Use Authorization

In presenting this dissertation in partial fulfillment of the requirements for an advanced degree at Idaho State University, I agree that the Library shall make it freely available for inspection. I further state that permission to download and/or print my dissertation for scholarly purposes may be granted by the Dean of the Graduate School, Dean of my academic division, University Librarian, or by myself. It is understood that any copying or publication of this dissertation for financial gain by a commercial publishing company shall not be allowed without my written permission.

Signature _____

Date _____

MILLENNIALS' USE AND PERCEPTION OF TECHNOLOGY IN FORMAL EDUCATION

by

Lennia J. Machen

A dissertation

submitted in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy in the Department of Instructional Design

Idaho State University

Spring 2018

To the Graduate Faculty:

The members of the committee appointed to examine the dissertation proposal of Lennia J. Machen find it satisfactory and recommend that it be accepted.

_____
Dr. Karen Wilson Scott
Committee Chair

_____
Dr. David Coffland
Committee Member

_____
Dr. Beverly Ray
Committee Member

_____
Dr. Dani Moffit
Committee Member

_____
Dr. Bryan Gee
Graduate Faculty Representative

July 19, 2017

Lennia Machen
Educ Leadership / Inst. Design
MS 8081

RE: regarding study number IRB-FY2017-302: MILLENNIALS' USE AND PERCEPTION OF TECHNOLOGY IN FORMAL EDUCATION

Dear Ms. Machen:

I agree that this study qualifies as exempt from review under the following guideline: Category 2. Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation. This letter is your approval, please, keep this document in a safe place.

Notify the HSC of any adverse events. Serious, unexpected adverse events must be reported in writing within 10 business days.

You are granted permission to conduct your study effective immediately. The study is not subject to renewal.

Please note that any changes to the study as approved must be promptly reported and approved. Some changes may be approved by expedited review; others require full board review. Contact Tom Bailey (208-282-2179; fax 208-282-4723; email: humsubj@isu.edu) if you have any questions or require further information.

Sincerely,

Ralph Baergen, PhD, MPH, CIP
Human Subjects Chair

Acknowledgements

I would like to thank my major advisor Dr. Karen Wilson Scott for her patient and kind support throughout this process. Despite difficult circumstances starting out, she took me in and made me feel very welcome and fully supported in this arduous process. I have greatly appreciated her leadership, timely suggestions, expert editing, coaching, and warm positive attitude. I also wish to thank my committee members; Dr. David Coffland, Dr. Beverly Ray, Dr. Dani Moffit and Dr. Bryan Gee, for their time and efforts in supporting the completion of this study. Leadership is not always position and title, it is more often action and example.

As Confucius says about learning, "it does not matter how slowly you go as long as you don't stop." This final degree is the last chapter in a tome that started in 1975 and spanned a full lifetime. I'm no quitter. And I'm very excited to start my next opus.

I would also like to thank my loving husband for his unending support and patience throughout my long educational career. In addition, I'd like to thank my mother and father for their continued and generous support to see me through until the end of this journey. Without the support and cheering on by my whole family, I couldn't have persevered and achieved this final degree. And lastly, I thank the Lord for blessing me with the skills I needed and the team to support those skills to see this long expedition to its completion. It's been a long but very gratifying trail to success and I am grateful for the opportunity to have traveled it through to the end of this edition and into the beginning of the next.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Millennials' Use and Perception of Technology in Formal Education

Dissertation Abstract – Idaho State University 2018

This study explores Millennial-aged college students' use and perceptions of technology used in higher education. The purpose of this descriptive survey study is to describe (1) the relationship between Millennial learners' use of technology devices and applications in personal versus formal education environments; and (2) the relationship between Millennial learners' preferences for technology devices and applications in personal versus formal education environments. Using an online survey distributed to 12,643 students at an Intermountain West university, 1281 responded to the 25-question instrument. The data were analyzed to produce descriptive statistics concerning participant demographics and relevant descriptions to support seven research questions. Chi-square and Cramer's V for effect size tests were applied to determine significant relationships between student age and technology perceptions.

Results from this study found significant relationships between the Millennial-aged student and digital devices used for educational purposes. Statistical significance was also found between the age of the student and their choice of course delivery method. A moderate to large size of effect was noted for Millennial students preferring face-to-face classroom courses over synchronous or asynchronous online learning methods.

This study reveals the perceptions and usage of the Millennial-aged learner and their preferences for technology use in their education through primary empirical data. Further, the study supports instructional designers in their need to supply students with appropriate, high-quality learning methods and design features which best support the Millennial learner.

Keywords: millennials, online learning, preferences, discussion boards, post-secondary, instructional design.

CHAPTER I

Introduction

Assumptions regarding technology use and skills in Millennial learners' education may be wrongly driving online learning design in higher education. "Millennials"— is a term coined by Strauss and Howe (1991) to describe the cohort born roughly between 1982 and 2004, a period which ushered in the Digital Age. These students have been exposed to a variety of technology devices for their entire lives before entering college or university as computers became commonplace for learning, work, and entertainment in the majority of American households. Since the turn of the twenty-first century, educators have made broad assumptions about Millennials and technology, presuming that their digital experiences in social and entertainment venues would naturally prepare them for emerging digital educational technologies. However, educators and researchers are now questioning this assumption that mere exposure to technology leads to the skills and attitudes potentially necessary for educational experiences such as online learning (Bennett & Maton, 2010).

Digital Natives and the Academic Environment

Marc Prensky (2001) unintentionally became a spokesperson for the movement to tailor academia to suit "Digital Natives"—his preferred term for Millennials, Gen-Y's, and Net-Gen's. "Today's students are no longer the people our educational system was designed to teach," he proclaimed (2001, p. 1). He asserted that instructional design should now be based on the premise that this cohort would naturally accept and prefer digital learning due to their inherent usage of technology in their lives overall, (e.g., video gaming, mobile phone use, social networking, Internet access in general, etc.). Many academic institutions heeded Prensky's call by initiating changes in curricula and instructional design with regard to technology use, as

evidenced in instructional design-related publications and applications (Bracy, Bevill, & Roach 2010; Farrell & Hurt, 2014; Merlino, 2009; Prensky, 2001; 2009).

Recently, however, dissenting authors (Barnes & Jacobsen, 2014; Bennett, Maton, & Kervin, 2008; Gallardo-Echenique, Marqués-Molías, Bullen, & Strijbos, 2015; Waycott, Bennett, Kennedy, Dalgarno, & Gray, 2010) contend that Prensky's assumption lacks validity for instructional design meant for Millennial learners. Lai and Hong, (2015) furthermore assert that significant differences do not exist among generations (Millennials, Gen-X, or Baby Boomers) when it comes to the use of technology for personal versus academic purposes. They also contest the commonly held assumption that digitally literate students prefer online learning over live classroom courses.

The challenge to Prensky-like assumptions extends beyond the United States to other nations with high digital literacy. In a survey of traditional students entering Australian universities aimed at providing empirical support for instructional design, researchers compared the types of technology students used in social versus academic venues (Kennedy, Judd, Churchward, Gray, & Krause, 2008). They found a clear discrepancy between devices and applications used in students' educational activities and those used in their social lives, thus disconfirming prevailing popular assumptions regarding Millennials and technology use. Accordingly, these authors called for further empirical research in this area. The present study is a response to this call. As noted by various authors, the transfer from social or entertainment technologies to learning technologies is neither automatic nor guaranteed (Barnes & Jacobsen, 2014; Bennett et al., 2008; Gallardo-Echenique et al., 2015; Kirschner & van Merrienboer, 2013; Koutropoulous, 2011; Thompson, 2013; Vaidhyanathan, 2008; Waycott et al., 2010).

Digital Device Overview

Since 2008, when Kennedy et al., discovered that students were not as demanding of technology-based devices and uses in their education as previously believed, much has changed in the available devices, processes and applications. For example, the Kennedy study listed a PDA (Personal Digital Assistant, such as a Palm Pilot) as one popular device, and a "Mobile phone with a camera" as another. The change in availability and usage of technology-based devices has shifted dramatically between 2008 and 2016, as shown in the 2015 PEW Research report on device usage: the PDA is no longer listed, the distinction between a desktop and laptop computer is gone, tablets are now commonly used, and smartphone ownership and use has risen from zero to 86% ownership by the general public in the last five years. Ubiquitous computing –an innovative concept defined as computing and learning anytime and anywhere— has also arisen during this period (Yahya, Ahmad, & Jalil, 2010).

Ownership of digital devices shows a sharp increase in several areas, according to the EDUCAUSE Center for Analysis and Research (ECAR) Study of Undergraduate Students and Information Technology (Dahlstrom, Brooks, Grajek, & Reeves, 2015). The authors list the devices as including desktop computers, laptop computers, tablets, Internet gaming devices, smartphones, and wearable devices such as a digital fitness tracker or smart watch. They report a slight drop in the number of students owning a desktop computer over the five years of the study, while ownership of laptops increased around 10%. Concurrently, the number of students owning a tablet rose from around 10% to 63% while the number of students owning smartphones rose from 53% to nearly 90%. While 98% of students owned at least one digital device, 92% owned at least two, 64% three or more, 31% four or more, and 15% owned five or more (and there likely are some with six or more). Considering the level of ownership of digital

devices, it is hardly surprising that instructional designers have become focused on the use of digital technology for educational purposes.

Beyond the issue of simple ownership of digital devices, questions about digital skills and preferences have arisen. The distinction between specific ICT (Information Communication and Technology) skills needed in educational use and those skills needed for social use raise further instructional design issues as mobile devices begin to dominate traditional desktop/laptop computing applications (MacCallum & Jeffery, 2013). While the decades-old debate of how much technology is needed in a classroom continues (Clark, 1983; Kozma, 1991), instructional design will still need to face the challenges of the changing world and students' practical needs and expectations. Not only are designers aiming to provide access to instructional materials, but they also must include additional elements, i.e., the reinforcement of foundational and soft skills and pathways to specific technical skills (Johnson et al., 2016).

The Statement of the Problem and the Statement of the Purpose

The problem to be addressed by this study is that the positive association between students' use of technology and their preference for its use at university leaves unanswered the question as to whether students' everyday skills with emerging technologies correspond to skills associated with beneficial, technology-based learning. These technology use concerns point to many unresolved issues that warrant further investigation. (Kennedy et al., 2008). Bennett and Maton, (2010) suggest that the assumption that mere exposure to technology leads to the skills and attitudes potentially necessary for educational experiences such as online learning should be investigated.

The purpose of this descriptive survey study is to describe (1) the relationship between Millennial learners' use of technology devices and applications in personal versus formal

education environments; and (2) the relationship between Millennial learners' preferences for technology devices and applications in personal versus formal education environments by Millennial-aged college students.

A literature review found a lack of empirical research on technology-based device choice and application by Millennial-aged students actively enrolled at a university. What does emerge from the literature is a striking lack of correlation between assumptions of Millennials' digital skills and their preferences in academia and the corresponding common suppositions that inform most instructional design. Digital devices are a critical component in instructional design, yet without adequately focused research, instructional designers are forced to rely on shaky but seldom questioned assumptions regarding learners' skills and preferences.

