeanette	5	5	3	3		3	3
PD	Javier	5	3	5	5	3	5	5
PD	Jorge	5	3	5	5	5	5	5
PD	Lily	5	5	5	5	5	5	5

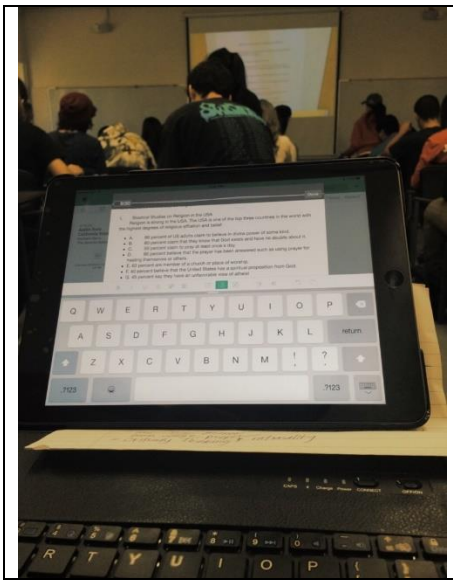
Theme 1: Situatedness of Technology

The meaning of a technology emerges from interactions within the aspects of its *situatedness*. The participants' interactions occurred within the nexus of work (e.g., note taking, reading, writing), learning context (e.g., curriculum, content, and learning experiences), persons (e.g., peers, teachers, parents), and place (e.g., class, school, home), as well as the student's assemblage of available technologies (e.g., devices, apps, connectivity).

Tablet technology is not an abstract notion defined in isolation. Rather its meaning is negotiated within a specific *context.* The same laptop computer in the 1990s would likely have been experienced differently in downtown San Francisco than it would have been experienced in a rural village in the Congo where electricity was unreliable and people did not value such technology (B. Burkholder, personal communication, 1993). This *situatedness* includes all of the participants' relevant interactions within everyday use. Similarly, students' meaning for a technology appears to emerge from the interactions within everyday use, which includes the work, learning context, people, and place as well as the student's assemblage of available technologies.

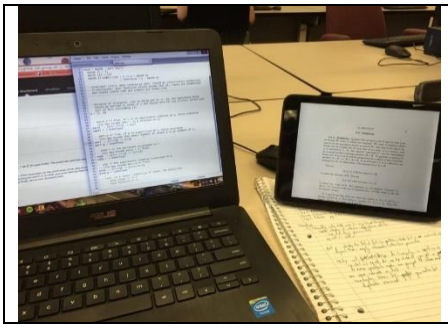
Sub-theme 1-1: Situated within work. The occurrence of ICT functions, within photo diaries and focus groups, were analyzed using five etic codes, which when ranked by code co-occurrence with 'tablet' from highest to lowest, results revealed value consumption, value production, access, collaboration, and entertainment. Photo diary interviews highlighted the value of tablets for searching, retrieval (e.g., 'download'), storage (e.g., 'instantly available'), reading (e.g., 'e-book'), and annotation. The conversation with the two teaching assistants in focus group 3 identified the value of tablets within the academic context as collaboration, search, and readily available content.

The photos from the photo diary ground participant assertions about the value of tablet use within their actual in-context use. Student participants mostly indicated tablets as effective for note taking and annotating. Figure 8 shows Jorge taking notes with his tablet in his sociology class. Note taking with a tablet did not appear to work as well for students in science, technology, engineering or mathematics disciplines. Chandler, for example, expressed that "pencil and paper" was his preferred device for note taking in engineering expressing, "it is hard to enter formulas and do lab reports on the tablet." Lily's photo, depicted in Figure 9, shows use of laptop, tablet and paper in her computer science lab.



I usually take notes on my tablet for my sociology class. It's easy to use and helpful because I can also record the lecture or listen to it again for another time in case I missed something.
(dscout snippet accompanying photo)

Figure 8. Photo and snippet of Jorge taking notes in sociology class



I was in computer science lab using my iPad to pull up a text online to help me out with the lab.
(dscout snippet accompanying photo)

Figure 9. Photo and snippet of Lily in computer science lab

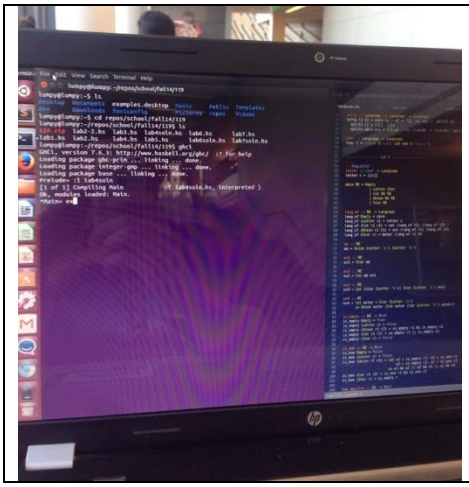
Student participants indicated that tablets were less effective tools than laptops or desktops for writing essays or long papers. Evelyn said, "It's harder to write essays on the tablet so I use my laptop for writing essays" and Javier stated, "Some homework is difficult to do on an iPad like typing in an essay."

The photo diary and focus group interviews indicated that no one device; whether desktop, laptop, or tablet met the students' needs to accomplish all of their academic work; however, each device could help the student accomplish a portion of their academic work.

Sub-theme 1-2: Situated within learning context. The meaning associated with a technology for academic purposes is situated, naturally, within the learning context. The learning context includes discipline, curriculum, content, and instruction. Students' interactions between these aspects in relation to their technology affected the meaning they ascribed to tablets for academic use.

Participants responded positively to faculty who meaningfully integrated technology into their instruction and responded well to instruction where mobile, media, and collaborative capabilities of newer technology were used. Focus group participants, Carmello and Trevor, expressed, "we use Google docs in class and believe the use of Google Docs has made it easier for students to learn." However, student participants from the STEM disciplines (science, technology, engineering and math) expressed challenges using tablets within these subjects. Braden noted as illustrated in Figure 10, "for advanced software, a laptop is the only option for completing necessary schoolwork, such as programming assignments." Chandler explained the same challenge, "It is hard to enter formulas and do lab reports on the tablet so I do these on my laptop … engineering applications on the laptop cannot run on a tablet." In responding to an inquiry as to whether there is an expectation to use a tablet for school, Lily stated, "No,

especially in computer science where I need the computing power of an actual computer to do things like running 'code'." Carlos expressed, "most programs in mechanical engineering use Windows computers due to certain software titles." Javier explained that he takes both "laptop and tablet [to class]. Some homework is more suitable to the laptop like MyMathLab."



At the moment, I am working on some homework for a computer science class at the school library. Due to the demand of having to program using complex software that is not offered on tablets, I still have to bring my laptop to school most days. Since there is nothing I can do on my tablet that I can't do on my laptop (besides occasional note taking), I tend to leave my tablet at home a lot.
(dscout snippet accompanying photo)

Figure 10. Photo and snippet of Braden working on computer science on laptop; leaves tablet at home

Sub-theme 1-3: Situated between persons. The meaning associated with a technology for academic purposes is situated between persons. This may be a product of the network effect of crowd-based, always-connected web apps/applications. Regardless, it shows up as social 'glue' whether intentionally initiated through persons within the group including faculty or whether it is enabled through practices that support such social connections. This affective experience from collaboration appeared often enough that the research team added an additional ICT function code termed COLX for collaboration.

A critical agent within the learning context is faculty. Student participants spoke about teachers who were not "tech-savvy." Trevor professed, "I would rather have not taken the class because I believe a lot of professors are not tech-

savvy." Carmello, agreeing with Trevor, purported, "professors have difficulties working with technology" and Antonio stated, "professors need to be more competent in using technology." Shauna, focus group 2 participant, expressed, "my experience so far has not been the best as a result of technical difficulties experienced in the classroom." Evelyn, studying to become a teacher, asserted that there are "bad teaching skills with some professors not knowing how to use technology ... throwing technology at everything is bad teaching … teachers need to know … when not to use technology."

Students spoke about faculty who effectively integrated technology in curriculum and instruction. Evelyn, with a sense of excitement in her voice, exclaimed, "Professor B. makes technology fun because he's so well versed [in how to use and where to use technology]." Jorge, a first generation student, stated "I was surprised to learn we get a tablet with this class … the use of the tablet was an interesting, new way of learning, and I really liked it." This was Jorge's first time owning or using a tablet. Jorge's parents did not use computers at work and he "forced them [parents] to buy me a computer" when he was growing up.

Sub-theme 1-4: Situated within place. Several students also referenced place as part of this learning context and how aspects of place like small desks in classrooms did not accommodate their technology use. Chandler noted that desks in classes are "tiny and can't even fit a piece of paper," given that "it does not work well for laptops – I put my tablet on my lap." Student participants indicated wireless Internet and charging stations as important aspects of place. Angela, a commuter, expressed her concerns about charging, "I did not want to go home in between classes so I am getting work done in the library. I was scared about keeping my device charged, especially since I live far away from campus"

Sub-theme 1-5: Situated within students' assemblage of technologies. ICT underwent a shift in the 1980s where computing went from many persons with a single, shared compute device (e.g., mainframe) to a person using a single compute device with a word processor. The shift continues into the current context where persons have a varying number of personal computer devices with applications local to these devices that share information and interactions with many users through cloud-based services. A person's set of technologies includes her compute devices, the devices' connectivity services, her local applications, and her cloud-based services. This set of personal technologies is herein termed the students' assemblage of technologies. A technology within this assemblage has important attributes like quality, functional capabilities, and an asset life cycle or remaining useful life. For example, Dell's business-line laptops may have a longer mean-time-to-failure and may be more durable than Dell's consumer-line laptops (C. Garnder, Dell, personal communication, January, 2011). The meaning of a given technology for a student emerges from this assemblage of technologies and the technologies' attributes.

The photo diary and focus group interview findings revealed that first generation student participants tended to have fewer personal technologies with lower quality, fewer functional capabilities, and shorter mean-time-to-failure or remaining useful life. As first generation students, Jorge, Javier, and Daniel exhibited a characteristically different assemblage of technologies than those who were not first generation students. Jorge shares his laptop with his younger brother. Javier's sister's laptop is shared with their parents. Daniel did not have a laptop or a tablet until he purchased tablet for a university class participating in the initiative.

Findings also revealed student participants who were not first generation students and, based upon the quality and age of their assemblage of technologies, appeared to come from socioeconomic conditions less than upper middle class. These students' assemblage of technologies included devices that were aged and less functional using terms like "ancient laptop" or "so big and heats up." Evelyn, for example, only had one desktop computer at home when she was growing up and "everyone used it."

In contrast, student participants who were not first generation students and, based upon the quality and age of their assemblage of technologies appeared to come from an upper middle class socioeconomic condition, seemed to have a larger and more current assemblage of technologies. When asked, *What other devices did you have in your household*? Carlos mentioned a laptop ("now a dinosaur"), a desktop all-in-one, an old computer from the 7th grade, the tablet purchased for his class, and then just three days prior to the interview he had purchased another laptop. During the interview, Chandler disclosed that his assemblage of technologies included a five-year old laptop, which was operating slower so he purchased another laptop as well as a tablet this past year. When asked about his inventory of technology devices at home, Braden mentioned several laptops, desktops, tablets, and "about 15 TVs."

Theme 2: New Ways of Practice

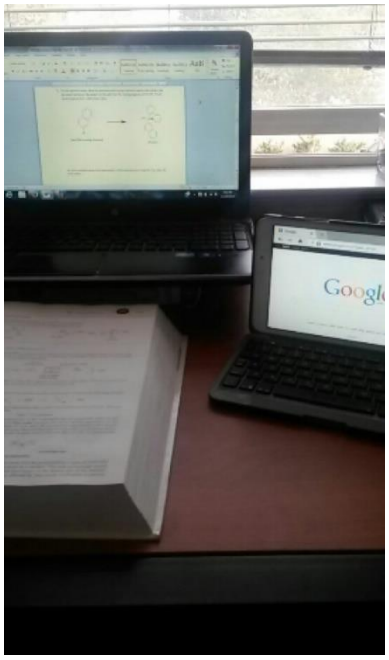
Participants exhibited new and distinctive ways of working with technology for academic purposes. These ways of working appear to be facilitated by mobile technology. Mobile technology, as connected and convenient, allows for the students' practice to leverage this nearly-always-constantly-connected state. Students reflected on expectations of instantaneous use as well as changes in physical posture relative to the compute device and place. Local storage and cloud-

based services provided new ways of working beyond device or place, which appeared to allow for asynchronous and real-time collaborative work by students. These new ways of working or *practice* were especially apparent in the recurring pattern of multiple concurrent workspaces for concurrent use. These new ways of work also appeared in the juxtaposition of place, physical posture, and device. Lastly, these practices showed up in collaborative work between students.

***Sub-theme 2-1: Multiple concurrent workspaces*.** Most student participants mentioned some form of concurrent use of devices. One of Jeanette's photos contained the snippet, "I am using my iPad to listen to a podcast that will help me finish up my essay." One of Javier's dscout pictures shows an Apple laptop with myMathLab running next to an iPad tablet with a sketch of equations. Javier is watching a film on his tablet while taking notes on his paper and then writes up the notes on the laptop. Jeanette explained that once she had used her tablet more often, she realized, "I could use my laptop and tablet simultaneously to write notes while watching a video." Evelyn, in one of her dscout photos depicted in Figure 11, is using her tablet for reading and her laptop to check the syllabus for the assignment. She complained during the interview, "with this [tablet] I can only look at one thing at one time ... and that's what I find annoying … [I find that] it's easier to look at one thing while I'm looking at something else." Brooke in a photo diary entry notes, "I am doing my homework for my Chemistry lab class on my laptop while I have Google open on my tablet." Brooke expressed as illustrated in Figure 12, "I couldn't get separate screens on my tablet so I used my computer to show my homework." Braden noted that "size wise a tablet is definitely better, but a laptop is what I prefer for tasks that require a split screen or the viewing of several things at once." Angela chose a Surface hybrid device because she wanted a split screen where she could "look at two applications at once."

At home reading and writing a paper for class. (dscout snippet accompanying photo)

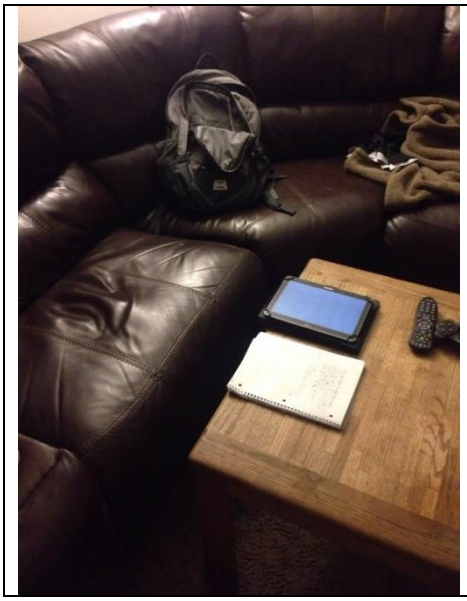
Figure 11. Photo and snippet of Evelyn reading and writing a paper



I couldn't get separate screens on my tablet so I used my computer to show my homework. From the desk in my room I often get my work done. (dscout snippet accompanying photo)

Figure 12. Photo and snippet of Brooke separate screens using tablet and computer

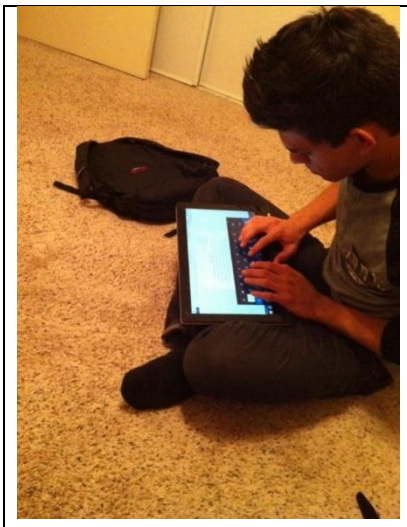
Sub-theme 2-2: Place and physical posture. New ways of practice also emerged as a theme within the interactions between student, place, physical posture, and device. The computer has left the desk and with it the person interacting with technology in a new place with different physical postures. Lily explained that she likes having e-textbooks on her laptop but prefers to read them on her tablet where she can have the "screen available beyond my actual desk." Angela stated that she watches educational videos lying on her bed. Braden, as illustrated in Figure 13, documents that he sits on the coach in his living room doing assignments.



During this time, I was taking notes from the resources given to us by the professor. A lot of the time when I am doing assignments or taking notes, I sit on the couch in the living room of my apartment. At this moment, my tablet was very useful because I was using it for reading a PDF, and in this workspace was much easier to use compared to my laptop.
(dscout snippet accompanying photo)

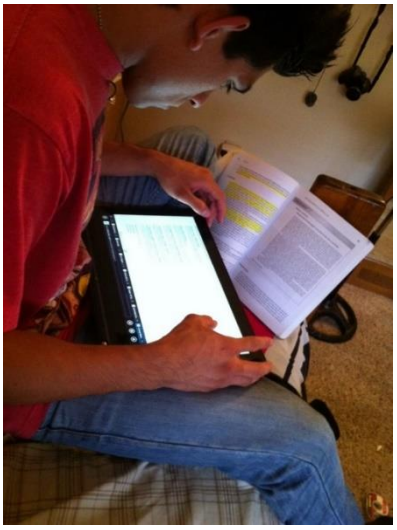
Figure 13. Photo and snippet of Braden sitting on coach doing assignments

Student participants mentioned the use of couches, tables, and floors to study. Antonio, as illustrated in Figures 14 and 15, moves interaction with his technology beyond the desk, where his interactions with technology take on new meaning.



I was working on my homework for English. the only trouble I had was using my touch screen keyboard, it seems to slow when I have to type. it's a lot harder than using a a regular keyboard because I feel like I have to keep looking down to make sure I'm hitting the right letter.
(dscout snippet accompanying photo)

Figure 14. Photo and snippet of Antonio working on floor



I was reviewing my criminal law book for my criminology class. I was in my room on my bed. felt more comfortable to do it there. my only problem was that my tablet was loading slow.
(dscout snippet accompanying photo)

Figure 15. Photo and snippet of Antonio working on bed

Sub-theme 2-3: Power of collaboration. Collaboration is more than just working together to get the job done. Students are shaping the meaning associated with digitally-enhanced interactions, where this meaning is more than synergistic accomplishment of task, group chemistry, or neurological affect. Braden spoke about the "new way of running a class, especially with the collaborations methods you can do from home [pause] it's easier and makes the class more … *more*

involving with the students [emphasis added]." Justine, Focus Group 2 participant, excitedly talked about how she is into the whole "file sharing thing" as if this were more than just a tool for sharing documents online with others. When asked, What one thing made the tablet good? Antonio, photo diary participant, summed up the power of collaboration as he responded thoughtfully and with excitement, "It seems a little bit more fun. It seems like I'm more engaged [hesitates] we're all just getting along, it's [pause] *becoming a class* [emphasis added]."

Theme 3: Choice Continuum and Resourcefulness

A choice continuum appears to exist, from none to much, in which student participants responded differently. This choice appears to be more than a socioeconomic condition and more like the habitus of social capital. First generation students appear to have less choice with both a dependence on social and institutional systems as well as learned resourcefulness. This learned resourcefulness shows up in better use of available resources as well as the ability to leverage resources available through social and institutional systems. Student participants from higher socioeconomic status appear less dependent on social and institutional systems with an inclination to change their condition where it serves them.

The researcher initially made some distinctions about devices and their use by student participants who were not from a low socioeconomic condition, and these distinctions indicated more particular technical expertise. However, upon further analysis and subsequent reading of the photo and interview transcriptions, the researcher disavowed this initial interpretation. Javier, a first generation student who did not have experience with the iPad2 prior to the semester, made distinctions about technology when he expressed that "getting into the tablet course is like oh wow my first time and so there are some pros and cons." Jorge,

also a first generation student, stated, "I saw other students using their laptops in classes and decided to use my tablet in other classes also." Jorge understood that the tablet was not a laptop and that he did not have the resources to purchase a lightweight laptop or the new hybrids, but instead figured out how to make the tablet work for him. Subsequent dialogue with professionals familiar with the sociology of class (S. Harvey, personal communication, March, 2014; V. Harris, personal communication, November, 2014) influenced framing this theme under the rubrics of choice and resourcefulness.

Sub-theme 3-1: More dependence and resulting resourcefulness. First generation student participants exhibited more dependence on social and institutional systems in their attitude towards the university's tablet initiative and technology support services than those participants who were not first generation students. Photo diary entries and interviews as well as the focus group interview findings revealed that first generation students demonstrated resourcefulness in relation to technology and support services. Participants displayed inventiveness in their use of the available technology. Jorge, whose parents' jobs involved manual labor, professed, "I forced them [parents] to buy me a computer." Jorge also explained that he made use of an afterschool program to gain experience with computers. During the interview, Javier, mentioned using an online service for his personal college application statements so he could pull them at a moment's notice to review with his advisors. First generation participating students did not complain about the challenge of task switching using the home button on the iPad as did other participating students. Instead, they figured out how to make task switching work.

First generation students' resourcefulness also showed up as sharing of technology assets. Jorge mentioned sharing his older laptop with his brother.

Javier's parents used his sister's laptop. Even those who appeared to be middle class students, based upon their assemblages of technologies, found ways to stretch resources. Antonio's family shared a desktop computer. Evelyn's family had one computer when growing up that "everyone used," and before Lily attended college, her family shared a tablet.

Dependence on institutional services and the resourcefulness to use these services emerged from the data and appeared to be connected with socioeconomic status. First generation participating students had used the university's technical support services and planned to use them again. Javier recalled, "I had a problem early in the semester when the tablet kicked me out of Google Drive and Blackboard. I went to the Hub [university's support service] on campus and they were able to fix my problem…" When asked how he would solve the wireless printing challenge that he expressed during the interview, Javier stated, "I will probably go to the Hub [university's support service on campus]."

Sub-theme 3-2: Less dependence and resulting choice. Participants in this study shared several examples of less dependence and resulting choice. Some student participants who appeared to not be from lower socioeconomic conditions tended to see the university's technical support services as less critical to their success and in some cases viewed these services with poor regard. Shauna professed that she does "not trust the institution and would be unwilling to contact the university for help … half the time people here don't know what they're talking about or are afraid they are going to mess up my stuff."

When the tablet seemed inadequate to perform the ICT functions required for academic use, student participants with better socioeconomic circumstances chose to purchase a new laptop or hybrid device. Chandler purchased a laptop to replace his five-year old laptop after using the tablet for three months. When

asked if there was a difference in how students from varying socioeconomic circumstances handled difficulty with tablets, Grace, a teaching assistant, stated, "Yes, absolutely, my wealthier students stopped bringing their tablet to class and started bringing their laptop and had a laptop to bring."

Focus group 3 participants explained that after they initially used the tablet and realized that it was no longer sufficient for academic work, the students who could afford to do so purchased laptops. Pat, a teaching assistant, noted, "About half-way through the semester students were bringing laptops. [Grace:] Same with my sections. The students who have laptops were bringing laptops and most of these were from a wealthier background."

Theme 4: Naturally Occurring Segments

This study focused on three demographic constructs to ascertain differences among these constructs relative to the determinants for acceptance and use of technology. However, there are other segments that occur naturally and have their own associated meanings pertaining to the use of tablet technology.

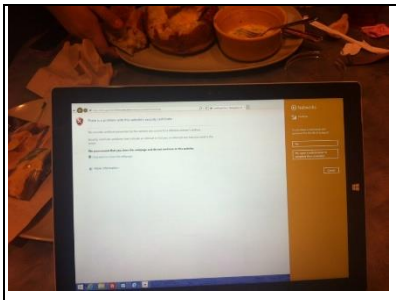
First, differences existed within the demographic constructs. First generation student participants in the photo diary and focus group interviews were primarily Hispanic. Socioeconomic status showed up as an economic continuum where students, who were not first generation students, could not afford an additional technology device. Angela explained that she was "interested in a [tablet] course but saw the requirement to purchase a tablet. I did not have that much money then but could not afford the cost of the 2-year Internet commitment. So I got out of the [tablet] class." Participants' previous experience with technology varied. Hispanic students, who appeared to be middle class based upon their assemblage of technologies rather than working class, exhibited some of the same proclivity to choice and less dependence on the institution than their

non-Hispanic colleagues. Gender did not appear to create distinctions in use among photo diary and focus group participants.

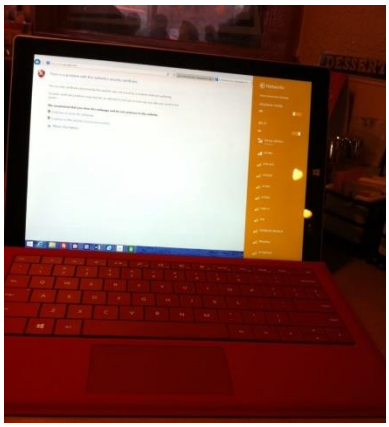
Secondly, differences in the requirement for and availability of connectivity existed among the participants. Students who commuted were often in search of places where they could get wireless access. Angela, a commuter, as illustrated in Figure 16, shared her Surface hybrid device with her friend who also commutes. Participating students who traveled for athletic events found a data plan valuable. Carmello noted, "the data plan is important to me because Internet is important to me when I'm travelling as part of the bowling team. … The lack of data connection is not a problem at school or home but it is a challenge when I'm traveling." Antonio, Hispanic and not a first generation student, noted that "the Yoga does not work for online research at home because it does not have a built-in Internet connection" and, therefore, found the tablet helpful "for looking up stuff online." However, there were student participants who found the cost of a data plan unwarranted. Trevor stated that he liked that it came with broadband for the 1 year (if purchased through the school).

> I found it useful because I was able to access notes and school work through Blackboard when I didn't have Wi-Fi and in these cases I would not be able to use my laptop. I will not continue though after the first year because it is fairly costly.

Thirdly, differences existed based upon disability. At least two student participants in the study experienced accessibility challenges. One female student participating in the survey portion of the study was partially blind, and for her the survey with a user interface that was responsive to her chosen device was helpful as was the ability to complete the survey after class. Another student, participant in both the survey and photo diary interviews, found the lightweight aspect of the tablet and its capability of storing electronic versions of books as very important.



at Panera – seeking Wifi
(dscout snippet accompanying photo)



No wifi at Denny's. It says limited so it connected but not really. It asked if I had a password so I said no and went to the other option of going to a website to sign in. Did not go to the website. Can do hoe work that needs Internet.
(dscout snippet accompanying photo)

Figure 16. Photo and snippet of Angela seeking Wifi access

Evidence indicated that the associated meaning for a technology may also be situated within a student's abilities and limitations.