One of the most recent comprehensive overviews of research on generational digital literacy, the 2016 Horizon Report, concluded that while today's students may appear more digitally literate than previous generations given their personal use levels, their heightened exposure to technology does not guarantee the necessary digital confidence or literacy in educational contexts (Johnson et al., 2016). The report cites a recent survey ranking adult digital literacy skills across developed nations which put the United States near the bottom, leading the report's authors to advocate for research into ways to improve digital literacy in Millennial-aged adults. This mismatch between university staff assumptions and actual digital literacy and technology preferences was also found in an earlier study (Kennedy et at., 2008). Overall, the literature shows the need for additional research into the discrepancies between Millennials' digital skills, use level, and preferences in personal versus educational environments.

Research Questions

1. What devices do college students choose for:

a. personal/social use?

b. formal education use?

2. What devices do college students prefer for tasks associated with:

a. personal/social use?

b. formal education use?

3. What are the preferences for technology use:

a. in personal/social applications by college students?

b. in formal education applications by college students?

4. What course delivery methods do college students prefer?

5. What online course features do college students prefer?

6. Is there a relationship between technology use by Millennial-aged college students and college students of other generations?

7. Is there a relationship between perception of technology by Millennial-aged college students and college students of other generations?

Definitions

Asynchronous learning: a general term used to describe online learning or courses that do not occur on a fixed time schedule (Asynchronous learning, 2017).

Blended synchronous learning: "Learning and teaching where remote students participate in face-to-face classes by means of rich-media synchronous technologies such as video conferencing, web conferencing, or virtual worlds" (Bower, Dalgarno, Kennedy, Lee, Kenney, 2015).

Cell phone: or mobile phone which is used for making calls, texting, or storing photos or data but which has no computing system or Internet connectivity.

Desktop: is a computer which uses a central processing unit (CPU) to hold the computing system and peripherals such as CD/DVD readers and burners, graphics cards, hard drives, and other devices. The desktop is designed to be stationary equipment as opposed to the portability of a laptop computer and will use a large monitor and separate keyboard and mouse.

Digital devices: any device that relies on digital signals that use "0" or "1" as a binary coding method. Examples of digital devices include computers, sound synthesizers, smartphones, MP3 players, and other computing devices capable of communications, computations, and sound or video reproduction (Digital, 2016).

Digital native: a synonym used to describe a person born between 1985 and 2005 and who are the first generation of people to have lived with digital technology for their entire lives (Prensky, 2001).

Digital skills – formal education: skills used for applications supporting college course learning. Examples may include the use of a learning management system for access to a course, researching through the use of databases and online repositories, specialized software used in specific course applications such as statistical calculations or mathematics, document preparation software used in creating artifacts for coursework, etc. (For a more complete list, see Appendix A.)

Digital skills: are skills used in applications and operations of digital devices and computing. For purposes of this study the definition will include knowledge and ability to use digital devices and applications to input, access, organize, and use digital resources to construct new knowledge, create, express, perform tasks, and communicate with others. Examples may include use of a smartphone and some of its features, basic word processing, use of a tablet or laptop, use of an available Wi-Fi connection, etc. (For purposes of this study see Appendix A.)

Formal education: for purposes of this study, this term shall refer to a degree-seeking program being taken at a university.

Information and communication technologies (ICT): a broad term describing any communications device, more recently focused on devices with Internet and digital communications capabilities (Ng, 2012).

Laptop: a portable computing device with an operating system that often has Internet connectivity through Wi-Fi or possibly a data plan using 3G/4G, designed to fit into a briefcase or backpack. The design uses a clamshell-type case enclosing a monitor or screen and keyboard and mouse touch pad. Smaller versions are called a Netbook or Chromebook. Computing power can range from a simple device designed to handle emails and web surfing to high powered computers with terabytes of memory and computing capacity.

Learning ecology: the set of contexts found in physical or virtual spaces that provide opportunities for learning. Each context is comprised of a unique configuration of activities, material resources, relationships, and the interactions that emerge from them (Baron, 2006).

Learning Management System (LMS): "A software application used to organize and distribute e-learning materials, assignments, and assessments; track and calculate grades and facilitate communication among students and teachers" (Learning management system, 2016, http://www.dictionary.com/browse/learning-management-system).

Millennial: used to describe a person born roughly between 1983 and 2005, so named for the change of the Millennial century. Millennials are the first generation to grow up with digital technology available since birth (Howe & Strauss, 2007).

Massive Open Online Course (MOOC): open online course, usually free, open to anyone and potentially having a huge number of enrolled participants (MOOC, 2017).

Net Generation: a synonym to describe a person born between the mid-nineteen-eighties and 2005, and to describe people who have grown up in a "wired" world – who are digital, connected, experiential, and social (Oblinger, 2005).

Personal/social technology use: for the purposes of this study technology device and skill use for applications outside of a formal education program will be included under this term.

Smartphone: A cell phone with a mobile operating system with features similar to a personal computer and which has Wi-Fi or 3G/4G connectivity to the Internet.

Smartwatch: a wristwatch with a computing system and Internet connectivity which functions like a smartphone, commonly used for mobile connectivity and physical training applications.

Synchronous learning: learning that takes place in a classroom environment at the same time but not in the same place. Examples include: web-based conferences, satellite-based distance learning, or real-time chat discussions (Synchronous learning, 2013).

Tablet: a portable device that uses a touch screen for input and which offers a computing system and often has Internet connectivity through a data plan (like for a smartphone) or through a Wi-Fi connection. Common types of tablets in 2018are iPads, Fire, and Surface.

Technology or Educational Technology: For purposes of this study the term technology will be operationally defined as the appropriate hardware or software tools, techniques, or processes that facilitate and enhance teaching and learning outcomes (Aziz 2010), or the use of devices such as laptop computers, smartphones, or other computing and communication devices.

Ubiquitous computing: an advanced computing concept describing the ability to

compute anywhere and everywhere, usually depicting the use of mobile technology, integration of Internet connectivity in devices used for computing or transmitting data (Ubiquitous computing, 2017).

Limitations and Delimitations

Limitations. Creswell (2003) describes limitations as boundaries that cannot be controlled and should be stated during the proposal stage of research. The boundaries of this study that could not be controlled included: (a) survey, as a methodology relies on a self-report questionnaire and participant candor which cannot be supported by objective third-party verification for participant truthfulness, accuracy, or completion, (b) the participant population of a Western university could not be relied upon to have homogenous technology skills or digital device experience, and (c) the motivation of those who completed and returned the questionnaire versus those who did not, is unknown. To help encourage full and focused participation, the anonymous survey was intended to be brief and with a scope limited to self-reported demographic information, the research questions, and related areas of interest.

While self-administered questionnaires tend to yield fewer reports than interviewer-administered questionnaires, they show an increase in accuracy (Kreuter, Persser. & Tourangeau, 2008). The authors suggested a higher rate of participation for studies targeting populations familiar with internet use and technology, as well as those with an associated interest such as this study. The intention of the researcher was to begin the survey phase in early September and was delayed to late October due to a delay in the competition of the pilot study. Responses were reported by 1281 (10.13%) providing complete and usable records. In addition, the percentage of males to females who completed the survey were not representative of the known enrolled student body at the time of the study. Only 31.9% of the participants were male,

and 68.1% female, while the enrollment showed a percentage of 47% males to 53% females. After discussion of the sex of participants and its importance to the study, the lack of corresponding ratios was deemed not to be an issue in concern of device use in education or personal/social overall but could skew results regarding online gaming (predominately male participants) or use of social media (predominately female participants).

Delimitations. Delimitations are those factors which are in the control of the researcher and determine the limits or boundaries of something (Delimitations, 2017).

- This study was delimited to college students who are 18 or older and enrolled in the 2017 Fall semester at an intermountain and rurally-located university, in eastern Idaho.
- The targeted population were those born between 1982 and 1999 satisfying the 18 years and older criterion and Strauss and Howe's (1991) definition of Millennials.
- This study was delimited to participants with an appropriate digital device to access the survey such as a smartphone, tablet, or computer and who have adequate broadband or Wi-Fi connectivity to access and respond to the survey.
- This study was delimited to the available understanding of technology and digital skill levels of the participants.

Significance of the Study

Considering the speed of change in technology used in education, current research was needed to guide designers towards useful and appropriate instructional designs that will be accessed by student-preferred devices. Without understanding which devices are used most in both personal/social and educational applications, the designer may rely on out-of-date research or anecdotal evidence to properly design learning interfaces. The call for current empirical research regarding Millennials' use of mobile and other current technology is ongoing and

necessary for applications in higher education, as well as in commerce and industry (Akçayır, Dündar, & Akçayır, 2016; Gallardo-Echenique et al., 2015; Hawi & Samaha, 2016; Kirschner & van Merriënboer, 2013; MacCallum et al., 2014; Margaryan, Littlejohn, & Vojt, 2011; Smith, 2016; Teo, 2013; Vázquez-Cano, 2014). While some studies provide results based on anecdotal beliefs and opinions from other generations regarding the preferences of Millennial users (Bracy et al., 2010; Farrell & Hurt, 2014; Merlino & Rhodes, 2012; Prensky, 2001a; 2001b; 2009; Week, 2016), very few studies were found based on the direct feedback of the Millennial participant. The significance of this study was found in providing understanding and direction for instructional design through the reporting of evidence regarding the relevant skills and preferences of Millennials for online learning access and success. As noted in the results and conclusions, Millennials reported a preference for face-to-face classroom courses over all asynchronous or synchronous technology-based course methods. Further, participants reported a distinct difference in digital device preferences when performing tasks for education versus personal/social use. By learning of these preferences and others reported in the results, instructional designers will now have more information with which to support design choices especially for Millennial learners.

CHAPTER II

Literature Review

The review of literature for this study utilized databases accessed through the Idaho State University library, which included searches in main subject groups such as college and university information (3 databases), computer science and technology (14), education (34), psychology (25), sociology (4), dissertations and theses (3), ERIC (education research information center), MasterFILE Premier, psychology and behavioral sciences collection, web news, and others. In addition to the search through ISU's library, other repositories were searched, including in order of frequency: Google Scholar, Merlot, Researchgate, Science Direct, Springer, Rutgers, JSTOR.com, Wiley Online Library, Semantic Scholar, First Monday, and others. Individual publications were also searched and some of the most used journal searches included: Scientific American, T&D, Time, EDUCAUSE Review, British Journal of Educational Technology, Computers & Education, Harvard Business Review, and others.

The search terms used for this study included multitudes of arrangements using keywords (not listed in order of importance) such as: asynchronous, digital device, digital literacy skills, digital mobile devices, digital native, e-earning, Gen X, Gen Y, generations, ICT skills, ICT, instructional design, learning ecology, learning management systems, Millennials, mobile learning, MOOC, online courses, Online earning, online satisfaction, perceptions of m-learning, smartphones, social media, synchronous, technology acceptance, technology, ubiquitous computing, ubiquitous learning, and many more terms.

The literature gathered were deposited into a Qiqqa™ library and annotated and tagged with appropriate keywords supporting the categories and sections of the study. The Qiqqa library supports keyword and comprehensive searching for words or annotated phrases. To

further support thoroughness of covering the study focus, research questions, sections and subsections of the study, Gingko™, a card-catalog type of organizer was used to create a searchable framework to note concerns and questions surrounding each focus area. This information in turn, was used to generate a mind map of topics and questions, of which were embellished with author names found to support each area of interest to the study.

The purpose of this descriptive survey study was to describe (a) the relationship between Millennial college students; use of technology-based devices and applications in personal/social versus formal education environments and (b) their preferences of technology-based devices and applications in personal/social versus formal education environments.