Theme 5: Levels of Responsiveness to Students' Brought-Technology

Participant interview findings revealed differences in the level of faculty and university responsiveness to students' brought-device(s). One end of the responsiveness continuum was highly restrictive, limiting which technology devices were allowed for use in class, while the other end of the continuum was highly responsive of student brought-devices and use was encouraged during class.

Sub-theme 5-1: Unresponsive to students' brought-technology. Many participant students experienced the university's tablet initiative as unresponsive

to students' brought-technology. Focus Group participants were asked, When you clicked on the class there was a pop-up that stated, 'This course is a tablet course.' What did you think when you saw that? This question generated much response from Focus Group 1 Participants,

> Imani responded, "I was honestly mad. Because I purchased a brand new Macbook right before [freshman orientation event], and I was like, I just bought a brand new Macbook, why do I have to buy a tablet? Isn't it the same thing, it's an electronic device, I can bring it to my course. And they're like, no it's required, so that didn't really make me happy, because I just spent a lot of money on this. Luckily I got the middle class grant, so they paid for half of it, but I still had to shell out like $400, it wasn't too fun.
>
> Juanita: Yeah that kind of happened to me, but I didn't buy it recently, but I had two iPads at home, like oh I could probably use it, but I was looking at the requirements, and I think that this had to be like something 60 or something gigabytes. But mine was like 32, and I was like, oh it doesn't fit the requirements. I have two, but…
>
> Hannah: Well I didn't get the popup, because I went to the Advising office, and I didn't do [freshman orientation event], so I didn't go to orientation right away, so when I was there he was like this one's open, but it's a tablet class, is that okay with you? I'm like yeah, sure why not, I already have a tablet. And then I found out that it has to be more gigabytes, and I have the 7 inch one, and I was planning on buying either a tablet or a Mac, so I got a new tablet. Planning on getting a mac next year.

Evelyn, Focus Group 2 Participant stated, "At first I was unsure about the course because I wasn't sure if I could afford to purchase a tablet. … I have an iPhone and a laptop so I really didn't get the point." When asked about the responsiveness of faculty to student brought-devices, Evelyn expressed that some teachers were afraid that students would be distracted by device use in class. Antonio, who had recently purchased a Lenovo Yoga, also purchased an iPad "because my teacher said you wouldn't be able to do Airdrop without Apple. So I

thought I would get the iPad in case I needed to share it. I guess that is the only reason why I got it … I just needed it to pass." Student participants expressed emotions of anger, frustration, and betrayal as they proclaimed the lack of responsiveness from teachers and the university.

Sub-theme 5-2: Responsiveness to students' brought-technology. Given that the subject of this study was adoption of tablet technology during a university rollout of tablets for academic purposes, student participants were not focused on reporting positive experiences of faculty responsiveness to their non-tablet brought-technology. However, the data revealed that (a) some faculty welcomed student brought-devices, (b) faculty were important agents in determining whether students experienced the classroom as responsive to student brought-devices, and (c) students' brought-devices varied.

First, some faculty welcomed student brought-devices. Pat, a teaching assistant and Focus Group 3 participant stated, "I talked with a professor from another department who was very techy, and instead of forcing students to sit up front so they wouldn't use the device for non-class work, his philosophy was teach them how to use it and encourage proper use and this will discourage improper use. And that seemed to work this semester …"

Secondly, faculty were important agents in determining whether students experienced the classroom as responsive to student brought-devices. Pat and Grace, teaching assistants in Focus Group 3, mentioned that students started to bring laptops later in the semester when they determined that tablets were not sufficient to getting their class work done. The focus group participants were asked, what happened in this class after students started bringing laptops? Grace noted, "The students who were bringing their laptops (and no longer bringing tablets) would just sit there until I asked them to bring out their laptops." Pat

confirmed that this occurred in her course sections also stating, "Students asked if they were allowed to use the laptop. Once they had permission they brought out the laptops regularly."

Thirdly, students' brought-devices varied. Survey results (Table 7, p. 126) revealed that the attributes of the devices students brought to class varied, however, all devices were capable of completing an online web-based survey.

Theme 6: Expertise across Social Networks

Findings appear to indicate that the depth of technical expertise within one's social network increases based on socioeconomic status. Findings also suggest that the breadth of one's social network is larger for Hispanics than for Whites. Analysis included coding excerpts where the situation registered facilitating conditions, the belief that resources and support are available for tablet use for academic purposes. Analysis distinguished excerpts for the FACX code, indicating that resources and support exist within the organization and technical infrastructure, and the FACZ code, indicating that resources and support exist within the user's social network. Three sub-themes emerged from analysis of the excerpts coded for FACX or FACZ: parents not tech savvy, race/ethnicity and network breadth, and depth of expertise and socioeconomic status.

Sub-theme 6-1: Parents not tech savvy. Student participants made it clear, with numerous references, that parents are not *tech savvy*. Evelyn proclaimed, "My parents would be 'utterly useless' [to provide help with a challenge I encounter on my tablet]." Javier indicated his parents were "Mexican immigrants so they wouldn't know how to answer any of the questions I have on tech problems." Focus Group 1 participant, Edna, said, "my parents, they're not good with technology." Haya responded, "my parents aren't tech savvy," and Diego agreed, "my parents aren't really tech savvy. My mom, she just completely

doesn't know." Imani qualified her view about parents, but still confirmed the inability of parents to provide support stating, "my parents are pretty tech savvy, but just like the texting and applications like baby social media, but when it comes to school work online and trying to figure out software, they wouldn't be able to do that." Focus Group 2 participants awkwardly noted that they could not go to their parents for help. The exceptions were student participants living in higher socioeconomic conditions such as Braden whose mother was an executive of a technology firm, or students whose parents' work involved the use of computers.

Sub-theme 6-2: Race/ethnicity and network breadth. Findings indicated that Hispanics have broader social networks than Whites. Jorge's extended family in Mexico introduced him to an app that allowed free phone calls. Javier mentioned that he could ask his relatives for help since they know how to use smartphones and computers. Antonio reaches out to his uncle in Wisconsin for tech help. On the other hand, Braden, a White student whose mother is a VP of a software firm, did not feel that he could go beyond his nuclear family to get support.

Sub-theme 6-3: Depth of expertise and socioeconomic condition. Participating students who were not first generation students appeared to have more depth of expertise within their social network regardless of its breadth. Braden, a Focus Group 1 participant who was not a first generation student, was the only participant from Focus Group 1 with parents deemed abled to provide support for challenges with tablets. All of Braden's relatives have tablets and his mother, a VP at a software firm with technical expertise, "would definitely be able to help." On the other hand, the data indicated that Focus Group 2 participants, with no first generation students among them, had more depth of technical expertise within their social network. All six Focus Group 2 participants stated

that they could get help from their family. Christopher noted, "I will ask my brother or sister for assistance." Tyler works with his brother on technical challenges, and Justina said she would contact her brother if she needs help.

Theme 7: Meaningful Experience Matters

Initial reading and analysis of the artifacts and interview transcriptions led to a hypothesis that a higher socioeconomic condition leads to greater efficacy and expertise. However, subsequent readings and analysis revealed that experience improves efficacy and expertise. Quality access to ICT may be affected by socioeconomic condition; however, meaningful experience can affect competence and confidence regardless of one's socioeconomic condition.

Javier, a Hispanic first generation student whose parents were Mexican immigrants, learned how to use computers in preschool and helped others in school with computers in fifth grade. Javier expressed, "getting into the tablet course is like oh wow my first time and so there are some pros and cons." He could make these distinctions due to previous experience with technology. Antonio, a Hispanic male, stated, "I do not have a lot of tech devices in my home ... I borrowed a laptop from [high school]." Trevor, a White male, explained that he troubleshoots computer problems on his own and believed his prior experience in technology helped him immensely. Trevor has had a computer since the fifth grade. Justina, a Hispanic female, said, "I'm good at fixing my own problems (using Google) but if I need help I would contact my brother (software developer)." Justina explained that she grew up using technology since 2nd grade so she is able to adapt to new technologies and has the confidence "to troubleshoot problems that may arise." The relationship between experience and level of expertise was also noted in a discussion with Focus Group 3 participants. Pat noticed "a large difference between my two classes and if I had to generalize I

would say the class that was less tech-savvy was also the class that was more lower socioeconomic status." Grace professed that she saw the same trend. Then Pat claimed, "the class with less tech-savvy students came from one high school while the other class came from another high school." So it appears that neither socioeconomic status nor race/ethnicity account for previous meaningful experience and that meaningful experience tends to create increased competence or expertise.

Qualitative Analysis - Summary of Findings in Response to Research Questions 4 and 5

Findings for Research Question 4

What are the facilitating conditions and associated meanings related to the acceptance and use of tablet technology relative to the demographic constructs of socioeconomic status and race/ethnicity? Facilitating conditions refer to the student's perceptions of the resources and support available to use tablets for academic purposes. Results revealed that socioeconomic status related most to the thematic findings of choice/resourcefulness, expertise/network, and responsiveness.

With regard to choice/resourcefulness, first generation students tended to be resourceful in their use of technology devices and institutional support services. This resourcefulness was partly necessitated due to the students' lower quality and older age assemblage of their technology. First generation students tended to have lower expertise levels within their social network. First generation students, with lesser assemblage of technologies, were not as troubled by faculty and university responsiveness to their brought-technology.

On the other hand, student participants with higher socioeconomic status tended not to depend upon institutional resources to address technical challenges. They tended to have higher expertise levels within their social network. However, low responsiveness to brought-technology, affected higher socioeconomic status students more than their first generation peers. Perhaps this is due to a more current assemblage of technologies.

Results revealed that race/ethnicity related most to the thematic finding of expertise/network. Hispanic students tended to have broader social networks than White students, which they used to address technical challenges.

Findings for Research Question 5

What are the performance conditions and associated meanings related to the acceptance and use of tablet technology relative to the demographic constructs of socioeconomic status and race/ethnicity? Results revealed that socioeconomic status related most to the thematic findings of *situatedness* of technology, choice/resourcefulness, and responsiveness.

With regard to *situatedness* of technology, first generation students had a stronger belief in the ability of tablet technology to support academic use. This belief may be due to the age and quality of these students' assemblage of technologies. For the theme of choice/resourcefulness, first generation students also reported a higher belief in the ability of tablet technology to support academic use than those who were not first generation students, and used their resourcefulness to better realize value from the technology. First generation students did not view the responsiveness of teachers or the institution negatively and were thus not as affected by the low responsiveness of teachers and the institution to students' brought-technology. Their belief in the ability of tablets to help them perform their academic work was re-enforced by faculty and

administration expectations that tablets were the appropriate technology for academic use. Overall, first generation students appeared more excited about the tablets ability to help them do their academic work than those students who were not first generation students.

In contrast, students with higher socioeconomic conditions tended to have a more current and capable assemblage of technologies. This factor appeared to affect these students' perceptions about the capability of tablet technology to support their academic use – especially in contrast to their newer non-tablet technology. For the theme of choice/resourcefulness, students from a higher socioeconomic status did not believe in tablet technology alone for academic use and used their financial resources to purchase laptops or hybrid devices to augment or replace their tablet technology used for academic purposes. Lastly, students from a higher socioeconomic condition were negatively affected by the low responsiveness of teachers and the institution to their brought-technology. The forced adoption of a tablet appeared to negatively impact the belief in the ability of tablets to help students perform their academic work.

Results revealed that race/ethnicity was not an important distinguishing factor affecting performance expectancy for Hispanic or White students. Most importantly, the qualitative data revealed that the *situatedness* of the technology may explain much of the meaning attached to the technology. Students' performance expectations for technology may not encompass the *situatedness* of the technology and its interactions within everyday use, which includes the work, people, learning context, and place, as well as the student's assemblage of available technologies.

Summary

This chapter presented the findings of the mixed methods case study, which investigated the variations in the acceptance and use of tablet technology by students at a 4-year, public university. This study explored the strength of the determinants for behavioral intention and use behavior. Variations in students' perceptions of the determinants for behavioral intention and use behavior, including the differences over time, relative to the demographic constructs of socioeconomic status, race/ethnicity and gender, were also explored. Furthermore, this study explored these differences directly through students' perspectives, lived-experiences, and socially constructed meanings.

The statistical analysis revealed the effect of the determinants on behavioral intention and use behavior. The analysis showed differences between and within the moderator categories on the determinants for acceptance and use behavior as well as the effect of time upon these differences. The qualitative analysis resulted in seven thematic findings: *situatedness* of technology, new ways of practice, choice continuum and resourcefulness, naturally occurring segments, levels of responsiveness to students' brought-technology, expertise across social networks, and meaningful experience matters. These thematic findings appeared to occur differently for different segments of the population based on socioeconomic status and race/ethnicity.

The mixed methods provided triangulation of the data. More substantially, the mixed methods allowed statistics to create distinctions based on segments of the population while qualitative analysis colored in the meaning of these distinctions. Furthermore, mixed methods allowed for the exploration of interactions where statistical models might not have considered these relationships. Lastly, as an instrumental case study, the findings evidenced aspects

of the phenomenon of technology adoption. One such aspect was the variations by which segments of a population experienced and gave meaning to technological innovation or how the *situatedness* of a technology effects its adoption.

Chapter 5 turns our attention to a discussion of this study's findings in light of the literature. These findings also lead to recommendations for policy and practice as well as subsequent research.

CHAPTER 5: MAJOR FINDINGS, DISCUSSION AND IMPLICATIONS

Effective information and communication technology (ICT) design, implementation, and support is critical to adoption and meaningful use of ICT by students as a means to enhance learning experiences, achieve 21st century learning outcomes, and develop students' ability to effectively adopt technologies that help them achieve life goals. Organizations facilitating learning experiences for students need to understand how to effectively design, implement, and support technology and promote meaningful use of technology that enhances learning experiences. Meaningful use of technology only becomes possible when students accept and meaningfully use the technology to participate effectively in 21st century learning experiences. Effective adoption of ICT becomes even more critical as the frequency of innovations increase and their life cycle shortens.

In order to improve the adoption of ICT, it is important to understand the determinants for acceptance and use of technology, the dynamics of the diffusion of innovation, and the perspective and contexts of prospective adopters. Variations may exist within a population such that a segment of the population has differing perceptions regarding a specific technology. Therefore, understanding variations within populations relative to the acceptance and use of a technology may lead to design, implementation, and support of ICT that results in accelerated adoption, lower costs and deeper integration. Furthermore, access to and meaningful experience with technology is vital to ongoing equity work in the 21st century where technology proficiency can create socioeconomic advantage.

The research findings confirmed that there are differences among populations in their acceptance and use of technology for academic purposes.

Substantial thematic findings emerged from the study that explored these differences among populations in ways that may inform practice, policy, and future research. The mixed methodology demonstrated the importance of quantitative analysis to differentiate variations between and within populations and qualitative analysis to explore the meaning attached to those variations. Lastly, findings from this instrumental case study related to the adoption of technology can be transferred to similar ecological contexts. This chapter reviews the major findings with summary responses for each research question; reviews the major thematic findings; distills the major findings from the research questions and thematic findings; acknowledges surprise findings; continues with a discussion of the findings relative to the research streams; explores implications for policy and practice, and considers implications for future research.

Summary of Major Findings

This study examined five research questions. Research question 1 explored the strength of the determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) on student behavioral intention and use behavior regarding tablet technology use for academic purposes. Data from the two-phase survey (phase 1 N = 652; phase 2 N = 440), an internally developed instrument meeting internal consistency standards (Cronbach's alpha = .70 or higher for each construct), were used to explore the strength of the determinants. Regression analysis was performed to examine the relationship between the determinants and behavioral use as well as use behavior. Analysis revealed 38% of variance in behavioral intention was explained by the variance in the determinants for behavioral intention with significant positive coefficients for all of the determinants except facilitating conditions. Additionally, 44% of variance in use behavior was explained by the variance in behavioral

intention, facilitating conditions, and access with significant positive coefficients for behavioral intention and access.

These findings confirm the relevance of the UTAUT model for acceptance and use of technology within this context. The regression results explained a sufficient amount of the variance in behavioral intention and use behavior to warrant its use for predictive purposes. The predictive use of the model can support adjustments in the design, rollout, and support for a technology. The lower than expected strength of the regression results may indicate the presence of other relevant determinants for behavioral intention and use behavior. The thematic findings may point to the existence of other determinants that could improve the UTAUT models and better explain, within the context of technology for academic use, the antecedents to behavioral intention and use behavior.

Research question 2 investigated differences among each demographic construct (socioeconomic status, race/ethnicity, and gender) on the determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value) for student behavioral intention and use behavior regarding tablet technology use for academic purposes. This investigation was a critical test of the thesis that variations exist within populations in the acceptance and use of technology for academic use. Data from the two-phase survey were used to investigate the differences. The inquiry used multiple regression analysis to determine the effects of the moderator categories upon the determinants including the direction and significance of these relationships. An ANOVA was then used to determine if categories within the moderator variables have a significant effect on the determinants.

Regression analysis showed a significant proportion of the variance in the determinants were explained by the variations within the demographic constructs.

For each determinant there were significant differences in the effect of the moderators on the determinants. Results also revealed a significant effect on the determinants by specific categories within the demographic constructs. Analysis of variance showed Hispanic students reported higher than their White peers on performance expectancy, effort expectancy, social influence, hedonic motivation, price value, and behavioral intention. Other gender students reported lower than male and female students on performance expectancy, effort expectancy, social influence, hedonic motivation, and use behavior while male students reported higher on facilitating conditions. First generation students reported higher than those who were not first generation students on performance expectancy and use behavior while lower on hedonic motivation.

Results from the statistical analysis confirmed that variations do exist within populations, such that segments of the population may have significantly different effects on the determinants for behavioral intention and use behavior. These findings have implications for practice. First, differences between segments of a population can be ascertained through a survey instrument. Second, these differences can be facilitated by adjustments to the design, rollout, and support for a technology innovation. Study findings also suggest that other races/ethnicities, such as the Asian segment, appear to also have different perceptions and lived-experiences with technology for academic use. A relevant finding for the equity discussion was the positive correlation of previous experience with behavioral intention as well as the positive correlation of access and efficacy with use behavior.

Research question 3 explored the differences over time among each demographic construct (socioeconomic status, race/ethnicity, and gender) on the determinants (performance expectancy, effort expectancy, social influence,

facilitating conditions, hedonic motivation, and price value) for student behavioral intention and use behavior regarding tablet technology use for academic purposes. Matched data (n = 137), data with matching ID numbers from students who completed both phases of the survey, were used to investigate differences over time. First, analysis included paired t-tests to determine if there was variance at a significant level within the determinants between phase 1 and phase 2. Next, regression analysis was used to determine if there was a significant effect on the variance in behavioral intention and use behavior based upon the variance in the determinants and moderators.

Findings revealed that differences in the determinants did occur over time. However, only performance expectancy and facilitating conditions showed a significant difference between phase 1 and phase 2 with a decrease in performance expectancy and an increase in facilitating conditions. This finding suggests that, between phase 1 and phase 2, students' belief that tablets would help them perform their academic work diminished. The thematic finding of the *situatedness* of technology deepens understanding of this finding and suggests performance expectancy may not just be a function of the tablet technology's fit with academic uses. The increase in facilitating conditions may indicate that students increased, over time, their belief that supports are available for their use of tablet technology from the institution and/or their social networks.

The moderators did not predict a significant effect on the determinants over time. No significant difference was found for how first generation, race/ethnicity, and gender students perceived a change in determinants over time. Changes in the determinants over time appear to be related to factors beyond those used in the regression models. The regression models predicted 24% of the change in behavioral intention and 25% of the change in use behavior between phase 1 and

phase 2. The change in behavioral intention was significantly predicted by access and hedonic motivation while the change in use behavior was significantly predicted by behavioral intention and hedonic motivation.

The presence of hedonic motivation, as a significant predictor of both behavioral intention and use behavior, was aligned with findings for technology adoption within consumer contexts (Venkatesh et al., 2012). This finding, namely, hedonic motivation's significant predictive strength, would suggest that students' adoption of tablet technology is influenced more by predictors of the adoption of consumer technology than those normally associated with institutional adoption. The presence of access, as a significant predictor of behavioral intention, might suggest that access to a specific technology is an important determinant of the technology students will be more inclined to use. Based upon the predictive significance of access for behavioral intention, the equity discussion might consider whether what is provided to students might predetermine what students might consider valuable for subsequent use.

Data from eleven photo diary interviews and three focus group interviews were used to respond to research questions 4 and 5. Iterative coding and thematic interpretation of the artifacts and transcripts, triangulated by discussions amongst the research team, confirmed seven thematic findings, which were the basis for the response to research questions 4 and 5.

Research question 4 explored the facilitating conditions and associated meanings related to the acceptance and use of tablet technology relative to the demographic constructs of socioeconomic status and race/ethnicity. Facilitating conditions refer to students' perceptions of the available resources and supports existing within the institution and/or from their social network to use tablets for academic purposes. Excerpts were coded where the situation registered

facilitating conditions distinguished by the FACX code (resources and support exist within the organization and technical infrastructure) and the FACZ (resources and support exist within the user's social network). Study findings revealed that first generation students tended to have lower expertise levels within their social network. On the other hand, students with higher socioeconomic status tended not to choose institutional resources to address technical challenges and indicated higher expertise levels within their social network. The statistical analysis did not reveal a significant variance in facilitating conditions relative to socioeconomic status. The analysis showed that race/ethnicity related to the thematic finding of expertise/network. Hispanic students tended to have broader social networks, which they used to address technical challenges.

Research question 5 explored the performance conditions and associated meanings related to the acceptance and use of tablet technology relative to the demographic constructs of socioeconomic status and race/ethnicity. First generation students had a stronger belief in the ability of tablet technology to support academic use than those who did not report as first generation students. This may be due to the age and quality of their assemblage of technologies. First generation students, compared to those who did not report as first generation students, also had a stronger belief in tablet technology for academic use, given a lower degree of choice, and used their resourcefulness to better realize value from the technology. Overall, first generation students appeared more excited about the tablets' ability to help them do their academic work. In contrast, the higher socioeconomic level of students presented a more current and capable assemblage of technologies. These students' assemblage of technologies appears to have influenced the students' belief in the ability of tablet technology, which was weak, to support academic use – especially in contrast to their newer non-tablet

technology. Higher socioeconomic students did not believe in tablet technology alone for academic use and used their ability to choose to purchase laptops or hybrid devices to augment or replace their tablet technology used for academic purposes. Higher socioeconomic students were affected and appeared concerned by the low responsiveness of teachers and the institution to their brought-technology. This experience of forced adoption appears to have led to a weak belief in the ability of tablets to help higher socioeconomic students perform their academic work. Lastly, the analysis showed that race/ethnicity was not an important distinguishing factor affecting performance expectancy for Hispanic or White students. Most importantly, the qualitative data revealed that the *situatedness* of the technology may explain much of the meaning associated with the technology. This finding suggested that students' performance expectations for technology may not encompass the *situatedness* of the technology and its interactions within everyday use.

Summary of Thematic Findings

Seven thematic findings emerged from the photo diary and focus group interviews which reflected the students' expressed meaning associated with tablet technology: the *situatedness* of technology; new ways of practice; choice continuum and resourcefulness; levels of responsiveness to students' brought-technology; naturally occurring segments; expertise across social networks; and the fact that meaningful experience matters.

The first theme, *the situatedness of technology*, suggested that the meaning of a technology emerges from interactions within the aspects of its *situatedness*. The participants' interactions occurred within the nexus of work, learning context, persons, and place, as well as the student's assemblage of available technologies.

The second theme, *new ways of practice*, reflected the pattern where participants exhibited new and distinctive ways of working with technology for academic purposes. These ways of working appear to be facilitated by mobile technologies' lightweight, instantly available, always connected character. This thematic finding was especially apparent in the recurrence of multiple concurrent workspaces; the juxtaposition of place, physical posture, and device; and the collaborative work between students.

The third theme, *choice continuum and resourcefulness*, revealed that there appears to be a continuum of choice along which students respond differently. This choice is more than a socioeconomic condition and its appearance is more like the habitus of social capital. Lower socioeconomic students appeared to have less choice with both a dependence upon social and institutional systems as well as learned resourcefulness. This learned resourcefulness shows up in better use of available resources as well as the ability to leverage resources available to them through social and institutional systems. Students from higher socioeconomic status appeared less dependent upon social and institutional systems with an inclination to change their condition where it serves them.

The fourth theme, *naturally occurring segments*, showed that segments occur naturally within populations and each of these segments have their own associated meanings pertaining to the use of tablet technology. These segments included the demographic constructs initially defined by the study (first generation student, race/ethnicity, and gender) as well as other naturally occurring segments such as commuters, athletes, and those with physical limitations.

The fifth theme, *responsiveness to students' brought-technology*, revealed differences in the level of responsiveness of faculty and the university to students' brought-device(s). One end of the continuum is highly-restrictive, limiting which

technology devices are allowed for use, while the other end of the continuum is highly responsive to student brought-devices and encourages their use in class.

The sixth theme, *expertise across social networks*, suggested that the depth of technical expertise within one's social network increases based upon socioeconomic status while its breadth appears related to race/ethnicity. The data showed that the breadth of one's social network is larger for Hispanics than for Whites.

The seventh theme, *meaningful experience matters*, suggested that experience with ICT increases efficacy and expertise. Socioeconomic status may affect the quality of access to ICT. However, meaningful experience can affect competence and confidence regardless of socioeconomic status.

Analysis of the intersection of the thematic findings and the demographic distinctions revealed that socioeconomic status related most to the thematic findings of *situatedness* of technology, choice/resourcefulness, expertise/network, and responsiveness. Regarding the *situatedness* of technology and choice/resourcefulness themes, first generation students tended to be resourceful relative to their assemblage of technologies and the institutional support services. This resourcefulness may be a result of the lower quality and older age of their assemblage of technologies. Relative to the expertise/network theme, first generation students also tended to have lower expertise levels within their social network compared to those who were not first generation students and, with less current assemblage of technologies, they were not as troubled by the low responsiveness from faculty to their brought-technology. Overall, first generation students appeared more excited about the tablets' ability to help them do their academic work.

In contrast, students with a higher socioeconomic condition seemed to have a more current and capable assemblage of technologies. This appeared to influence these students to have a weaker belief in the ability of tablet technology to support academic use – especially in contrast to their newer non-tablet technology. Relative to the choice/resourcefulness theme, higher socioeconomic students did not believe that tablet technology alone was sufficient for academic use and chose to purchase laptops or hybrid devices to augment or replace their tablet technology. Students with higher socioeconomic status tended to not rely on institutional resources to address technical challenges. They tended to have higher expertise levels within their social network. These students were more affected by low responsiveness from the institution and faculty to their brought-technology. The experience of a forced adoption resulted in weaker belief in the ability of tablets to help higher socioeconomic status students perform their academic work.