The literature research began with the terms "Millennial" and digital native, which resulted in a plethora of materials, including a range of definitions and similar terms. To shed light on the myth of the digital native (Gallardo-Echenique et al., 2015; Margaryan, Littlejohn, Vojt, 2011; O'Neil, 2014; Vaidhyanathan, 2008), the search then focused on locating scholarly publications dealing more specifically with the issues of Millennial college students and technology, including their digital skills and their preferences for technology in learning. Sifting through the results, it was discovered that there were widespread reports of assumptions and opinions regarding Millennial learners' and their perceptions about educational technology, but surprisingly little empirical research to substantiate them.

Also included in the research was the investigation of technology use in higher education of technology which turned up empirical studies as well as diverse and opposing views on various issues, including how much technology is desired in the classroom, the pros and cons of mobile device use in the classroom, and the pitfalls and concerns about distractions by portable device use during classes.

The second half of the literature review explored Millennials' actual digital literacy and technological preferences. Several recent empirical studies, including a meta-analysis, were found regarding Millennial ownership of and use of digital devices for personal/social purposes. Additional studies and commentary were found regarding Millennial preferences for, intentions to adopt, and satisfaction with technology-based learning applications. The focus of understanding Millennial college students' perceptions about technology included a thorough search for studies which surveyed Millennial-aged students and asked them for their perceptions about online learning applications. The results of the literature review were clustered into the following categories which serve as sections for this review of literature: Millennials, digital natives and the net-gen generation, the myth of the digital native, technology use in education, technology used in higher education, portable devices – multitasking and distractibility, assessing Millennials' technology skills and attitudes, digital skills, , student satisfaction with online learning, and Millennials' perceptions about technology.

Millennials, Digital Natives, and the Net-Gen Generation

Every generation is defined and shaped by the key historical events and social trends of its formative years, e.g., a major war, a presidential assassination, etc. (Howe & Strauss, 2007). The approach of a new century inspired Strauss and Howe to use the term Millennial for the generation that would begin graduating from high school in 2000 (Strauss & Howe, 1991). In addition to Millennials, other labels such as the "Net-Generation" or "Net-Gen" for short also took hold to describe the first generation to be born after digital computing became available readily (Tapscott, 1998). Yet more terms for the generation born between roughly 1985 and 2005 were coined by other authors searching for creative titles to describe the first all-digital-all-the-time generation. "Digital native" was popularized by Marc Prensky (2001a, p. 1), who,

in his first article on the topic boldly asserted that "this generation would be different than any other" (p. 1).

While Prensky's work was largely anecdotal, his timely published assumptions and assertions allowed for a plausible labeling of this new generation which was otherwise undefined. Many in the academic world accepted his timely assertions, and the idea of a new kind of student was hastily accepted. *Digital native* soon became the widespread label for the age group whom Prensky (2001a) claimed was "a generation which had changed radically and whom are no longer the people our educational system was designed to teach" (p. 1). He claimed that "digital natives' brains are likely physically different due to the digital input they received growing up" (2001b, p. 1). Prensky's dramatic assertions sparked a kind of moral panic among academics who were unsure of the needs of this allegedly new type of student and thus overly accepted of any input that might help them handle the situation (Bennett, et al., 2008).

Furthermore, Prensky also created the label "digital immigrants" (2001a, p.2) to refer to those who were not born within the digital natives' time frame, but who immersed themselves in the new technology, thus highlighting the divide. "The single biggest problem facing education today is that our Digital Immigrant instructors, who speak an outdated language (that of pre-digital age), are struggling to teach a population that speaks an entirely new language," (p. 2) he wrote (2001a). As his ideas gained attention, other articles supporting his assertions reinforced the moral panic sweeping universities and colleges as administrators scrambled to meet the needs of this purportedly new all-digital student. Studies supporting Prensky's digital native assertion received serious consideration as universities began to face the many rapid, global changes in technology.

Merlino (2009) published a qualitative study in which selected faculty were interviewed and surveyed about course design changes they might need to make to meet the needs of the students entering university business programs. Results revealed a general disgruntlement on the part of the digital immigrant faculty towards the digital native students, with faculty blaming Millennial shortcomings and differences as the cause to needing major pedagogical changes in their existing teaching methodologies. Merlino found the Millennial student was pro-technology, unrealistic about work and life, multi-tasking, and not prepared for college, having poor written communication skills, short attention spans, and a global view as per the study input. However, Merlino also found a lack of faculty support towards training and development using the technology needed to meet today's expectations.

In a later article on the same topic, Merlino and Rhodes (2012) reported key strategies that seem appropriate to any aged learner (e.g., using real-world examples, creating activities such as applied learning, projects, group work, and providing clear structure) and recommended to administration to prioritize training on technology for all faculty as well as use of blended learning methods, applying online programs and providing feedback (p. 126). The authors' attempt to paint a negative picture of the digital native as being the reason for change may have served only to highlight the lack of preparedness on the part of the faculty involved. The article did not find any significant differences of Millennials over previous generations, rather, they identified strategies geared towards all students using technology.

Bracy, Bevill, and Roach, (2010) discussed teaching challenges related to the Millennial generation and point out negative attributes of the Millennials with findings like "their reliance on and comfort with all things technical can also be irritating and frustrating to faculty who tire of seeing students with phones 'attached' to their ears (or fingers) as they walk around campus"

(p. 1). However, they also gave praise to the positive characteristics culled from other studies about Millennials in their efforts to make useful recommendations for educators, whose average age was above 50. Conversely, they found complementary attributes showing Millennials to be very tech-savvy, embracing diversity, more socially responsible and civic-minded, preferring multi-tasking, and desiring more fun and more laid-back ways of being than previous generations. Notable within the conclusions intended for educators is the advice to moderate the use of technology, vary their methods of delivery, and to include more group and interactive activities. In spite of the title of the article suggesting recommendations towards overcoming teaching challenges when working with Millennials, there only seemed to be recommendations that are highly suitable for any generation.

Farrell and Hurt (2014) researched literature relevant to training or hiring Millennials in the corporate arena, finding them to have a distinct ability to multi-task, a desire for structure, a focus on achievement, are technologically savvy, team-oriented, and to have a strong desire for attention and feedback. These conclusions were based on the authors' literature review of fourteen articles published between 2006 and 2010 and reached a generalized description of any aged college student, serving more to nullify any theories about differences or major pedagogical changes needed for Millennial-aged students.

Generational differences in higher education were also investigated by Lai and Hong (2015) finding that while students spent a large amount of time using digital technologies, the range of their skills were limited. They did not find any practical generational differences in the technology use pattern or in learning characteristics among their subjects. They suggested that generation is not a determining factor in students' use of digital technologies for learning and that generation alone has not had a radical impact on learning characteristics of higher education

students. Moreover, they found that while students use many new technologies for social and recreational purposes as well as for learning, they may not be as technology savvy as some have claimed. They assert the mere exposure to digital technologies from an early age does not necessarily make the Millennial generation a single and coherent group. Notably, their conclusions coincided with other studies which found that although the Millennial generation students use some new technologies in their everyday life, they do not use them extensively for learning purposes. Differences in skills and desire to use technology were found in all ages in the survey causing the researchers to notice that in spite of expectations of skill levels due to common use of digital devices, there were gaps in skill levels useful towards online learning. They also report that the technology use and experience of the student may simply depend on the degree program, familiarity, cost, and perception of use and less on the age of the student (2015). "Although digital technologies use is part and parcel of young people's daily lives, how they are used is not homogeneous" (p. 735).

Given concerns about the nature of Millennials and learning, Timothy Teo at the University of Auckland created the Digital Natives Assessment Scale (DNAS), a self-report instrument designed to measure students' perceptions of the degree to which they are digital natives. Teo maintains there is more to being a digital native than simply being born within a specific time frame, and that the digital native classification might overlap other generations due to skill and preferences. The scale asks respondents to rate their agreements to statements in four areas that indicate digital nativeness: (a) having grown up with technology, (b) being comfortable with multi-tasking, (c) being reliant on graphics for communications, and (d) thriving on instant gratification and rewards. Once the scale was validated, the author suggested further testing in areas where educators seek a more accurate demographic of their student base

independent of age. Teo's scale was developed to support instructors wishing to better understand their students towards the end of instructional design.

Akçayır, Dündar, and Akçayır (2016) used the DNAS to study university students from Turkey and Kyrgyzstan who were active users of technology prior to enrolling. They reported no significant differences in the participants' perceptions of themselves as "digital natives" due to their sex, academic disciplines, or age:

> As a result of our findings, we conclude that age should not be considered a determining factor for whether or not an individual is a digital native. Those who invest sufficient time and effort to learn to use digital technologies, and who earn the requisite experience with them can be regarded as a "digital native," even if born long before 1980. Likewise, it is clear from the data in this study that not all people born after 1980 are digital natives. (p. 439)

Furthermore, Akçayır et al. concluded that a university education significantly affects a person's standing as a digital native. They discovered significant differences between even one to two years college grade levels, indicating birth age matters less than educational experience, countering prevailing notions. They also found no significant sex difference in DNAS scores. Highlighting the lack of empirical evidence in defining the nature of the digital native, they called for more studies of the concept.

In investigating the digital native generation as learners, Thompson (2013) explored the relationship between technology use patterns and learning characteristics. Thompson noted finding a weaker relationship between technology and learning than previous authors had claimed. The study found the technology-based skills Millennials use frequently in their social lives, games or blogs, not to be used much in their educational applications, leaving Millennials

no real educational advantage in online learning environments. Thompson's conclusion that Millennials do not use technology in educational environments to the extent others claimed coincides with the earlier work of Kennedy et al., (2008) and Bennett et al., (2008). While college-aged individuals may show proficiency in some technology use for basic life function such as texting, messaging, emailing, gaming, social networking, etc., this may not imply proficiency in the technology skills used in education. As Thompson observed,

> Most importantly, this study suggests that technology is not a deterministic force that usurps the role of the teacher while molding students' brains according to its own ends, as much of the popular press literature seems to imply. Technology is indeed an important influence in students' lives, but it is one influence among many, and teachers still have an opportunity to help their digital native students navigate successfully through the promises and pitfalls of learning in the digital world. (p. 23)

Thompson's study serves to warn instructional designers about buying into the belief that Millennials prefer digital learning methods above all others and suggests a closer evaluation of the purpose in using technology as purposeful to the subject matter and desired outcomes.

Jones and Shao (2011) discuss "the new millennium student" (p. 41) in light of the fast-changing technological advancements students had experienced by 2011 as compared to those only a few years previous. They note:

> Social networking sites were barely on the horizon when the Net Generation and Digital Native literature became popular and this points to a regular temporal feature of technology innovation and one that affects digital and network technologies in particular. It is hard to predict what the next big innovation will be and the speed of change following an innovation can be prodigious. (p. 41)

The authors found that the current population of young students is diverse and does not form a single generationally directed cohort, thus educators might be misled in assuming Millennials might be categorized by definitions written in 2000 to 2005. The authors favored another method of categorization; that of applying levels of technology usage (power, ordinary, irregular, and basic users, found in Kennedy et al., 2008) to the question of demographic identification when planning instruction. "Results suggested that while age was the most significant factor, other variables such as sex, mode of study (traditional or distance learning), national origin (local or international students) all played an important role in defining students' engagement with technologies" (p. 42). In keeping with others' suggestions not to change all methodologies based on assumptions about Millennials, they suggest instructors and designers use more professionally-based discretion than simply following an anecdotal trend.