The analysis showed race/ethnicity related most to the thematic findings of expertise/network. Hispanic students tended to have broader social networks, which they used to address technical challenges. Analysis also indicated that race/ethnicity was not an important distinguishing factor affecting performance expectancy for Hispanic or White students. Most importantly, the qualitative data revealed that the *situatedness* of the technology may explain a significant amount of the meaning attached to a given technology. Findings seemed to indicate that students' performance expectations for technology may not encompass the *situatedness* of the technology and its interactions within everyday use which include the work, people, learning context, and place, as well as the students' assemblage of available technologies.

Surprise Findings

The data provided a few surprises. The first surprise finding was that the UTAUT model did not explain as much about behavioral intention and use behavior within this study's context compared to UTAUT studies within organizational or consumer contexts. The second surprise finding was that the category of other gender students revealed significant variance within gender relative to the determinants for behavioral intention and use behavior. The third surprise finding was that hedonic motivation appeared to be a significant predictor of behavioral intention and use behavior while access predicted behavioral intention. The fourth surprise finding was the occurrence of the COLX (ICT function of collaboration) as a recurring and important meaning attributed to tablet technology.

Conclusions

The quantitative findings and emergent thematic findings have been distilled into a few compelling observations to guide the design, rollout, and support for ICT for academic use.

Segments of the population have different perceptions about and meaning associated with a technology innovation.

Technology is situated and can only be understood by persons' interactions within learning contexts and with persons, place, and their assemblage of technologies.

Adjustments in design, rollout, and support of technological innovations can be made to accommodate for differences between segments in ways that support these segments of the population in their adoption of the technology. These adjustments may result in accelerated adoption, lower costs, and deeper integration.

Well-prepared faculty with curriculum designed to meaningfully use technology may improve engagement of students.

Well-supported faculty and students allow meaningful use to occur, and this support is especially relevant for groups with less technical expertise within their social networks.

Experience with technology in academic settings helps develop confidence in students so that they are more likely to meaningfully use subsequent technologies.

Universities and classrooms should be responsive to students' brought-technology by dictating the parameters of what technologies support the work, allowing students to choose what technologies they use to do the work, and providing appropriate resources and supports where students need them.

Discussion

The study's findings align with and intersect the research streams examined in the literature review, and in some cases these findings open new opportunities for research. The research streams include diffusion research; technology adoption research; information systems implementation research; the research on design and implementation with and for persons; and research on students, technology and equity. This section concludes with a re-examination of this study's theoretical framework.

Diffusion Research

The diffusion research stream considers how, over time, individuals within a social system decide whether to adopt a technological innovation and how information about this technological innovation is conveyed (Rogers, 1983; Rogers, 2003; Straub, 2009). This study confirmed the social-construction of

meaning for a technological innovation as well as the limits of change agents' ability to diffuse their given meaning. Social influence, while a meaningful part of the regression model, did not emerge as a significant predictor of behavioral use and use behavior. However, the qualitative analysis confirmed the dynamics of social systems and the process and effects of the communication of information regarding the technological innovation.

The thematic finding, *expertise across social networks*, suggested that people's social networks have different levels of knowledge relative to the technological innovation as well as different breadths in terms of the extent of the social network. The thematic finding, *meaningful experience matters*, demonstrated that persons exist within segments who garner experience relative to a technology regardless of the adoption stage of the group. These findings align with Rogers' (2003) analysis of diffusion networks (e.g., heterophily) and in this study the students' social network included family, peers, faculty, staff, and the administration.

The influences from these social networks were prevalent throughout the data especially within the thematic finding, levels of responsiveness to students' brought-technology. Survey participants, who used brought technology to classrooms, were, in some cases, strongly influenced by faculty to purchase additional tablet technology. Focus Group 3 participants described a poignant instance of faculty influence when some of the students expressed that once they realized that the tablet was insufficient to perform academic work, they would not bring out their purchased and/or brought laptops in the classroom without the teacher's permission. These findings aligned with Margaryan et al. (2011) that student acceptance and use of educational technology is highly correlated to

faculty adoption of educational technology given the social influence of faculty to affect student behavior.

In addition, this study's findings revealed that segments do exist within populations where these segments have different perspectives on and meanings associated with the technological innovation. This study's findings also confirmed the diachronic or over time dimension of the adoption decision and the diffusion of information within social systems. However, study findings support the critique of diffusion research where adopter categories are based on the rate of adoption rather than persons' perspectives on and meanings associated with the innovation. Adoption is also a function of the fit between the attributes of the design, implementation, and support for a technological innovation, and the populations of prospective adopters. To this end, the findings confirmed the theoretical framework's assertion that adoption can be predicted based on perceptual constructs such as those found in the UTAUT and UTAUT2 models (Venkatesh et al., 2003; Venkatesh et al., 2012) as well as the meanings that emerge from students' lived experiences (Dourish, 2004; Suchman et al., 1999).

Fichman's (1992) critique of diffusion theory was important to this study, namely, the effect of the target technology and the social context upon the adoption process. Classical diffusion research assumed that individuals were adopting innovation for independent use. In this study, tablet technology use for academic purposes was both an individual and institutional adoption. Furthermore, tablet technology use for academic purposes is subject to network externalities (e.g., cloud-based services) and organizational practices (e.g., teaching). This study's findings also supported Rogers' (2003) critique of source agency bias in the introduction of technological innovation and the importance of providing a voice or agency to the prospective adopters. Rogers (2003) asserted

that learning about people's perceptions regarding an innovation, rather than the technology change agent, is key to overcoming pro-innovation bias. This study heeded Rogers' (2003) methodological critique of diffusion studies by incorporating data gathered over time during the adoption and diffusion process as well as using mixed methods to better understand the meanings associated with the innovation by prospective adopters.

Lastly, Rogers noted the socioeconomic consequences of technological adoption, which often impact equity. This consequence of technological adoption was reflected in this study in the differences among students' assemblage of technologies and the advantage this might give to students with more current and appropriate technology (e.g., laptops in STEM disciplines). This consequence of technological adoption was particularly evident in the thematic finding, *meaningful experience matters*, where experience improved efficacy and expertise. This consequence of technology adoption was also visible within the thematic finding, *choice continuum and resourcefulness*, especially where those students who deemed the tablet insufficient for their academic work brought technology, which differentiated these students from those for whom these choices did not exist.

Adoption Research

The adoption, or acceptance and use of technological innovations, research examines individuals' perceptions, norms, and beliefs as well as their choices relative to a particular technological innovation (Rogers, 1983; Straub, 2009). The goal of adoption research is to understand the relevant determinants for behavior relative to a particular innovation, improve predictability of behavior based on the determinants, and understand variations in populations relative to the determinants (Davis, 1989; Venkatesh et al., 2003). The study's findings aligned with the

technology adoption research with results confirming the relevance of the UTAUT and UTAUT2 models for the prediction of behavioral intention and use behavior (Venkatesh et al., 2003, 2012). The predictive power of models within this research stream vary: the eight dominant models explained within an organizational context variance in intention ranged from 17% to 42% (Venkatesh et al., 2003); the technology adoption model predicted adoption success between 30% to 40% of cases (Davis, 1989); the next version of the technology adoption model predicted 34% to 52% of the variance in usage intentions (Venkatesh & Davis, 2000); the UTAUT model predicted behavioral intention and use behavior with an adjusted R^2 of .70 (Venkatesh et al., 2003); and the UTAUT2 model explained 56% to 74% of the variance in behavioral intention and 40% to 52% of the variance in technology use (Venkatesh et al., 2012). This study's findings, using regression analysis, revealed that 38% of the variance in behavioral intention was explained by the variance in the determinants for behavioral intention and 44% of variance in use behavior was explained by the variance in the determinants for use behavior. Given the eight models reviewed by Venkatesh et al. (2003), the R^2 for behavioral intention was well within range of 17% to 42%. Compared to the initial UTAUT2 study results, the adjusted R^2 for behavioral intention was lower while the adjusted R^2 for use behavior was within the range found in the initial UTAUT2 study.

The ecological context of this case study was both a consumer and institutional adoption context. To that end, both the UTAUT and UTAUT2 were relevant. The UTAUT2 found *habit* as a critical factor within a consumer context for predicting technology use (Venkatesh et al., 2012). In retrospect, this study could have incorporated the habit construct found in the initial UTAUT2 research to compare the results of the earlier research through replication (Venkatesh et al.,

2012). However, the survey items that asked about earlier experience with technology and access to technology may present a reasonable proxy for this construct and future comparison to the UTAUT2 results regarding the habit construct. This study's findings revealed access as a predictor variable for both behavioral intention and use behavior. Similarly, the photo diary and focus group interviews seemed to confirm the importance of access and previous experience. And, as with the UTAUT2, facilitating conditions was a significant predictor of both behavioral intention and use behavior. Similar to earlier research, performance expectancy decreased between phase 1 and phase 2 of this study (Venkatesh, 2003). Lastly, the presence of hedonic motivation as a significant predictor for both behavioral intention and use behavior was similar to the findings for technology adoption within consumer contexts (Venkatesh et al., 2012). Furthermore, the study's findings connect with research reflecting the systems context (Greenhalgh et al., 2004) and ecosystem context (Adner, 2012) pertinent to the adoption of consumer technology within an institutional setting. These broader contexts appeared often within the photo diary and focus group interviews.

The technology acceptance model was criticized for not acknowledging differences within a population or the constraints limiting chosen behaviors (Agarwal & Prasad, 1999). The UTAUT2 study of adoption within a consumer context did not include socioeconomic status or race/ethnicity as moderating factors but did include gender. Venkatesh et al. (2012) acknowledged that socioeconomic status may influence performance expectancy, facilitating conditions, and price value. This study found that differences exist within demographic constructs. The findings showed that first generation students reported higher than their peers on performance expectancy and use behavior

while lower than their peers on hedonic motivation. Furthermore, within the thematic findings, socioeconomic status seemed to relate to students' meaning-making relative to the price/value of a tablet, especially relative to the students' existing assemblage of technologies. The findings also indicted differences based on race/ethnicity with Hispanic students reporting higher than their peers on performance expectancy, effort expectancy, social influence, hedonic motivation, price value, and behavioral intention. Contrary to earlier studies, this study's findings did not reveal a significant difference for males and females. However, other gender students reported lower than their peers on performance expectancy, effort expectancy, social influence, hedonic motivation, and use behavior while male students reported higher on facilitating conditions. Differences in behavioral intention related to first generation students, Hispanic students, and other gender students may also be a function of degrees of *choice* (H. Delcore, personal communication, March 18, 2015). Technology acceptance theories rely on Bandura's concept of self-efficacy where agents have perceived behavioral control over intentions and actions. Considering the emergence of the thematic finding of *choice/resourcefulness* and further research regarding differences between working class and middle class, it appears that technology acceptance theory may rely too heavily on independent choice. Stephens, Fryberg, and Markus (2012) found within their research on different models of agency, an interdependent model for working-class and an independent model for middle class. This interdependent agency is demonstrated in the importance of being in relationship with others, fitting in, and being responsive to others. Stephens et al. (2012) suggested, "given the working-class emphasis on interdependent models of agency … the reliance on the independent model of agency as the cultural standard creates the experience of a cultural divide that serves to systematically disadvantage

working-class Americans" (p. 93). These sorts of constraints limit chosen behaviors (Agarwal & Prasad, 1999) and indicate the importance of continued technology acceptance research exploring differences in social class, race/ethnicity, and gender.

In this study both the statistical analysis and thematic findings reflected differences within the student population with each segment possibly having unique concerns (e.g., depending on their assemblage of technologies or the level of expertise within the social network). The thematic finding, *naturally occurring segments*, showed segments occurring naturally within the population beyond the demographic constructs (first generation student, race/ethnicity, and gender), which were formally explored within the study. The thematic findings, *expertise/social network* and *choice/resourcefulness*, demonstrated different concerns for first generation students as well as Hispanic students relative to their peers. These findings intersect with Hall's Concerns Based Adoption Model, which consists of three diagnostic dimensions: stages of concern, levels of use, and innovation configuration (Hall, 1973). Hall defined concerns as the composite representation of a person's beliefs, feelings, and considerations relative to a specific matter. Dooley (1999) noted that each person perceives and mentally contends with an innovation differently. The Concerns Based Adoption Model suggests that segments of students have different concerns, levels of use, and innovation configurations which when understood may be better addressed.

Information Systems Implementation Research

Information systems (I.S.) implementation research examines the factors that help or hinder adoption, diffusion, and assimilation of technological innovations. This research was applied to educational contexts with theoretical models that include contextual factors, concerns about the innovation, and the

individual's stage within the adoption decision-process; as well as recurring factors such as professional development, support, and time (Cox et al., 2000; Dooley, 1999; Vaughan, 2001).

Study findings confirmed that facilitating conditions, or resources and support to realize use, were pertinent to use behavior. The thematic finding, *situatedness of technology*, showed that within the learning context, teachers must be well prepared in knowing why, how, and where to use technology meaningfully within curriculum and instruction. The thematic finding, *expertise/social network*, suggested that students rely, to varying degrees, on the institution's and their social network's resources and supports during the adoption of technology. The study's findings point to professional development and technical support as critical factors for successful adoption of ICT, and these findings align with much of the information systems implementation research (Cox et al., 2000; Dooley, 1999; Jacobsen, 1998). Vaughan (2001) concluded that participation by those concerned was the most likely factor to increase the success of an information systems implementation within higher education.

This instrumental case study seems to reveal that the voice of students was not as present during the design and rollout of the tablet initiative. The surprising import of hedonic motivation and the excitement experienced by students with collaborative learning experiences intersects with the research indicating that teachers are also motivated to make learning more interesting and engaging (Cox et al., 2000). The findings confirmed the key factors that helped promote adoption, diffusion, and assimilation of technology for educational use, namely, professional development for faculty and training for students, as well as technical support and working technical infrastructures (Covington et al., 2005; Sahin, 2006).

Faculty involved in the initial tablet initiative were early adopters according to Rogers' adopter categories. Students who participated in the photo diary and focus group interviews were also earlier adopters (even if the adoption was a requirement for academic performance). It is worth noting that subsequent waves of prospective student adopters may require training and support since students' technology skills do not easily transfer to learning activities (Gros et al., 2012). Furthermore, subsequent waves of prospective faculty adopters may have different concerns than the early adopters (Margaryan et al., 2011). This study's findings confirmed Margaryan et al.'s findings that the interchange between instructors and students, the requirements of the discipline, and the value the tool provided within a given context influenced technology use. This point is salient given that faculty *early adopters* are different than subsequent adopters. *Early adopter* faculty are risk takers, mostly self-sufficient, and attracted to the technology itself while *early majority* faculty are more concerned about teaching and learning problems and want working technology with low likelihood of failure (Gros et al., 2012; Wertheimer & Zinga, 1998). Singh and Hardaker (2014) discovered that technological innovation within higher education is often geared towards technically proficient and innovative faculty – a strategy they suggest reduces the likelihood of mainstream adoption. The lived-experience of students suggested that well-prepared and supported faculty are critical for the *situatedness* of technology to emerge with meanings that reflect a higher value for the technology.

Design and Implementation with and for Persons

The research herein entitled "design and implementation with and for persons" is a broad field with the common element of design wherein stakeholders participate in the design process and where design outcomes result in innovations that fit the use and needs of stakeholders (Holmlid, 2009; Kumar, 2013). These

design *practices* (e.g., HCI) have yielded similar sets of principles including the complexity of systems within which agents act and the *situatedness* of agent's practice within a given context. Singh and Hardaker (2014) recommended that innovation research within higher education recognize the complexity and multiple dimensions of social reality. These social dimensions within education include alignment with professional goals, interests, and needs; patterns of work; sources of support; and social networks. Suchman et al. (1999) pointed to the *situatedness* of technology contending that meaning for technologies emerges from within technology's interactions and relationships to its everyday use by agents. Therefore, a phenomenological methodology is needed to give voice to students and situated action within the students' work (Dourish, 2004). Dourish's research was relevant to the thematic findings that emerged from this study including *situatedness of technology* and *new ways of practice*. In particular, *situatedness of technology* suggests that the meaning of a technology emerges from interactions within the aspects of its *situatedness*, namely, from the nexus of work, learning context, persons, and place, as well as the student's assemblage of available technologies. And, building upon Dourish's work related to ubiquitous computing, the thematic finding, *new ways of practice,* reflects the pattern where participants exhibited new and distinctive ways of working with technology for academic purposes. Dourish defined adoption as the meaning emerging from interaction with the technology where such meaning cannot be removed from the context or its social world. This concept was particularly relevant and poignant throughout this study's findings and was resonant in the thematic findings.

Students, Technology and Equity Research

Research on technology and equity has revealed a digital disconnect related to access to technology and adoption and meaningful use of technology

(Warschauer & Matuchniak, 2010). Effective use of technology is considered a critical competency in the 21st century (Friedman, 2006; Reich, 1991; Warschauer & Matuchniak, 2010). Subsequently, the adoption of technological innovations has been found to lead to increased wealth as well as fiscal and social capital (Rogers, 1983; Sun & Metros, 2011; Warschauer & Matuchniak, 2010). Lastly, socio-cultural factors affect access to technology (Sun & Metros, 2011; Warschauer & Matuchniak, 2010) and can result in different degrees of access based on race/ethnicity (Lopez et al., 2013). The study's findings were aligned with the research on equity that distinguishes degrees of access with differences among socio-cultural groups. Socioeconomic status related most to the thematic findings of *situatedness* of technology, choice/resourcefulness, expertise/network, and responsiveness.

This study contributed to the research on students, technology, and equity by confirming the effects of adoption on equity as well as the differences among students relative to choice/resourcefulness, expertise/networks, and the role of prior experience to adoption of subsequent technological innovations. First generation students, compared to those who did not report as first generation students, tended to be more resourceful in their use of technology devices and institutional support services. First generation students, compared to those who did not report as first generation students, tended to have lower expertise levels within their social network and, with a less current assemblage of technologies, appeared less troubled by low responsiveness from faculty to students' brought-technology. The study's findings indicated that the first generation students with less independent choice to buy technology used tablets while students who could afford to buy newer, more functional technology chose to do so. The study

revealed that prior experience (e.g., high school) contributed to how tech-savvy the student might appear in the University classroom.

Re-examination of Theoretical Frame

The four research streams were chosen to cultivate a holistic understanding of adoption, diffusion, and integration of technological innovations for persons within educational contexts. This theoretical frame builds on the social dynamics of diffusion research, the predictive uses of determinants from acceptance and use research, mindfulness of the factors that help promote adoption and diffusion from information systems implementation research, and emphasis on stakeholder perspectives and meaning from the research on design and implementation with and for persons. Four themes emerged across these research streams: (a) innovation emerges within a dynamic interchange of persons, work, technology and social systems; (b) context affects dynamics of adoption and diffusion; (c) innovation affects equity; and (d) variations exist within populations. This study's findings and subsequent discussion with the research affirms the tenets of this theoretical framework as a coherent framework.

Implications for Practice and Policy

Based on the study's findings and conclusions, eleven key implications for practice are presented regarding the design, implementation, and support of technology for academic use.

Implications for Practice

First, leaders must become more aware that adoption requires understanding variations within populations. This study's theoretical framework effectively addresses differences within populations and provides guidance on the successful design, rollout, and support of technological innovations. This study

supports the importance of higher education institutions learning how to continuously improve the design, rollout, and support of learner technology in ways that engage learners, and reminds practitioners that on-going persistent use requires on-going support.

Second, leaders must comprehend the interchange between persons, work, technology, learning context, and social context. This dynamic interchange affects classroom space and virtual learning spaces. The realization that learning is situated with new resultant practices will shift the design of such learning spaces.

Third, segments of the population have different perceptions about and meaning associated with a technology innovation. Practitioners should use tools such as the Concerns Based Adoption Model, the Unified Theory of Acceptance and Use of Technology, and ethnomethodology to better understand these differences among segments of the population.

Fourth, technology is situated and can only be understood through persons' interactions within learning contexts and with persons, place, and the students' assemblage of devices. Practitioners should use tools like ethnomethodology to better understand the meanings emerging from participants' interactions as well as participative design and design thinking methods to fashion technology with students in ways that fit the *situatedness* of students' practice. The use of such tools provides both veracity and utility. Veracity emerges through the use of predictive determinants to ascertain variations within populations amplified by the expressed meanings emerging from the as-lived experiences of those concerned. The utility is reflected in shorter time required to gather data relative to its value.

Fifth, make adjustment in the design, rollout, and support of technological innovations to accommodate the differences between segments of the population so that these segments are better equipped to adopt the technology. These

adjustments may result in accelerated adoption, lower costs, and deeper integration. Practitioners may want to consider (a) tools to address implementation such as the Concerns Based Adoption Model or context specific change models and (b) tools (i.e., service blueprinting) to develop the appropriate services and supports.

Sixth, design curriculum and prepare faculty to meaningfully use technology to increase student engagement and improve learning outcomes.

Seventh, teach and support faculty and students in the effective use of technology. This support is especially relevant for those groups with less technical expertise within their social networks.

Eighth, provide access to and meaningful experience with technology for academic purposes so that students can develop relevant proficiency for subsequent use of technology for academic purposes.

Ninth, avoid pro-technology, pro-innovation bias. Instead, learn what works and how to make what works work for the respective segment of the population. It is important to note that within the study, pen and paper still remained tools among students' assemblage of technologies. Use an asset-based development model that supports effective practices such as the resourcefulness of first generation students and leverages existing assets and technologies that sufficiently meet goals for student success.

Tenth, universities and instructors should be responsive to students' brought-technology by setting the parameters of what ICT works for instruction and learning, allowing students to choose the technologies they will use to do their work, and providing appropriate resources and supports to students where needed. In regard to technology adoption within higher education, Singh and Hardaker (2014) emphasized drawing on diverse motivators without imposing constraints

that assume that a single solution fits all eventualities. If universities do not welcome all devices that can access and support common apps, then specific requirements lead to additional devices that students must purchase.

And lastly, the adoption of technological innovations can support or hinder equity. Since students have an existing assemblage of technologies, it is important to understand where and when students need additional resources so that all students have a reasonable way to keep the minimum quality and functional capabilities required within their assemblage of technologies. Institutions must be aware of the antecedents, such as access and experience, which support students' adoption of technological innovations. Universities and leaders should: (a) understand the short and long term consequences of technological innovations so the results support equity, (b) understand the technology roadmaps for the respective disciplines and careers so students are ready for the 21st century within their career of choice, and (c) recognize that technology adoption is an ongoing process that can be referred to as the student's technology adoption journey. Sending students down a substandard path may lead them on a journey where the destination is inferior to their peers. Therefore, educational institutions must recognize that adoption can lead to socio-cultural differentiation and set students on equitable technology adoption journeys.

Implications for Policy

Based on the study's findings and conclusions, there are four implications for policy related to equity and the adoption of technology for academic use.

First, this study deepens and extends the research knowledge that should be used to inform policy including a nuanced view of the digital divide as the *digital discontinuum*, an understanding of variations in the determinants for acceptance

and use of technological innovations within segments of a population, and an approach for effective targeted interventions that decrease inequity gaps.

Second, the *digital discontinuum* should be addressed by making technology access and meaningful experience available to K-12 students with funding for technology devices in schools and universities for lower socioeconomic status students. Currently, the Federal Communication Commission (FCC) Universal Service Fund E-Rate program provides funding to K-12 schools and libraries at a percentage off the purchase price of eligible equipment, based on district level of free and reduced lunches. A similar program could be initiated for K-12 schools to fund the acquisition and refresh of computer devices so that students who are unable to get access to technology within their home or social network can do so at their local school, library, or community center.

Third, the *digital discontinuum* should be addressed by supporting Internet access for home use and community centers through a discounted purchasing program similar to the FCC USAC E-Rate program where home Internet access would be partially subsidized. The government should consider a program that encourages increased adoption of Internet connectivity within those areas with lower socioeconomic conditions. This program could incentivize Internet providers with consumer subsidies coupled with rewards based on the level of market penetration while also encouraging consumption through incentives for Internet use by consumers. Also, a similar model for students' use of mobile devices should be considered since this technology, compared to wired Internet access to homes, is quickly becoming more affordable and directly impacts students.

Most importantly, this research reminds policy makers that variations exist within populations which, when acknowledged, can lead to change where all can participate in technological innovations that bring value to those concerned.

Limitations of Study

There were a few limitations with this study related to the measurement of use behavior, the measurement of the construct first generation student, as well as sample population site and composition. The survey instrument recorded self-reported perceptions of use behavior while students' actual tablet use for academic purposes was not recorded due to feasibility and privacy concerns. However, the survey as a proxy measure for use behavior was triangulated with data from photo diary with interviews and focus group interviews. The conceptualization of behavioral use varied across technology adoption studies including breadth, extent, variety, and users' cognitive absorption (Venkatesh et al., 2012). This study conceptualized use behavior as breadth and extent measured through survey items on perceived extent and frequency as well as lived-experience and associated meanings evidenced in the photo diary with interview and focus group interviews.

Socioeconomic condition was measured through the proxy construct *first generation student* defined as neither parent of the student has earned a bachelor's degree. The first generation student designation is often correlated with lower socioeconomic status (Engle & Tinto, 2008). This correlation is likely due to the fact that parental educational attainment is the most stable component among parent education, occupation, and income; and is highly correlated to income in the United States (Sirin, 2005). Furthermore, the survey item used to determine first generation student was *Are you the first person in your family to attend college?* The wording of this item may have limited the number of affirmative

responses and therefore, limited the number of first generation students identified in the sample population. Other proxy measures for socioeconomic status were considered including Free and Reduced Lunch or Free Application for Federal Student Aid. These other proxy measures were not used given the stigma often attached to Free and Reduced Lunch and the knowledge required to accurately respond to a survey item on Free Application for Federal Student Aid. Therefore, first generation student was chosen as a reasonable proxy for socioeconomic condition.

There were also limitations related to the population sample size and composition. The data were collected from one university site. This site provided ecological validity since at the time of the study the site was undergoing a significant and intentional introduction of a technological innovation. The instrumental case study research design focused on the phenomenon of technology adoption, in this case by students at a university. Regarding population sample composition, it would have been desirable to have a few more first generation students within the photo diary and focus group interviews to reach a deeper level of saturation relative to the thematic findings pertaining to first generation students.