Gallardo-Echenique et al., (2015), conducted a literature review study examining 127 articles published between 1991 and 2014, which aimed to define the digital native. Their findings suggest that despite a higher comfort with technology of those born between 1985 and 2005, the digital competence of this age student might be much lower than those of their digital immigrant teachers. Through their well-referenced study, they challenged the digital native theory of Prensky and others, and concluded it is necessary to consider other variables besides age to better understand the nature of the use of digital technologies by students (p. 156). Their literature review supports less assumptive changes of delivery methods and more critical application for instructional design on a case by case basis. The tenet of the digital native was also challenged by Margaryan, Littlejohn, and Vojt (2011), who assessed university students' use of digital technologies for learning and socializing. Their study also did not find evidence to support popular claims that young people adopt radically different learning methods or styles

due to their digital nativeness. They concluded that although the calls for transformations in education may be legitimate to keep up with changes in technology, it would be misleading to ground the arguments for such change in students' shifting patterns of learning and technology use.

> Our study found no evidence to support previous claims suggesting that the current generation of students adopt radically different learning styles, exhibit new forms of literacies, use digital technologies in sophisticated ways, or have novel expectations from traditional higher education. Our findings show that, regardless of age and subject discipline, students' attitudes to learning appear to be influenced by the teaching approaches used by lecturers (p. 429).

Margaryan et al., (2011) found no evidence of increased technology preferences or skills regardless of the age of the student and suggest instructional designers carefully assess the benefit of increasing technology use in relation to the subject and application (p. 439).

Millennial preferences concerning learning and technology. Among the listed attributes of the Millennial digital native or Net-gen'er, is the preference for using digital devices to access information. However, Baron (2015) reports that not all digital natives prefer reading with digital devices and that in fact, "the majority–sometimes the vast majority—say they prefer reading in print" (p. 12). She also questions the increasing availability of e-books in schools, suggesting that this may be less for the stated purpose of giving Millennials what they prefer, but rather for saving money on buying books. She asked students when they prefer digital books and found the reasons were less about preference and more about efficiency, e.g., their appreciation for the searchability and the direct resource links, the cheaper cost, and sometimes free access. While her book is not aimed at dispelling the digital native myth overall,

her research presents an important question with regard to preferences by Millennials: Do they really prefer all things digital, or are they simply accepting what is being offered?

One instructor who sought to understand the Millennial for purposes of better understanding her students, is Russo (2013), who surveyed 204 Millennials about their learning processes and teachers. Russo spotlighted the difficulty in making sweeping assumptions about Millennials in education situations because an increasing number of students are non-traditional-aged and may share Millennials' high technology use but do not belong to the Millennial cohort. Further, Russo found many discrepancies between the popular notions of Millennials and her study participants. "Their responses also were not consistent with the claims that all Millennials are tech-savvy and desire extensive integration of digital technology into the classroom" (p. 14). Russo concluded instructional designers should use technology when appropriate and not be so quick to assume Millennial students prefer it over other traditional methodologies.

Educational technology. While many studies and articles aim to define the Millennial generation in order to prepare the educational environment for them, very few articles use empirical evidence to address student preferences for digital devices or technology to direct design (Roblyer & Knezek, 2003). The authors assert most articles advocate greater use of educational technologies in general, however, Roblyer and Knezek contend that puts the cart before the horse—and rather, suggest the important question to ask is <u>why</u> students or faculty should use technology more. They recognize the irresistible attraction of innovations, but caution towards more emphasis on the medium, and instead suggest more interest towards the appropriateness. Roblyer and Knezek assessed literature to reveal that only 4% of the research involving educational technology (between 1999-2003) focused on reporting current technology

uses aimed towards helping shape desired directions and advocate much more is needed.

The Association for Educational Communications and Technology (AECT) has defined educational technology as "the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources" as quoted in Hlynka and Jacobsen (2009) in their commentary article on the topic. However, one challenge in understanding and defining the term *educational technology* remains in using the phrase to apply in more discrete ways. Lakhana (2014) calls the concept of educational technology ambiguous and discusses interpretations and definitions in her position paper. While she advocates the broader concept to include both conceptual technologies as well as hardware and applications, her position reinforces the need to understand educational technology as an umbrella of several education-purposed aspects. The exhaustive literature review by Lakana revealed a designation of: (a) "soft technology" which includes processes, theories, and knowledge, and (b) "hard technology" for tangible items such as machines, devices, software programs and the skills to use them (p. 2). Hlynka and Jacobsen (2009) also discuss the various factions of AECT's definition which contains soft and hard technologies and how they fit together.

> Educational technologists are interested in creating and evaluating, learning and performances that are more effective or efficient because of the technological process and resources. Further, educators are interested in creating, adopting, and managing new, novel and innovative learning experiences that only become possible because of technological processes and resources (Hlynka & Jacobsen, 2009, p. 3).

ERIC, the Educational Research Information Center, defines educational technology as the systematic identification, development, organization, or utilization of educational resources

and/or the management of these processes - occasionally used in a more limited sense to describe the use of equipment-oriented techniques or audiovisual aids in educational settings (Educational technology, 1969).

Aziz (2010) offers a definition of "educational technology is the considered implementation of appropriate tools, techniques, or processes that facilitate the application of senses, memory, and cognition to enhance teaching practices and improve learning outcomes" (p. 1). Aziz adds a clarification for the word *appropriate* to make clear it's importance in distinguishing those uses of technology-based hardware or software bringing value to education, versus those which do not.

Digital skills and savvy. Not all authors have regarded the Millennial generation negatively, and many have recognized their technological skills as one of six distinctions over previous generations (Farrell & Hurt, 2014). In their literature review-based study looking at Millennials, Farrell and Hurt found nine out of fourteen articles included the term "technologically savvy" in describing this generation. Not only has it been noted that Millennials generally use digital devices for social and educational purposes, they tend to be early adopters of new technology devices and while Millennials may not be concerned about the device itself, they may be more interested in what function the new device will allow the user to do (p. 52). Farrell and Hurt presented suggestions for using digital and technological methods in training and warned against overlooking the Millennial preferences at the cost of losing their interest (p. 55). Unfortunately, the Farrell and Hurt study did not uncover any unique or exclusive characteristics attributed to Millennials but recognized traits of students of any age.

One interesting finding concerning the notion of a digital native having a "changed brain" (Prensky, 2001a, p.1) is found in a study by Small and Vorgan (2008). They surveyed a

group of Internet-savvy individuals and another group with little to no experience with technology while using magnetic resonance imagery (MRI). Both groups performed assigned Internet search tasks during the MRI. Small and Vorgan immediately found increased activity in the dorsal prefrontal cortex in the tech-savvy group and little to no activity in the control group. As the dorsolateral prefrontal cortex is involved in our ability to make decisions and integrate complex information, control our mental process of integrating sensations and thought, our working and short-term memory, the results were somewhat predictable. What the authors also tested was the time needed for the control group to demonstrate increased activity of the dorsolateral prefrontal cortex to the same level of activity as the savvy group. Within five days the authors noted same or similar levels of activity suggesting that our brains are capable of adapting to new technological challenges regardless of age (p. 55). However, these results do not support understanding of human affinity or volition towards adaptation of new technology, perception of usefulness, ease of use, or the desire to use a digital device.

Not everyone accepts that all Millennials are digitally savvy due to age and believe global location may also be an important variable. The Educational Testing Service (ETS) reports American Millennials score second to last in problem-solving in technology-rich environments (PS-TRE) as compared to the 21 Programme for the International Assessment of Adult Competencies (PIAAC) member countries (Goodman, Sands, & Coley, 2016). The ETS report graphs show disappointing outcomes of American Millennial-aged adults when tested for literacy, numeracy, and problem-solving. The Americans tested well below the majority of participants in literacy by placing sixteenth out of the 21countries, scoring eight points below the global average. In numeracy, American Millennials placed dead last, 21points below the average, and 41 points behind Japan, the leader. In the PS-TRE problem-solving test, American

Millennials placed second to last, only ahead of Poland and 11 points less than the average score. The PS-TRE assessment focused on how well adults understood and could interact effectively with technology. Fifty-six percent of Millennials performed below level two (minimum standard level) out of the four possible levels, marking American Millennials as the least capable of the 21 countries tested (p. 7). Goodman, et al., stated, "If our future rests in part on the skills of this cohort—as these individuals represent the workforce, parents, educators, and our political bedrock—then that future looks bleak" (p. 5). Interestingly, the report states that while the American Millennials score dismally low in skills, the U.S. is still within the top three countries in educational attainment. As the test looked at all grades from K-16, the results point towards high participation in education without reaching a competitive level on a global scale revealing a general lowering of graduation standards over the past generation.

The Myth of the Digital Native

Even as a consensus has been developing in some quarters that digital natives are a generation of exceptionally digital-savvy and well-skilled individuals, there are very few studies providing evidence of a strong preference for increased educational technology by Millennial students. Gallardo-Echenique et al., (2015) state "Moreover, research does not support the view that digital natives are – by default – digitally competent and that these skills transfer to the academic environment" (p. 174). The original digital native persona appears to be largely discarded in favor of a more complex description according to several studies of Millennials' preferences for digital and technology-based devices in their education (Bennett, Matton, & Kervin, 2008; Kennedy et al., 2008; Koutropoulous, 2011; Lai & Hong, 2015; Magaryan et al., 2011; Thompson, 2015) and some authors even refer in their article titles to a digital native myth (Margaryan, et al., 2011; O'Neil, 2014; Vaidhyanathan, 2008). Becker (2009) compared

all living generations in how technology is used for education, looking closely at actual applications and not simply time spent, and he asserts "The prowess of the digital native is a dangerous myth and a primary example of how labeling a generation is a disservice" (p. 50). Becker's study found digital natives spent more time using technology for entertainment than education (p. 351).

With an aim towards affecting university instructional design, these studies investigated actual habits and preferences of Millennial-aged college students. The findings called into question the assertions that Millennial students are somehow different than previous generations based on the digital native canon. Furthermore, the data demonstrated such students were indeed less adept in using technology-based devices and applications than commonly believed. In fact, some studies found Millennials actually prefer less technology use in their educational endeavors (Bennett, Matton & Kervin, 2008; Kennedy et al., 2008; Koutropoulous, 2011, Lai & Hong; 2015, Magaryan et al., 2011; Thompson, 2015). It is important to note that these studies were conducted six to ten years after the original digital native definition and thus begin to set the stage for a more evidence-based approach towards instructional design.

Kennedy et al., (2008) challenged Prensky's digital native and immigrants' theory with regard to the lack of homogeneity of technology skills and use in incoming Millennial students. They discovered widely differing levels of access to, use of and preferences for an array of established and emerging technologies and technology-based tools in their personal/social and educational lives.