As an instrumental case study, the study examined the phenomenon of technological adoption in the case of adoption of tablet technology by students for academic use at a 4-year public university. The study's findings could be compared to similar studies where it mirrors the situation within those studies, namely, the introduction of an innovation. Such ecological validity may allow the transferability of this study to similar situations. However, as noted in both the literature and findings, this case study occurred within a context that had characteristics of both consumer and organizational adoption.

The finding of the *situatedness* of technology, namely, that the meanings associated with a technology emerged from within a particular context where students were interacting with technology within their daily activities, suggests transferability must acknowledge the *situatedness* of technology within the target context.

The findings in this case study confirmed the assertion of variations within populations relative to the determinants for behavioral intention and use behavior. This fundamental assertion of variations within populations is generalizable while the thematic findings may or may not be transferable depending upon the context and population under study.

Implications for Future Research

There are several implications for future research. First, from a methodological perspective, additional studies like this one might refine the use of ethnographic explorations of participants' meanings in conjunction with UTAUT surveys. Such studies might strengthen the research method and also lead to discovery of additional constructs such as *situatedness* and ways of practice that might further explain the variance in behavioral intention and use behavior. Second, additional research should be conducted to test the UTAUT and UTAUT2 using socio-cultural constructs such as socioeconomic conditions and race/ethnicity. Third, research focused on exploring why other gender students had significant predictive effects on the determinants for behavioral intention and use behavior should be considered. Research focused on variations in perceptions by other race/ethnicities, such as Asian students, would also be valuable. Fourth, additional ethnographic studies should be conducted with a focus on the classroom to determine the meanings ascribed by students to the interactions of technology within the context of the classroom. Studies focused on the value of training for

segments of the faculty population and the effect of different types of training on these segments should also be considered. The faculty who participated in this tablet initiative were well trained during a summer 'boot camp' on the use of technology within curriculum and instruction. Fifth, research should be conducted to explore the meaning of hedonic motivation (which was statistically relevant) and collaboration (which was subsumed within performance expectancy). This research might consider using some form of physiological tracking or brain monitoring to determine the level of personal excitement and where this excitement most occurs within the educational context. Sixth, research should explore changes in the determinants for UTAUT and UTAUT2 relative to socioeconomic moderators to determine if these moderators reveal differences in the degree of choice for working-class and middle-class participants (a concept attributable to H. Delcore, personal communication, March 18, 2015). Seventh, conduct research that explores whether Hispanic students have a different ethnic self-identity relative to technology than those students who identify as both Hispanic and White. This research need not be linked to acceptance and use of technology. However, there are implications for practice and policy if Hispanic students experience their self-identity differently than students who identify as Hispanic and White. Eighth, the UTAUT model is mature enough that research should be conducted on the types of interventions to determine what adjustments to design, implementation, and support for a technology are efficacious and perhaps what interventions are appropriate for various situations. Lastly, longitudinal studies should be conducted to determine the effects of the level of quality access and meaningful experience on efficacy and proficiency with technology.

Concluding Remarks

The landscape of educational technology abounds with incomplete and inequitable adoption and diffusion. Executives launch well-intentioned I.T. initiatives with innovators and early adopters cheering on the change. One envisions a cattle chute with innovators scuffling forward in near-religious belief that technological innovation is in and of itself the greener pasture while the remaining prospective adopters recognize that these cattle chutes result in branding and other undesirable consequences. The 20th century may have tolerated the informal practices of design, rollout, and support of technological innovations with the result of partial adoption, wasted resources, and shallow integration of technology within practice. However, the 21st century won't tolerate yesterday's practices in light of the 21st century's emphasis on knowledge and innovation and the fact that those who cannot effectively adopt and meaningfully use technological innovations are socially and economically punished. Universities, as the public stewards of democracy and promoters of equity, must improve their practices for the adoption and diffusion of innovations for the sake of their students, their institutions, and society.

The way to improve practice is found within the theoretical framework presented in this study: understand the dynamics of adoption and diffusion; understand the predictors of behavioral use and use behavior, be mindful of what helps and hinders implementation, and practice participative design and design thinking. This theoretical framework confirms that (a) innovation emerges within a dynamic interchange of persons, work, technology, and social systems; (b) context affects dynamics of adoption and diffusion; (c) innovation affects equity; and (d) variations exist within populations. This theoretical framework leads to improved sensitivity to variations within populations and can lead to adjustments

in the design, implementation, and support of technology in ways acceptable and beneficial to stakeholders as well as achieve faster, less expensive adoption and yield deeper integration within practice. More specifically, ethnographic methods are critical to understand the lived-experience and associated meanings relative to a given technology. Understanding students in context should be an ongoing effort given the dynamic nature of students, faculty, technology, and learning. Recognizing and encouraging students' agency relative to technology is important to their lives in the 21st century as adopters, users, and critics of technology. Lastly, the effort to promote equity requires an understanding of the interplay between innovation and equity, the effect of social class on adoption and use of technology, and application of economic development wisdom to technological initiatives that may hinder the career and educational prospects of students with less advantaged socioeconomic conditions.

We must carefully design, implement, and support technological innovations in ways that promote equity through better student learning and student outcomes.

We must foster a critical pedagogy towards technology that (a) understands how to effectively use technology to improve learning experiences and student outcomes, (b) encourages the ability to adopt appropriate technologies, (c) teaches students to be critical of technology, especially where technology is reified, (d) ensures equitable outcomes derived from and necessary for the adoption of technology, and (e) discovers with students how to be effective agents in a digital age. Humans as agents, through this critical pedagogy, can shape the acceptance, use, and outcomes related to technology in ways aligned with and for persons.

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APPENDIX A: STUDENT ACCEPTANCE AND USE SURVEY

Student Acceptance and Use of Tablet Computers

Q1.1 Welcome to the Student Acceptance and Use of Tablet Computers Survey. This survey explores student's perspectives on the acceptance and use of tablet computers. We're asking you to share your perspective. This survey should take less than 10 minutes.

We define a "tablet" as a personal electronic device with a touch screen. It may but does not need to have a detachable keyboard. It is not a laptop with a keyboard that cannot be detached. It is not a mobile device that is mostly used as a phone.

We define "class work" as school related work done during a class and "homework" as school related work done outside of the class. We define "school work" as school related work done inside and/or outside of the class.

The information gathered from this study will remain anonymous except as required by law. Your decision to participate or not will not affect your relationship with your professor or with the university in any way. The Committee for the Protection of Human Subjects has reviewed and approved the present research. Questions regarding the rights of research subjects may be directed to the Chair of the Committee for the Protection of Human Subjects.

I am at least 18 years of age and agree to participate in this study

Yes (1)

No (2)

Q2.1 Are you enrolled in at least one course where your teacher expects use of a tablet for class work or homework (not a computer or a laptop)?

Yes (1)

No (2)

Q2.2 [This question only appears in the second phase of the survey and only if the respondent answers Yes to Q2.1]? Please rank in order the reasons why you took a tablet course in which you are enrolled?

Degree requirements

Course fit schedule

Specific faculty teaching course

Friend's recommendation

Course used tablet technology

Do not know.

Q3.1 I think using a tablet would help me do work in class more quickly.

Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.2 I think using a tablet would allow me to be more efficient with homework (to work faster or get more homework done).

Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.3 I think using a tablet would be helpful during class.

Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.4 I think using a tablet would help me be more organized.
Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.5 If I had unlimited access to a tablet, I would use it for non-school activities whenever I could.
Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.6 I think learning to use a tablet would be easy for me.
Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.7 I think it would be easy for me to develop the skills needed to use a tablet.
Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.8 I think homework would be easier to do if I used a tablet.
Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.9 I think checking on class assignments would be easier to do if I used a tablet.
Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.10 I think it would take me more time to do my homework if I used a tablet.
Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.11 I think my family believes I should use a tablet to do my school work.
Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.12 I think my friends believe I should use a tablet to do my school work.
Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.13 I think my teachers at this university believe I should use a tablet to do my school work.

Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.14 I think my classmates believe I should use a tablet to do my school work.

Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.15 If I needed help using a tablet, I would know how to get help.

Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.16 I think I could figure out what I would need to know to use a tablet.

Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.17 If I needed help using a tablet, I think I would know how to get help from the University Help Desk.

Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.18 If I needed assistance using a tablet, I think I would be able to get help from friends or family.

Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.19 If I had unlimited access to a tablet, I would use a tablet for classwork during class time in …

None of my courses (1)

Some of my courses (25)

Most of my courses (3)

All of my courses (4)

Don't know (5)

Q3.20 If I had unlimited access to a tablet, I would use a tablet to do homework for …

None of my courses (16)

Some of my courses (2)

Most of my courses (3)

All of my courses (4)

Don't know (5)

Q3.21 If I had unlimited access to a tablet, I would use a tablet for non-school work

None of the time (40)

Some of the time (41)

Most of the time (42)

All of the time (43)

Don't know (5)

Q3.22 Before I came to the university, I regularly used a computer or a tablet to do classwork in high school or at my previous college.

Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.23 Before I came to the university, every student had easy access to a computer or a tablet at the high school or previous college I attended.

Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.24 If you encountered a challenge using a tablet, what is the level of help you would need to overcome the challenge?

I could figure it out on my own. (1)

I would need online help or training. (2)

I would need someone available to help me by phone. (6)

I would need someone available to help me face-to-face. (3)

Don’t know. (5)

Q3.25 I think using a tablet would make homework more enjoyable.

Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.26 I think using a tablet for homework might distract me from doing the actual work.

Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.27 I think spending money on a tablet to help me do school work would be worth it.

Strongly Disagree (1)

Disagree (2)

Agree (3)

Strongly Agree (4)

Don't know (5)

Q3.28 I currently use a tablet for homework.

None of the time (1)

Some of the time (2)

Most of the time (3)

All of the time (4)

Don't know (5)

Q3.29 I currently use a tablet during class time.

None of the time (1)

Some of the time (2)

Most of the time (6)

All of the time (3)

Don't know (5)

Q3.30 I currently use a tablet for non-school work.
None of the time (1)

Some of the time (2)

Most of the time (3)

All of the time (4)

Don't know (5)

Q3.31 I have regular access to a tablet.
Yes (1)

No (2)

Q4.1 What is your ethnic background? Select all that apply.
American Indian and Alaskan Native (1)

Asian (Please specify; e.g., Chinese, Hmong...) (2) _____

Black or African American (3)

Hispanic, Latino or Spanish origin (4)

Native Hawaiian and Other Pacific Islander (5)

White (6)

Other (Please specify) (7) _____

Prefer not to answer (8)

Q4.2 Are you the first person in your family to attend college?
Yes (1)

No (2)

Don't know (3)

Q4.3 In high school did you "receive free or reduced lunch"?
Yes (1)

No (2)

Don't Know (3)

Q4.4 What is your gender?

Female (1)

Male (2)

Other (5)

Prefer not to answer (6)

Q5.1 There is a drawing for $25 and $10 Bulldog Bucks gift certificates. If you want to be in the drawing you will need to provide your contact information. The drawing will be within 7 days after this survey. Contact information will be deleted after the drawing. Do you want to be entered in the drawing?

Yes (1)

No (2)

Q5.2 Just like the survey you took, additional input on student perspectives will be collected through the use of photo diaries and focus group interviews. We invite you to participate in one or more of these opportunities to provide feedback. The information will be used to improve technology services on campus. [A photo diary includes taking photos using your smartphone based upon a prompt related to tablet technology. A focus group is a group of students coming together and discussing some questions related to tablet technology.] Please indicate below where you would be willing to participate.

Photo Diary (1)

Focus Group Interview (2)

Both Photo Diary and Focus Group Interview (3)

Neither (4)

Q5.3 This study also explores academic indicators and their relation to how students adopt and use new technologies. The consent below permits the research team to review your academic records for research purposes only, and the results of that review will remain confidential. Please indicate your consent to participate

in this important study by selecting YES and entering your Student ID in the contact information below.

Yes (1)

No (2)

Q6.1 You chose to participate in the drawing or additional research, so please enter your contact information below.

- Student ID (8)
- First Name (9)
- Last Name (5)
- Email Address (2)
- Phone Number (4)

Thank you for your participation!

APPENDIX B: PHOTO DIARY – PROMPT

Materials needed: Smartphone

If you have not done so already, please visit your smartphone's app store and download the free app called, dscout. Dscout enables you to submit "snippets" (dscout lingo for pictures and comments) to the researchers. The research team will access your snippets online using a password-protected dscout website. Your pictures and comments will remain anonymous. The web server on which they reside will be protected from public view. Only the research team will see your snippets. If you have any problems making dscout work, a research assistant is available to help you.

In the next two weeks, you will be looking for opportunities to take pictures based upon the prompts. Each time you take a picture, use the dscout comment box to briefly describe the context of the picture and why you took it. If you don't encounter some of these situations, it's ok. Do what you can and we will talk about the results when we meet.

First, tell us a little about the people and technology around you.

If you live in the household in which you grew up, or visit that household during the photo diary period, please:

Make a photo inventory of all computing devices in the household.

Ask at least one person in the household, whose technology skills and knowledge you respect, which device he or she think would be the most important for school and why (take the individual's photo if he or she are willing and if they are not willing then a photo of the device).

If you do not live in the household in which you grew up, or do not visit that household during the photo diary period, please do an inventory with the

people with whom you currently live. If you live alone, please do this with a group of peers.

Next….

During the next ten days, please take a picture of your tablet and the surrounding workspace every time you use your tablet for school work, both in and out of class (make sure to capture those times when you had challenges making your tablet work for you).

Specifically, take a picture of your workspace when you are using your tablet for school work or for your inventory of devices at home. Give your snippet a title. Then briefly, identify where were you and what were you doing when you took the picture. If you were having trouble with your tablet, tell us about that.