> . . . the premises underpinning these arguments [assumptions] warrant closer examination before university educators set about overhauling established curricula and teaching and learning practices. These arguments are predicated on a general assumption

that students coming into universities have had a comparatively universal and uniform digital upbringing. (p. 2)

While some freshmen had embraced digital devices, others had not. Those students who had embraced technology reported proficiency in using common devices and programs (e.g., computers, mobile phones, and email) in daily life, however, they did not report high skill levels in other uses and applications used most in education. Their study also revealed an important skills differential between freshmen and upper-class students. Students with a couple of years of experience with university-level technology-based devices and applications reported greater proficiency than the freshmen—who were assumed to also be digital natives. As Kennedy et al., (2008) observed, "Clearly we cannot assume that being a member of the 'Net Generation' is synonymous with knowing how to employ technology-based tools strategically to optimize learning experiences in university settings" (p. 117). The researchers acknowledge that many skills and experiences overlap personal and academic pursuits (e.g., mobile phone use, texting, posting on blogs), however, they did not ask students how they might use their personal/social technology skills in education. Kennedy et al., (2008) suggest further study in this area to determine specific circumstances under which students would like their "living technologies" to be adapted as "learning technologies," recognizing that this transfer is neither automatic nor guaranteed (p. 119).

Shortly after the call for qualitative research by Kennedy et al., (2008), Waycott, Bennett, Kennedy, Dalgarno, and Grey (2010) published their study examining the use of new technologies in students' daily and academic lives. This team of investigators looked at the "digital divide" (p. 1202) that allegedly separates digital native students from digital immigrant instructors. Data did not confirm "a substantial gap between more technology adept younger

students and their less savvy teachers, caused by differences in exposure to technology during their lives" (p. 1208). Instead, they found that many of the same technologies were used by both groups in their everyday lives, with mobile phones, the Internet, email, and MP3 players most prominent. While they found some who kept their educational and personal/social digital uses separate, others blurred the lines. Waycott et al., also found no clear or defining use of technology that distinguished students from instructors, asserting that it was overly simplistic to portray faculty as resistant to new technologies and younger students as more accepting of them. The gap, they suggested, may lie between "staff perceptions of students' apparent skills, motivations, and prior experience, and the reality of how students can and do use technology to support their learning" (p. 1210).

In a literature review by Bennett, Matton, and Kervin in 2008 of technology use by digital natives, some evidence was found to support the notion that young people use technology devices for information gathering and communications, however not to the extent predicted by proponents of the digital native theory. Bennett et al., warn that administrations who prepare to shift all courses towards greater technology use may be over-planning, and in the process, they could be overlooking a large proportion of their student base that is not as adept or enamored of technology use in education as assumed. In explaining the widespread acceptance of Prensky's theory in 2000 despite supporting evidence, they observe that Prensky offered a plausible explanation with a timely delivery at the turn of the century for a receptive audience, thus inciting a kind of moral panic. The concept of moral panic emerged when Cohen (1972) addressed a generational-based social phenomenon in Great Britain in the late nineteen sixties. British adults had become alarmed at the antics of youth who were acting out in new and different ways, and Cohen accused journalists of inventing sensationalized stories that added

fuel to the fire, e.g., by blaming odd incidents on the youth and creating a "moral panic" (p. 782). Thereafter, the process of creating a moral panic became a popular method of drawing attention to unprecedented behavior by youth and terminating further debate. The idea of the digital native simply fits the method of a moral panic, and Prensky provided the stimulus (Bennett, et al., 2008).

In 2013, Kirschner and van Merriënboer recognized three urban legends concerning the nature of learners, learning, and teaching and questioned the emerging thought that the learner knows best about appropriate learning design. One of the legends they researched was that of the digital native and the presumption that older teaching methods would no longer work. They explored Prensky's assertions of preference and increased abilities to digital-based learning skills, multitasking, and device usage (p. 170). They also questioned other reports making claims of a changed student who "learn in a significantly different way" (p. 171). Their results concluded that university students as a whole do not really have special knowledge of technology and are often limited to basic office suite skills, emailing, text messaging, Facebook-type social networks, and surfing the Internet (p. 170). Further, Kirschner and van Merriënboer also considered the assertion of the digital native being exceptional at multi-tasking and thus, the need to design instruction accordingly. They found increased time needed to complete work, impaired performance and learning, and recommended educators not to expect positive effects from requiring multitasking-based activities. They concluded with overwhelming evidence that a digital native, as per Prensky's (2001a) idea, does not exist, there is no change needed in student learning methods in regard to digital technology, and cautioned that students may actually suffer if educators play into the moral panic driven postulations of the digital native (p. 174).

In the article *Generational Myth*, the idea of there being a generation segregated by technology is argued. Vaidhyanathan (2008) asks "if the concept of a generation is unenlightening at best and harmful at worst, why do we persist in describing cultural, historical, and social change as generational?" He suggests identifying generations is not useful or respectful and oftentimes misleads marketers towards thinking an age defined population will share so many characteristics. He further stresses that the Millennial-aged student is no different in tech-savviness than other generations. As a university instructor Vaidhyanathan (2008) claims to see no difference in today's students liking or disliking printed books so much as their dislike for the cost of books, which may account for a preference towards inexpensive online alternatives.

Birth year may not be sufficient to define a digital native. Teo (2013), who developed the Digital Natives Assessment Scale, which measures one's digital nativeness in terms of attributes other than age, asserted that "While digital natives are defined by age, not all youths are digital natives" (p. 1). Reflecting the spirit of Prensky's writings in 2000, Teo defined digital natives as: (a) those who have grown up with technology, (b) who are comfortable with multitasking, (c) who enjoy graphics to communicate, and (d) who thrive on instant gratification and frequent rewards. His data demonstrate that people of any age may score high in these four key areas and therefore be a digital native. Teo's perspective leads to new questions about how much people immerse themselves in technology, how they adapt to the digital devices of the time, and how such experiences determine learning preferences and choices.

Studies about Millennials and their learning preferences. Howe and Strauss (2007) described Millennials as the product of the Gen X –aged overprotective parents who constantly hovered over their children, particularly in educational and competitive pursuits. Millennials

then emerged as the protected and cultivated kids who grew up with the "Baby-on-Board" signs, trophies for participation, and protection from harm or correction (p. 7). The product of this well-meaning hovering brought about a generation which gravitates towards large institutions, which seeks teamwork and protection against risk, and which shows a solid work-life balance. Millennials, according to Howe and Strauss, are more conventional and have closer relationships with others including parents and extended families, than previous generations back to 1900 and the beginning of the Silent Generation. In contrast to the many authors who have written negatively of this generation, Howe and Strauss likened them to the hero pattern of the GI generation which faced the Depression and World War II and advised against misinterpreting Millennials' confidence as self-centeredness. Howe and Strauss predict Millennials, with the use of technology, will aim to improve social communications, community interactions, and demonstrate strong traits of cooperation and organization as they become political powerhouses undaunted to face challenges in our global world. Furthermore, they assert that Millennials consider money and technology to be mere tools as their real affinity is towards the people with whom they work and live.

Some studies have found discrepancies between popular suppositions of Millennials and actuality –noting that popular assumptions about this generation lack validity and fail to represent Millennials' self-perceptions adequately (Barnes & Jacobsen, 2014; Bennett et al., 2008; Gallardo-Echenique et al., 2015; Kirschner & van Merrienboer, 2013; Koutropoulous, 2011; Russo, 2013; Thompson, 2013; Vaidhyanathan, 2008; Waycott et al., 2010). Russo (2013) for example, found a lack of research supporting generalizations used for racial, social, economic, or location factors. She found that many in this age cohort do not feel that the term Millennial applies to them and she questions whether the label is appropriate (p. 3). Russo also

questioned the assumptions of true enrollment numbers of Millennials as so many schools show a strong trend towards non-traditional student age enrollments. In surveying her own university students for instructional design input on many issues including technology, Russo found Millennials were not as tech-savvy as commonly alleged and that they did not require extensive integration of digital technology into the classroom. She recommended more research before educators accept global assumptions regarding technology-related preferences of college students of such a wide variety of ages, social backgrounds, and technology experience.

Many publications reflect strong negative attitudes towards Millennials, observed Koutropoulos (2011) in his comprehensive literature study of the digital native. His study reviewed over 100 writings published between 2000 and 2010, falling into two categories: empirical or anecdotal. He found considerable anecdotal and suppositional writings following the common digital native myth—saying that proximity to technology has led to physiological transformations of the Millennial. On the other hand, he found substantial evidence for attributes dispelling the enduring digital native canon. The research, he concluded does not identify any monolithic group that one can point to and call digital natives. As a matter of fact, he noted, individuals fitting the purported digital native stereotype appear to be in the minority of the population (p.531). Prensky changed his views in 2010, Koutropoulous noted, to concede that while those born between 1985 and 2005 are digital natives by definition, they are not all technology savvy. Koutropoulos identified other contradictions to the digital native canon, e.g., the belief that the digital native requires instructional methods with more technology, while in truth, the digital natives were the least likely to expect such changes. He advised moving from grouping and naming this generation as the terms often do not fit, and to instead realize that the Millennials may need more instruction than commonly thought on the use of technology in

education, e.g., in information retrieval, critical thinking, analytical skills, and approaches to learning options. Koutropoulos reminded instructional designers that Millennials will not know what they do not know, and thus designers should not overlook quality pedagogy and student engagement in favor of a new focus on technology-based delivery.

Merlino and Rhodes (2012) also studied the Millennial literature in their qualitative study which interviewed fifteen faculty looking for useful key strategies for instructional design. Many of the participants agreed that "Millennials are pro-technology, unrealistic about work and life, multitaskers, and not prepared for college" (p. 113). No Millennial-aged students or faculty were invited to contribute. Despite Merlino and Rhodes's original aim to present pedagogical strategies for Millennials in business courses, they were not able to identify unique Millennial needs as much as offered simple strategies applicable for any age college business student. In their literature review, however, Farrell and Hurt (2014) identified six characteristics of Millennials: (1) ability to multitask, (2) desire for structure, (3) achievement-focused, (4) technologically savvy, (5) team-oriented, (6) seeking attention and feedback. Aiming to identify a Millennial learning style appropriate for Millennials, the authors posited that this generation most likely benefits from active engagement in learning events, especially those utilizing team or collaborative activities and may not respond as well to traditional forms of instruction such as lecturing. The authors further recommended instructional designers take note of Millennials' preferences for constant feedback, group interaction, shorter and more hands-on/activity-based training, less traditional delivery formats (lectures, reading) and assessment methods (exams). Farrell and Hurt (2014) also considered learning styles of the Millennials and felt they are different than previous generations, and included suggestions to "use active learning methods, increase feedback and attention, and to employ more technology as key design features" (p. 55).

In a comprehensive literature review of 127 articles, Gallardo-Echenique et al., (2015) found 48 terms used to describe the people born from roughly 1982 to 2005. The three most popular terms were Millennial, digital native, and net-generation (p. 160). The article discusses various characteristics that have been ascribed to Millennials, e.g., special, sheltered, confident, conventional, team-oriented, achieving and pressured. Furthermore, they describe Millennials as having a focus on social interaction and connectedness to friends and family, preferring group-based approaches for both educational as well as social applications (p.163). One of the aims of the study was to find common terms, commonalities in definitions, and discrepancies in the research on this topic. They learned there is no commonly accepted definition of digital native, discovering three different views of this population, ranging from "enthusiasts" who are convinced that technology contributes to specific physiological and inherent skills, to "concerned" authors who accept the idea that Millennials are different yet believe only negative results will befall society, to "critics" who question all ideas of digital technology causing profoundly changed learners, or authors who use over-generalization to describe this generation. The research, they concluded, does not support defining a digital native simply by age as the data show that technological skill and savviness to be characteristics held by people of any age (p.174). Furthermore, they found "the Millennial-aged student may actually be less technology savvy than their instructors--and may not be the ones demanding changes in instructional design or methodology" (p. 173). Overall, it is worth highlighting that Gallardo-Echenique et al., found very few empirical studies, many anecdotal assertions, and few useful studies which support making drastic changes to learning methodology in higher education.

Akçayır, Dündar, and Akçayır (2016) used Teo's Digital Native Assessment Scale (Teo, 2013) to determine if their students were indeed digital natives. As with other recent studies,

these researchers observed that the very few recent empirical studies on this topic are far outnumbered by subjective assertions and assumptions. In addition to Teo's digital native criteria (e.g., having grown up with technology, multitasking, thriving on graphics, and preferring instant gratifications and rewards), they identified additional attributes (e.g., year in college, national culture, and experience with technology) to describe digital natives. The researchers found no evidence that sex or academic discipline contribute to the digital native phenomenon, nor did age emerge as an important factor. Akçayır et al., concluded from the data that global location and technological experience far outweigh age as a predictor of digital nativeness and recommend more empirical research to support the topic.

Technology Use Debate

"Complaints about the role and use of technology in education have been with us since Socrates declared students should not be taught to write because he believed that writing diminished memory" (Becker, 2010, p. 1). In the 1980's the debate on how much technology was advisable in a classroom heightened as computers became tools used in formal education. While theories on this concern began as early as 1950 as the military employed technology in training and learning, educational theorists have argued over technology in education for decades since. The following category is meant to provide background regarding the original debate between Clark and Kozma.

"Consistent evidence is found for the generalization that there are no learning benefits to be gained from employing any specific medium to deliver instruction," asserted Clark in 1983. Given that his words were written well before the adoption of digitally-based learning applications in academic environments, he affirmed his position in a long-lasting debate on the need for change in instructional design that began in 1912 with Edward Thorndike (1912).

Clark suggested that current studies on media do not influence learning under any circumstances. His point was that materials and content produce learning, not the delivery medium; he felt strongly about curriculum changes that were overly focused on media-based delivery methods. Clark likened technology/media to that of a delivery truck bringing produce, observing that the vehicle is not the factor responsible for nutritional changes. Clark also recognized the dangers of the novelty effect, cautioning against the lure of innovations in media and technology. Clark conceded that some forms of media were useful, but he also suggested research exploring the relationship between media and learning be suspended unless a novel theory is proposed.

An opposing perspective more open to instructional innovations was offered by Robert Kozma (1991), who asserted that students may benefit from a variation in delivery devices. He was "not interested in *how much* computers were used in classrooms, as much as *how* they were used" (p. 29). In contrast to Clark's proposed research hiatus, Kozma called for more research to examine the interaction of learning processes with the capabilities of technology-based media. He was particularly interested in computer capabilities to record student work and to provide insights into the development of outcomes. "Ultimately, our ability to take advantage of the power of emerging technologies will depend on the creativity of designers, their ability to exploit the capabilities of the media, and our understanding of the relationship between these capabilities and learning" (p. 207). Kozma proposed research on the benefits of technology-based delivery systems and collaborative contributions while remaining in partial agreement of Clark and his lack of interest in the devices themselves.

In 2003, Roblyer and Knezek recognized the evolution towards more technology-based methods as integral components of solutions to instructional problems rather than simply as

delivery media (p. 6). The authors asked for a new research agenda by the Department of Education to gain understanding about the use of technology in instruction. Their suggestion was to begin at the beginning by finding a rationale for technology use instead of relying on current unsubstantiated acceptance of all technology or new devices (p. 11). They noted the absence of clear benefits promoting the use of technology over traditional methods and advantages to support adoption (p. 14). In their article they identify examples of success in technology-based instruction but remain unwavering on the need for empirical studies to provide the needed foundations of such expensive and global change (p. 7). Roblyer and Knezek noted the lack of evidence available to address the question of *why* more technology-based methods are needed—but found considerable attention given the questions of *what* is available, or *how* to use it (p. 16). Furthermore, they highlighted the lack of data and insufficient information available from smaller studies, asking for larger-scale studies with more definitive, generalizable results (p. 16).

Jones and Shao (2011) emphasized that while arguments continue about the learning needs of Millennial-aged students versus those in previous generations, the evidence shows that students are diverse and do not form a single generationally defined cohort (p. 11). Throughout their literature review, they identified studies which recognized levels of technology use, frequency, and experience as the factors which should be in the center of the debate on the use of technology (pp. 41-44). Jones and Shao showed the pitfalls involved in labeling an entire generation as digital natives, finding that it is the individuals who choose to engage with technology often –whether for personal/social or academic purposes– who will be more adept than those who choose to use it less. For example, compared to those not enrolled, those with several years' experience in higher education will obviously have very different levels of

technology-based experience. Their results suggested that several variables besides age, e.g., sex, mode of study, national origin, and being in college, all played an important role in defining students' engagement with technologies.

Technology Used in Higher Education

It is common knowledge that universities are moving more courses to online platforms and systems. The Babson surveys (Allen & Seaman, 2014) show a continual growth pattern for the number of students enrolled in a least one online course, totaling 7.1 million in 2014. With a growth rate of over 6% and one-third of all students taking at least one online course, it is clear that online learning is popular with the administration as well as enrollees. While the numbers rise annually, the definition of online learning shifts. Currently, universities may offer a variety of online learning including the following:

1. Blended: a synchronous and asynchronous mix of classroom and online
2. Fully online: asynchronous through a learning management system or LMS
3. MOOC: asynchronous massive open online courses
4. Webinar: synchronous using specially designed interface programs
5. Traditional classroom meetings supplemented by online repositories for materials.

"Today's digital landscape has created additional learning opportunities for students outside of brick-and-mortar institutions, and universities are gradually changing to accommodate evolving expectations" (p. 10), wrote Johnson et al., (2016). Universities are finding new and innovative ways to use technology within programs. For example, *The Horizon Report* describes how Boise State University uses technology for a two-week intensive online course to bring together students across several disciplines to create a baseline for cross-communications across fields. Within the mix of approaches is the redefining of technology-

based devices. Presently at a large university there may be upwards of 35,000 wireless connections taking place on any one day via over 500 device types through more than 30 operating systems (p. 40). This alone presents challenges in handling of the Wi-Fi systems on campus, as well as design concerns for LMS use. Universities are no longer operating with clear expectations of what devices will be used and thus need to remain flexible and receptive to the BYOD, "bring your own devices," (Johnson et al., 2016, p. 36) culture now enrolled. Further, it is no longer assumed that students arrive on campus with only a laptop, but rather that they will bring along a multitude of devices with Internet connectivity. Those other devices generally require design changes, e.g., applications for use with touch screens or by mouse. Anderson (2016), in the Pew Research report about technology device ownership in the general population, claims the number of adults owning smartphones is nearing 90% for Millennial-aged owners with college degrees (p. 7). Those adults owning a tablet is at nearly 50% while 80% own a laptop or desktop computer. These statistics suggest the question of ownership of a technology-based device is no longer about whether you own a device, but which devices and how many. Anderson actually recognized a drop in computer ownership for Millennial-aged adults along with a rise in both smartphone and tablet ownership giving affirmation to the trend towards mobile computing becoming the favored device-driven delivery medium on campuses today.

Ubiquitous computing describes the use of commonplace mobile devices. Originally used to describe the prevalence of information and communication technologies in the workplace, the expression arose in the early 1990's-well before most American households contained a computer, much less wireless connectivity (Yahya, 2010, p.1). Today the term describes the multitude of devices using radio frequency identification technology (RFID) to

transmit data over an array of devices and environments. The term later gave way to ubiquitous learning, which refers to the use of ubiquitous technology to support learning at any place and at any time (Yahya et al., 2010). The article states activities formerly reserved for stationary desktop computing have now been augmented and even supplanted by mobile devices, e.g., smartphones and tablets, due to such advances as connectivity, extended battery life, compressed data storage and accessibility, cloud computing, and specially designed interfaces.

Millennials embrace their mobile devices, using them for recording their lives with photos, videos, and recordings of daily activities as found in *Millennials in Adulthood* by Taylor, Parker, Morin, Patten, and Brown (2014) who compare four generations on differences in technology use. The authors found that the "selfie" (defined as a photo taken with oneself in front of others, a backdrop, or with an object) emerged as a phenomenon which clearly distinguishes generations, with 81% of Millennials reporting haven taken one compared with only 24% of Gen X'ers, and just 9% of Boomers. According to Taylor et al., (2014), Millennials, unlike the other generations, flock to social networking to share selfies, photos, and personal information with friends and acquaintances through applications such as Facebook (p. 7). Furthermore, Millennials are more accepting than other generations of cell phone use during meals and events, including during school lectures, and may not understand others who may take offense at this practice (p. 49).

Horrigan's (2016) Pew Research Center Report investigated the adoption of technology for learning in schools and workplaces, discovering that potential learners are not all equally well-prepared for online learning. The report presents a new approach to the assessment of technology savvy by measuring *preparedness* rather than *access.* It concludes that digital readiness emerges from a combination of several factors (see Table 1):

- Digital skills – the skills necessary to initiate an online session, to surf the Internet, and to share content online.
- Trust – belief about one's ability to determine the trustworthiness of the information and to safeguard one's own information
- Use – the degree to which people use digital tools and devices

While the technology is available to more of the population, adoption is still uneven, Horrigan (2016) cautioned. A respondent's adoption of technology and digital readiness level was related to socioeconomic status, race, ethnicity, access to broadband connectivity, education level, experience, and desire to learn. Those less digitally ready were consequently less likely to use and adopt new technologies. This report offers timely insights regarding adults who could become non-traditional students, but choose not to enroll, possibly due to their perceived lack of skills, trust, and experience (p. 12).

Table 1

Digital Readiness Grouped Least Ready to Most Ready

Group	%	Subgroup	Likely characteristics
Relatively hesitant 52%	14%	**The unprepared –** low levels of tech adoption, do not use the Internet for learning, may need help setting up new tech devices, not familiar with tech terms. Unprepared and do not have confidence in their computer skills and are untrusting of online information.	Female, average age 50 and older, lower income, lower levels of education
	5%	**Traditional learners** – Active learners, use technology, but are not as likely to use the Internet for learning and are hesitant to trusting online information	Women, minorities, average age 50 and older, lower income
	33%	**The reluctant** – Higher levels of tech skills than the unprepared, low levels of awareness of new education concepts. Low level of Internet learning usage	Men, average age 50 and older, lower income, lower levels of education
Relatively more prepared 48%	31%	**Cautious clickers** – Have high levels of tech ownership and confidence in their online skills and abilities to find trustworthy information. But may not be familiar with online learning terms and are less apt than the Digitally Ready to use online tools for learning.	Higher income, some college experience, average age 30 to 40's.
	17%	**Digitally ready** – Ardent learners for personal enrichment, high-level owners of technology and are confident about their digital skills and abilities to find trustworthy information. They also know the most about online learning resources.	Higher income, higher education, average age 30 to 40's

Note. From *Digital Readiness Gap*, by J. B. Horrigan, 2016 (p. 3), retrieved from Pew Research Center website: http://www.pewinternet.org/2016/09/20/digital-readiness-gaps. Copyright 2016 Pew Research Center. Adapted with permission.