APPENDIX C: PHOTO DIARY – INTERVIEW QUESTIONS

The Pictures

At each picture, restate the participant's comments on the snippet and ask them to elaborate.

For example, the research might say "In this snippet, you took a picture of a blank screen on your tablet and said, 'I don't know why it's doing this.'"

To what item on the prompt was this snippet directed? (Possible answers include, "You found you have the appropriate knowledge to use your tablet effectively.")

Where were you when this happened?

What were you trying to accomplish at this point?

How did you handle the problem?

What would have made you more effective in this situation?

We appreciate your participation and have a $25 Starbucks gift card available to each participant. Thank you.

APPENDIX D: FOCUS GROUP INTERVIEW – MODERATOR SCRIPT

Welcome and Introductions

Thank you for agreeing to participate in this focus group interview. We appreciate your willingness to participate. I, [name], am the moderator for this focus group interview. My colleague, [name], will be recording our conversation and taking notes.

Purpose

This study is exploring student's acceptance and use of tablet technology for academic purposes. We want to hear your perspective so please be open with us as you share your thoughts.

Ground Rules

We want you to do the talking. We want everyone to participate. So I may call on you if I haven't heard from you in a while.

There are not right or wrong answers. Everyone's perspective is valuable. So speak up whether you agree or not.

What is said here stays here. We want you all to feel comfortable sharing your perspectives.

We will be tape recording our conversation. We want to capture everything that is said. We won't identify any one by name in our reports.

Guided Interactions

We first want to explore [performance expectancy] where you see tablet technology as useful, better than the alternatives, or particularly valuable.

Would a tablet enable you to do your homework faster? If so, how?

When would you find a tablet especially useful, helpful or valuable? [After exploring each episode then ask, with appropriate time for processing] Why was the tablet especially useful in such a situation?

Next, we want to explore [facilitating conditions] where you have had a particular challenge with tablet technology and what you did to get this resolved.

If you encounter a challenge using a tablet, what is the level of help you would need to overcome the challenge? For example, you might believe any of the following: I could figure it out on my own; I would need online help or training; I would need someone available to help me by phone; I would need someone available to help me face-to-face.

When would you find the tablet especially challenging and what did you do to resolve this challenge?

Finally, we want to explore [social influence related to performance expectancy] what your family and friends believe is more valuable: a smart phone, tablet computer, or laptop computer.

Which device; a smart phone, tablet computer, or laptop computer; would your family and friend believe is the more valuable device? Why would they think this device is more valuable?

Are there times when the second or third most valuable device is more helpful, useful or valuable?

Closure and Dismissal

Is there anything else you would like to say about what makes a tablet computer valuable or useful?

We appreciate your participation and have a $10 Starbucks gift card available for each participant. Thank you for participating in this group study.

APPENDIX E: SURVEY VERBAL INTRODUCTION

Phase I

"Hello. I'm [insert name]. I'm part of a research team exploring the acceptance and use of tablet technology by students. This information will be used to improve technology services on campus and inform research regarding student adoption of educational technology.

Today, we're asking you to participate in a survey that explores student's perspectives on the acceptance and use of tablet computers. This survey is phase one of a two-phase survey - which means the survey is given now and again in November. This survey should take less than 10 minutes. The survey should work on any mobile device including a computer, laptop, tablet or smartphone.

Your participation in this survey is voluntary. However, your perspective is very important so we appreciate your time. Please click through the link provided to you and begin the survey."

Phase II

"Hello. I'm [insert name]. I'm part of a research team exploring the acceptance and use of tablet technology by students. This information will be used to improve technology services on campus and inform research regarding student adoption of educational technology.

Today, we're asking you to participate in a survey that explores student's perspectives on the acceptance and use of tablet computers. This survey is phase two of a two-phase survey. This survey should take less than 10 minutes. The survey should work on any mobile device including a computer, laptop, tablet or smartphone.

We also want to let you know that there are opportunities to participate in additional research opportunities. One opportunity is what is called a photo diary - where you take photos using your smartphone and then jot a note down with each photo. We provide a prompt and, after seven days, we may interview you about your photo diary. The other opportunity is a focus group. Both opportunities include a small thank you gift for your participation.

Your participation in this survey is voluntary. However, your perspective is very important so we appreciate your time. Please click through the link provided to you and begin the survey."

APPENDIX F: SURVEY – INFORMED CONSENT ITEM

Welcome to the Student Acceptance and Use of Tablet Computers Survey. This survey explores student's perspectives on the acceptance and use of tablet computers. We're asking you to share your perspective. This survey should take less than 10 minutes.

We define a "tablet" as a personal electronic device with a touch screen. It may but does not need to have a detachable keyboard. It is not a laptop with a keyboard that cannot be detached. It is not a mobile device that is mostly used as a phone.

We define "class work" as school related work done during a class and "homework" as school related work done outside of the class. We define "school work" as school related work done inside and/or outside of the class.

The information gathered from this study will remain anonymous except as required by law. Your decision to participate or not will not affect your relationship with your professor or with the university in any way. The Committee for the Protection of Human Subjects has reviewed and approved the present research. Questions regarding the rights of research subjects may be directed to the Chair for the Committee for the Protection of Human Subjects.

I am at least 18 years of age and agree to participate in this study.

APPENDIX G: PHOTO DIARY – INFORMED CONSENT

You have been asked to participate in a photo diary study. The purpose of this study is to understand students' acceptance and use of tablet technology for academic purposes. The information learned from the photo diary will be used to improve services for students and inform research on student's acceptance and use of technology.

There are no right or wrong activities or items to record. We are interested in your perspective.

You can choose whether or not to participate in the photo diary and stop at any time. The information gathered from this study will remain confidential except as required by law. Your decision to participate or not will not affect your relationship with your professor or the university in any way. The Committee for the Protection of Human Subjects has reviewed and approved the present research. Questions regarding the rights of research subjects may be directed to the Chair for the Protection of Human Subjects.

I understand this information and agree to participate fully under the conditions stated above:

Signed: _____ Date: _____

APPENDIX H: FOCUS GROUP INTERVIEW – INFORMED CONSENT

You have been asked to participate in a focus group interview. The purpose of the focus group interview is to understand students' acceptance and use of tablet technology for academic purposes. The information learned from the focus group interview will be used to improve services for students and inform research on student's acceptance and use of technology.

There are no right or wrong responses to focus group questions. We want to hear many different viewpoints and want to hear from everyone. We want you to be honest even when your response may not be the same as others. In respect for each other, we ask that only one individual speak at a time and that responses made by participants remain confidential outside of the focus group.

You can choose whether or not to participate in the focus group interview and stop at any time. Although the focus group interview will be recorded, your responses will remain anonymous and no names will be mentioned in subsequent research reports.

The information gathered from this study will remain anonymous except as required by law. Your decision to participate or not will not affect your relationship with your professor or the university in any way. The Committee for the Protection of Human Subjects has reviewed and approved the present research. Questions regarding the rights of research subjects may be directed to the Chair for the Protection of Human Subjects.

I understand this information and agree to participate fully under the conditions stated above:

Signed: _____ Date: _____

APPENDIX I: CLOSED CODES

Function of Information and Communication Technology (ICT)

Note: Can code for more than one in this group, however, VALPRO and VALCON must be mutually exclusive. VALPRO and VALCON are both present, decide which is dominant and code for that.

Value Generation-Production (VALPRO): Student is using ICT to produce text, audio, video, or some other output. Includes both paper and pen products and digital products. Examples include doing problem sets, writing a paper, composing a presentation, editing video. When coding snippets, apply this code when production is the dominant activity.

Value Generation-Consumption (VALCON): Student is using ICT but not producing output. Includes reading, studying for an exam. When coding snippets, apply this code when consumption is the dominant activity.

Access (ACCX): Student is using ICT to access information. Examples: using a search engine or database. When coding snippets, apply this code whenever present, even if not the dominant activity.

Control (CONX): Student is limiting or enabling others' access to some resource, either digital or physical. (We are unlikely to see this.)

Entertainment (ENTX): Student is using ICT in a way that they identify as primarily about enjoyment, relaxation, etc. When coding snippets, apply this code whenever present, even if not the dominant activity.

Collaboration (COLX): Student is using ICT in a way that brings them into contact and engagement with others. Can be about school (e.g. using Google Drive to give a classmate feedback on a shared assignment) or non-schoolwork

(e.g. online multi-player game). When coding snippets, apply this code whenever present, even if not the dominant activity.

Type of Work

Schoolwork (SCHX): The work is in response to school requirements or assignments. When coding snippets, apply this code when schoolwork is the dominant activity.

Non-Schoolwork (NONX): The work is NOT in response to school requirements or assignments. Could include entertainment, hobby-related activities, etc. When coding snippets, apply this code when non-schoolwork is the dominant activity.

Location

In-class (INCX): Student is in a classroom while class is in session.

Residence (RESX): Student is at home (defined as where they are sleeping).

Public-off-campus (OFFX): Student is in a public space off-campus.

Public-on-campus (ONX): Student is in a public space on-campus.

Constructs

Performance Expectancy (PERX): The situation registers performance expectancy, defined as "the degree to which an individual believes that using the system will help him or her to attain gains in job performance" (by being more effective or efficient). Includes cases when the tablet actually helped or hindered job performance. Beware of simple declaratives about function; it is PERX when it is said or seen to actually increase/decrease or improve/impede performance.

Effort Expectancy (EFFX): This is about ease of use. The situation registers effort expectancy, defined as "the expected degree of ease associated with user's use of technology." Includes cases when the tablet, including its OS and apps, actually was or was not easy to use. Beware simple statements of function; it is EFFX when it is said or seen to be easy/difficult to use.

Social Influence (SOCX): The situation registers social influence, defined as "the degree to which an individual perceives that important others believe he or she should use the new system." Also includes any mention of social influences on choice to use or not use (e.g. a prof encourages a student to download and use a new app on a tablet for the course - without supporting or personally facilitating that action).

Facilitating Conditions (FACX): The situation registers facilitating conditions, defined as "the expected degree to which an individual believes that organizational and technical infrastructure exists to support use of the system. This is the user's perception that resources and support will be available to help the user perform the desired activity." Includes any mention of steps taken to resolve challenges to use, or any support offered by a representative of the university to facilitate use (e.g. a prof talks a class through the download and use of a new app for use on the tablet in the course).

Devices

Note: Include both devices pictured and devices mentioned, even if they are not in the picture. When coding snippets, assign one code to each device present.

Cell Phone (CLPH): Personal communications device that is intended for cellular communications and Internet browsing functionality is at best limited.

Smartphone (SMPH): Personal communications device that supports Internet browsing and the use of device specific applications or 'apps'. Phablets are phones with large screens and this will be coded as Smartphone.

Tablet (TBLT): Portable personal computer with a touch screen as its primary input device (EDUCAUSE, 2014). It normally does not have the compute capacity of a laptop. It may have a detachable keyboard. Slates are tablets where the keyboard is optional and this will be coded as Tablet.

Laptop (LPTP): Portable personal computer with a keyboard as its primary input device. It may have a detachable keyboard.

Hybrid (HYBD): Portable personal computer with a detachable keyboard and a touch screen. The user may choose to use the computer as a tablet (detach keyboard, use touch screen) or a laptop depending upon the circumstance. Laplet or 2-in-1 is also used as a term for a laptop/tablet with a detachable keyboard and more processing power. However, the term Hybrid will be used here.

Challenges

Note: Apply these for challenges related to tablets only.

Knowledge (KNGE): The student was challenged due to a lack of knowledge expressed as "I did not know how to..." or evidenced by "I then was able to … when I learned how." When coding snippets, apply this code whenever present, even if not the dominant challenge.

Connectivity (COTY): The student was having difficulty connecting to the Internet, wired or wireless connection. The student may be experiencing this due to a problem with wireless or broadband access. When coding snippets, apply this code whenever the student cannot connect to the Internet, even if not the dominant challenge.

Equipment (EQNT): The student has a device failure due to a hardware problem or the because the base operating system is not working. This may be evidenced by "device won't turn on", "screen goes black (or white)", "screen is broken" etc. When coding snippets, apply this code whenever present, even if not the dominant challenge.

Applications (APNS): The student is having difficulty with an app or application. This can be the result of a bug in the application (e.g., the app just disappears or quits), an authentic issue (e.g., can't log on), a functional issue (e.g., it won't save

my ePortfolio to Blackboard), or a compatibility issue (e.g., Notability version x does not work with iPad version y). When coding snippets, apply this code whenever present, even if not the dominant challenge.

Performance (PECE): The student is having difficulty because their device, application or Internet connection is performing poorly. This may also be caused by Internet access beyond their device being negatively impacted or the enterprise/cloud service supporting the app or application performing poorly. Nonetheless, the student is experiencing poor performance. This may be evidenced by comments like "the application crawls" or "this web page is really slow but I can watch a YouTube video without a problem." When coding snippets, apply this code whenever present, even if not the dominant challenge.

Convenience (CONVX): Registers the person's experience of the physicality of the device and/or the relation of the device to the physical environment. Includes traditional understandings of "convenience," such as not wanting to carry three devices (laptop, phone, tablet), or feeling the portability of a tablet confers an advantage over laptops. Also includes ergonomic experiences such as the tablet fitting well on a small desk or on your thigh, or preferring a laptop's larger keyboard and screen to type text. Device relation to the physical environment includes, for example, lack of outlets for charging, room lighting, etc.