In 2015, The Educause Center for Analysis and Research (ECAR) collaborated with 161 institutions to survey 50,274 undergraduate students in 11 countries about their technology experiences. The key findings, as reported by Dahlstrom et al., (2015) pointed to increased ownership of Internet-connected mobile or computing devices, but not to an increase in their use in academics. "Today's undergraduates feel no more (or less) prepared to use technology in higher education than their counterparts from a few years ago," observed the authors. In fact, smartphone ownership exceeded laptop ownership. This represents a notable development since 2007 when smartphone availability and popularity took off, and laptops were the new technology of choice, displacing desktop ownership at an alarming rate. In this 2015 study, fewer than half of the participants reported owning a desktop, while 92% owned a smartphone, 91% owned a laptop, and only 54% owned a tablet. Further data revealed that 6% owned only one Internet-capable device, 92% owned at least two, 64% owned three, and 31% owned four. As the trend moves strongly towards the mobile form of computing, this places concerns about online learning design and effectiveness on the table. The study found that while students expected their education to involve technology, technology has only a moderate influence on students' active involvement in classes. For example, compared to undergraduates in 2012, a smaller percentage of students in the 2015 survey reported more active involvement in courses that employ technology. Most students (67%) felt prepared to use technology, while 42% felt they were not prepared for a specific use such as LMS courseware. In ECAR surveys from 2013 to 2015 included in the Dahlstrom et al., report, fewer than 60% of respondents reported feeling more connected to their institution, instructors, other students, or feeling more engaged due to the use of technology. ECAR Survey respondents from 2013 to 2015 consistently reported less than 60% felt more connected to their institution, instructors, other students, or feeling more

engaged due to the use of technology.

Furthermore, Dahlstom et al., (2015) report the proliferation of mobile devices in classrooms creates challenges due to distractions, slow broadband speed (p. 4), and limited faculty support (p. 51). Students reported that faculty seem prepared to use technology, although not all were effective in using it for coursework (p. 5). Faculty reported mixed feelings about smartphones as distractions given the predictability of poor results when students multitask. In Dahlstom et al., (2015) only 17% of instructors said their institution made mobile learning a priority, only one-third created assignments involving mobile technology, and half of them banned devices in classrooms altogether. Many faculty showed interest in using mobile technology while complaining they do not receive the training needed for implementation (p. 5). Students report that the use of technology in their learning is only one part of their expectations and suggested that instructors increase the use of mobile technologies for functions like posting of grades, course feedback, progress input, and so on (p. 27). The study concluded that while students and faculty alike increasingly use technology in education appropriately, administration continues to under-support both populations. Dahlstrom et al. (2015) concluded faculty need more technical support and instructional design application to use technology effectively, and students also need ways to bolster their technology savvy and confidence when it comes to learning applications.

The survey commissioned by the Australian Department of Education (Kennedy et al., 2009) offered a list of hardware devices commonly used in educational application, in order of popularity (from most to least): mobile phones, desktop computers, memory sticks, digital cameras, mobile phones with cameras, laptops, MP3 players, mobile phones with MP3players, and Palm Pilots. At that time, the smartphone had just been invented and existing mobile

phones were limited to the simple functions of 2G technology, e.g., phone calls, texting, playing music, and taking photos. Nor was Wi-Fi readily available, and laptops, which were becoming increasingly common, were tethered to stationary Ethernet or other cable-type connections. Nonetheless, students reported enjoying using their technology-based devices, finding them most useful for research or social purposes apart from educational environments such as classrooms. Self-report survey data showed that 75% relied on broadband and dial-up connections and 90% used a desktop computer for school-related tasks.

Chen, Seilhamer, Bennett, and Bauer (2015) conducted a multi-year study on current trends regarding students and technology. "Although 83% of adults between the ages of 18 and 29 own a smartphone, mobile device ownership among college students is even higher; 86% of undergraduates owned a smartphone as of 2014, and nearly half (47%) owned a tablet" (p. 5). Despite these high ownership trends reported in the 2015 report, only half actually were using the devices for daily schoolwork, implying that many students may be less adept at using them for education applications than suggested by their overall popularity. The survey found that more than 95% of respondents of any age owned a smartphone, but of those, found a relatively low percentage using applications in education. For example, while 79% use their phones for social networking or music, only 39% or fewer use them for education. Of those enrolled in a formal education program, they found 72% use their mobile apps and devices to *access* schoolwork, but only 42% felt the technology increased motivation to *complete* their school work. Also, 35% of enrollees felt there was a lack of technical support from their instructors or the university, 21% found limited or no mobile device access, and 19% had limited or no training resource access. Interestingly, the proportion of students *not* using devices for school in 2014 were significantly higher than in the 2012 survey, indicating the situation is getting worse

for students feeling supported in 2014 (p. 14). Chen et al., concluded that while students have the requisite devices, they lack the skills and technical support necessary to integrate more mobile learning use into present education-based applications.

Perceptions of technology in higher education. What kinds of educational technology are prevalent in universities and how are they perceived? Currently, many universities employ Learning Management Systems (LMS's) or Course Management Systems (CMS's) to operate online courses. These systems offer content accessibility, discussion boards, chat rooms, assignment drop boxes, tests, surveys, collaboration tools, access to grades and evaluations, and portals for easy communications. Nevertheless, Walker, Lindner, Murphrey, and Dooley (2016), found their implementation and use creates new challenges with concern to faculty resistant to change or without technical support or time to implement. A majority of the faculty study respondents believed that perceived LMS effectiveness depends heavily on the individual instructor and student and that instructors could drop their resistance to change by seeking out training for using an LMS more effectively.

As Walker et al., (2016) observed, the decision to adopt an LMS and the process of choosing one raises complex issues, including its intended uses by faculty and the training time to master the various features. Indeed, time constraints on faculty remain one of the primary issues in LMS use, and study participants reported a desire for more training and time to properly use the LMS. The features of each brand of LMS must also be considered in the adoption phase as they then influence the kinds of instructional design necessary for positive learning outcomes.

Lane (2009) observed each LMS is constructed emphasizing distinct pedagogical focuses; this results in different site features and tools available for course design. Most popular

LMS's generally offer the same features, but the default arrangements vary in pedagogical design. Lane suggested that the pedagogy of a university could be challenged if care is not taken in the selection of the LMS default design. For example, if the LMS design is more linear design, its learning outcome may differ from those with a more self-directed approach. She strongly recommended that institutions and instructional designers carefully consider the LMS's default design page when selecting an appropriate LMS as few instructors ever venture past the default when creating their courses. Lane notes that "opt-out" systems, e.g., Blackboard and Moodle, allow instructors and student to decide which features to turn off or on, while "opt-in" systems require that instructors select features to turn on, which may result in a rather blank page for students. With either system, the default design may leave the course design either over-cluttered or under-utilized as the process demands that those with little time and experience design the course interface while keeping pedagogy in mind.

The satisfactoriness of an LMS may be directly related to each learner's perception of usefulness, according to a survey of student opinions by Chung and Ackerman (2015). In this study, participants engaged with the Moodle platform as a supplement to face-to-face learning rather than as a fully online course. Students felt positive about using the system for communications with classmates and faculty, and those with higher technology aptitudes reported overall higher perception of usefulness. In short, students with technology experience or skills or with the desire to try online applications all gave positive feedback on the usefulness of an LMS.

Another application of online learning is through a massive open online course (MOOC), a fully online learning LMS-based environment, provided by a university (Harvard, Yale, MIT, etc.) or non-profit learning company (edX, Kahn Academy, etc.). A MOOC brings

no-cost learning to any age student and seems to appeal to those who are advanced in learning skills prior to enrollment (Biemiller, 2014). While many universities have offered MOOC's since around 2010 to 2012, more are being developed as costs for tuition continue to rise. The College Board's 2015 study found that even adjusting for inflation, tuition and fees at public four-year institutions rose 40% in the decade between 2005 and 2015 (Johnson, et al., 2016). However, one design shortcoming in MOOC's seems to be the lack of student engagement, causing most enrollees to drop out well before the culmination of the course (Biemiller, 2014). Age appears to work as a protective factor: learners over the age of 30 are twice as likely as Millennials to actively participate and complete work in a MOOC, while those between 26 and 30 years old are one and a half times as likely, as those in the 18- to 25-year-old bracket (Shrader, Wu, Owens, & Santa Ana, 2016). Prior education also influenced completion rates. Those with more years of college and higher academic degrees were twice as likely to complete a MOOC course as those with less educational experience. The investigators found no significant correlation between enrollment and learner age, including Millennial status. Furthermore, they found the majority of learners were enrolled for personal or lifelong learning purposes, as opposed to degree or certification attainment. The Shrader et al., study is noteworthy as one of the very few studies of the MOOC demographics. Given the major differences between MOOC's and more traditional online learning methods, which they describe, Shrader et al., conclude with a clear call for further research into the success or failure of MOOC's.

Portable Devices: Multitasking and Distractibility

There is little doubt smartphones or tablets are quite useful, but they can also be detrimental to learning due to their potential for distraction. A recent study (Aagaard, 2016)

explored the social effects of mobile devices, especially the phenomenon of *absent presence*, defined as the state in which one is physically present, yet mentally absent due to absorption in the world mediated by the digital device. He found that any use of a mobile device causes the user to "check out" and become absent mentally to those around them (absent presence). Tell-tale signs include impaired social interaction, delayed responses, mechanical intonation, motionless body, and a lack of eye contact. Additionally, the person may show a kind of unintentional mis-attunement, disrupting interactions, and signaling indifference to what is being said. While becoming absent in social situations could result in social mishaps, the effects could be further reaching in educational environments where focus and attention are crucial. Chen and Yan (2015) reviewed 132 recent studies on distraction and multitasking in academic performance and concluded that such multitasking impairs learning as the phone use takes up the limited capacity of learners' information processing channels. They agreed with Mayer and Moreno's theory of multimedia learning published in 2003, that multitasking leaves insufficient space for meaningful learning. While many learners believe themselves to be skilled multitaskers and capable of split attention; unfortunately, the continual use of partial attention has been shown to reduce focus and increase stress. Multitasking is described by Chen and Yan as performing functions using the same machine-switching method of altering back and forth to complete a function. The switching increases the overall time needed, and the focus is thus shared, resulting in less retention and learning.

A related study asked students to forecast the levels of distraction and negative influence when multitasking and found that students were aware of the negative consequences yet still chose to allow media distractions to exist during homework and study (Calderwood, Green, Joy-Gaba, & Moloney, 2016). They found that most students inaccurately predicted

performance decrement effects, but the data did not allow them to conclude that distractions caused lower grades. While the study did not measure the decrements, it opens the discussion on how much distraction is understood by the student and how much they consider allowable. Calderwood et al., report that the explanation for this phenomenon of choosing to study while being distracted, is complex, and involves emotional and social connections, lack of willpower, and a preference for a pleasurable homework session, regardless of the consequent sacrifices of time or focus.

Millennials do not appear to be the technology "power users" of technology predicted by believers in the digital native concept, according to a study by Judd and Kennedy (2011) of multitasking. They found that experienced learners (those in their third to sixth years of study) multitasked and task switched less than those in their first or second year of study, and that males and international students reported higher levels of multitasking than their female counterparts. "Students who entered University directly from secondary school were significantly more likely to multitask than graduate students, as were first-year compared to second-year students, suggesting that post-secondary experiences may temper students' propensity or inclination to multitask," (p. 625). In summary, Judd and Kennedy rejected the digital native theory of an increased proclivity of technology use by Millennials and any increased ability to multitask attributable to age.

The distinction between educational versus personal/social use of technology is complicated by the fact that the devices themselves (smartphones, tablets, computers, etc.) all easily lend themselves to mixing uses and multitasking. For example, Judd (2016) found supervised students stayed on task and focused for only six minutes before succumbing to distractions such as Facebook, texts, watching TV, etc. Unsupervised students averaged only

2.3 minutes and even less time when Facebook was involved, suggesting a need to offer additional support and information to students who are uninformed of the detriment to learning by multitasking. Watson and Strayer (2010) studied *supertaskers*, i.e., those with an ability to drive a vehicle well with distractions. They found only 2.5% of the population truly capable of performing more than one task without a detriment to either task, observing that most people overrate their ability to multitask. Their results cast doubt on the idea of Millennial-aged students efficiently multitasking with mobile devices or checking their phones during class or study time.

Assessing Millennials' Technological Skills and Attitudes

Technology skills of Millennials. Misunderstandings about Millennials' technology skills may have begun with an umbrella assumption that all digital natives are adept at technology (Bracy et al., 2010; Farrell & Hurt, 2014; Week, 2016). Some empirical research has emerged to test that assumption. "It cannot be assumed that knowing how to look up cheats for computer games on the Internet bears any relation to the skills required to assess a website's relevance for a school project" (p. 781), observed Bennett et al., (2008), who found that skill levels varied greatly among Millennial-aged participants.

Kennedy et al., (2008) approached the question by asking 2,000 incoming first- year students about which digital devices and applications they use and found that Millennials vary in their technology skills and in their desire to acquire such skills. The students with greater expertise were those who had a liking for technology or had a reason to develop it, reporting higher skill levels for social media and instant messaging than those who did not share a liking or need for such skills. Not surprisingly, they found freshmen were less adept than those with more experience in educational-type skills, e.g., photo and media editing, blogging, other web

2.0 applications, focused research, etc. While many of the Kennedy et al., findings are not surprising, it is worth emphasizing that some Millennials simply did not wish to become technologically adept – they remained comfortable with more traditional educational practices and less technology use. This finding sparked interest in additional research on Millennials' varying preferences for technology, including percentages of early technology adopters and differences from previous generations. MacCallum, Jeffery, and Kinshuk (2014) realized that those who were most familiar with technology were also the most likely to adopt new technology. Through a survey using the Technology Acceptance Model (TAM), they examined the impact of both ICT anxiety and literacy on the adoption of mobile learning in the classroom. They found that intention to adopt mobile learning was determined by a complex set of interrelated motivational, perceptual, and belief factors, resulting in a set of recommendations for administration for facilitating the adoption of digital technology. First, they advised making any new mobile learning initiatives as easy to use as possible to reduce student anxiety. Second, they suggested promoting the benefits to the student. Finally, they recommended the development of strategies to combat predicted resistance due to prior bad experiences. Their proposals highlight the complexity of initiating new educational technology given that not all students will arrive with the same experience, desire, or aptitudes for them.

MacCallum et al. (2014) also used the survey data to develop a classification system for technology skill levels and attitudes that could provide helpful distinctions for course designers. Participants rated their user level from *never used* to *extremely skilled* on sixteen commonly used skills, e.g., using a word-processing program to sending texts, searching on the Internet, downloading files, etc. Eleven additional items measured attitudes towards technology perceived control with ICT, and anxiety level while using ICT. Some of the survey items

included statements such as “I feel apprehensive when using a computer” and “I have a lot of confidence when using a computer.” From the data, the investigators created the following three-tiered classification of computer literacy:

1. Basic ICT Literacy: competent and comfortable with everyday usage like online shopping, email, Facebook, word processing, etc.
2. Advanced Mobile Literacy: expert and advanced ICT usage such as using a mobile device for online learning applications, advanced mobile functions, etc.
3. Advanced ICT Literacy: better than basic technology use, which might include editing photos or videos, using online programs for file sharing, collaboration, etc.

Generational differences were also examined, and the study revealed that Millennials showed stronger familiarity and use of social networks compared to faculty of gen-x age. The same was found for mobile device ownership and experience with more sophisticated devices compared to traditional computers. The findings revealed a very practical approach of Millennials for learning a new technology in that they consider the need to learn as highly important and are unlikely to bother with those which are unneeded at the time. Furthermore, the quality of previous good or bad experiences is another strong indicator. In the end, those with positive experiences and attitudes towards technology are more inclined to adopt and learn new technology.

Kennedy et al., (2009), in a study examining digital native assumptions, also defined technology skill levels in their study, creating the categories shown in Table 2. They used a self-reported survey to identify five groupings of skill levels based on both frequency of use of a set of named functions, as well as their self-reported experience levels, as in the MacCallum et al., (2014) study. As this study was done more than ten years ago, there are obvious differences in

popular skills in use today, as illustrated by mobile phone uses. This study revealed significant differences in Millennial-aged participants' use of advanced mobile devices and media sharing for social purposes compared to that of Gen X or baby boomer participants, but not significant differences between Millennial-aged students and Gen X-aged participants regarding technology-based activities. Further, those under the age of 25 were significantly more likely to engage in advanced mobile use and media sharing, as well as Web 2.0 publishing. They observed that some technology-based applications, such as blogs and wiki's, scored low on the perceived usefulness scales, and suggested course designers carefully plan changes and features accordingly.

In Caruso and Salaway's (2008) study aimed at assessing and categorizing skills, survey participants were asked to rate their skill levels as *not at all skilled, not very skilled, fairly skilled, very skilled,* or *expert*. Respondents reported they were very skilled or experts in using presentation software, in using the university library, in searching on the Internet, and in using spreadsheets and LMS's. When asked about their adoption of new technology, just over half considered themselves mainstream adopters, 35.4% considered themselves early adopters, and 13.2% considered themselves late adopters. Nearly 60% preferred moderate IT use, 25% preferred extensive IT use, and almost 16% preferred little to none. In 2005, less than 12% of the participants were taking any online courses. While there are few studies that ask students their preferences regarding online learning, this one did, with 65% agreeing with the statement, "IT makes doing my course activities more convenient," but only 46% agreeing that the such use improved their learning.

Table 2

Definitions of Categories of Technology-Based Activities

Activity	Defined by
Advanced mobile use	Using a mobile phone as a personal organizer, to take and send pictures or movies, listen to MP3s, make video calls, access the Internet, or to send or receive email
Media sharing	Downloading or sharing MP3 files or podcasts, publishing podcasts, sharing photos or digital files on the Internet, using social bookmarking.
Creating and using media	Using a computer to create, manage or manipulate digital images, for creating presentations and for creating or editing audio and video files.
Traditional Web use	Using the Internet to look up reference information for study purposes, to browse for general information, to send or receive email, and for other pastimes.
Web 2.0 publishing	Creating or commenting on blogs or vlogs, contributing to a wiki, and using social networking software.

Note. Definitions as given by Kennedy et al., (2009).

Digital Skills

As an exhaustive search was unsuccessful in locating specific studies or lists of what Millennials might consider *personal/social* digital skills, a focus on general digital skills will be used in this study, such as texting or emailing, file storage, group collaboration, accessing online learning systems, basic photo and video editing, accessing and interacting with social media, basic understandings of computer security and connectivity. A discussion of skills related to education follows.

Hargittai (2010) studied digital skills in young college students in general topic courses. The study found that differences in skill levels are affected by culture, parental encouragement,

and socioeconomic status contribute to skill levels. Overall, the research suggested a complex relationship between digital skills, socioeconomic standing, educational experience, and accessibility to technology. As Hargittai states:

> Regarding widespread assumptions about the inherent digital savvy of young users often referred to as ‘‘digital natives,’’ it is important to note that the data presented here do not support the premise that young adults are universally knowledgeable about the Web. Rather, we observe systematic variation in online know-how even among a highly wired group of young adults based on user background. (p. 109)

Another study aiming to understand digital skills in young adults found sex and education levels to be strong predictors of digital skill levels (Correa, 2015). However, results did not show age to be a factor and thus failed to support the digital native canon. Use of social media such as Facebook was found to be higher in younger and less educated females but was not associated with digital skill levels. Furthermore, data indicated that higher education was associated with more technology use for productivity purposes, while lower socio-economic status was associated with more use for social purposes. Correa concluded that the digital native age premise provided no insight into digital skill levels. While educated males may have used technology more frequently, he observed, this alone did not guarantee digital skill levels or savvy. Despite Millennials' high connectivity, he asserted, the digital inclusion process is (a) more complex and multifaceted than assumed, and (b) will involve more specific skills to be taught to level the playing field. He recommended further studies to explore how social and personal/social use-based skills support the building of digital self-efficacy and digital skills over time.

In an article aimed at students considering future job searching, Petronzio (2013)

suggests ten digital skills that should be mastered before college graduation:

1. Setting up a Wi-Fi network and its associated hardware and software instead of relying only on available and existing Wi-Fi connections.
2. Backing up files onto the cloud using popular services such as iCloud or Dropbox to avoid the loss of important work, e.g., a thesis, due to a hardware failure.
3. Basic photo editing through editing software to increase understanding of needed functions in marketing and communications.
4. Basic video editing as a handy skill in various work-related tasks.
5. Using Google Drive or Microsoft Office for word and file processing (including documents, spreadsheets, and forms) for collaboration as well as presentation software skills.
6. Doing basic HTML and coding in order to understand website maintenance and design on a basic level.
7. Setting up a website or domain as a self-promotion skill or in support of workplace functions, as well as in learning more about social media and security.
8. Converting file formats, e.g., from an Apple-based program to a Windows-based program.
9. Online banking and other web-based utility-based tasks that support the management of personal finances and understanding of mobile technology.
10. Branding oneself in order to present the best impression before sending out job applications to avoid social media issues and pitfalls.

While Petronzio's (2013) news article recommends fundamental digital skills to those entering the world of work, no similar precedent exists for establishing which personal digital

device skills could be transferred to the realm of education. Setting up a thorough approach needs to consider both available devices and relevant skills that could enhance the educational experience.

Universities are finding it useful to screen new students' digital skills while also offering a list of minimum skillsets needed for online learning. The School of Information Sciences at the University of Tennessee (n.d.), for example, presents a detailed list with suggestions for supplementary tutorials, including the use of an LMS such as Blackboard and collaborative software such as Zoom. The UT list also includes various skills in such categories as basic knowledge of computers, proficiency in using productivity software, electronic communications skills, Internet skills, and moving files. The university's communication states that the skill items will be expected of students from day one and encourage those without the named skills to supplement through a number of self-directed learning methods. It also states that it is the student's responsibility to learn the listed skills prior to taking a course or they may risk being asked to withdraw. The list contains items that range from simple proficiency in basic email use to advanced skills such as moving files using secure file transfer protocol.

Deakin University (2016) highly values digital literacy and proficiency to ensure graduates are prepared for a technological world. The university employs a digital literacy framework to enhance student learning outcomes through the identification and use of identified skills that can be described in a matrix (See Figure 1). This exhibit of their framework shows development stages from foundational basics to an advanced level. As students' progress, they become increasingly efficient at using and disseminating information through the use of appropriate technologies commensurate with research and expected graduate outcomes. Deakin identifies eight criteria for evaluating instructional design decisions:

1. Does the practice address digital literacy?
2. Is the practice consistent with principles of good learning, teaching and assessment?
3. Is the practice integrated with discipline learning?
4. Does the practice involve authentic assessment in support of graduate employability in the discipline?
5. Does the practice use the affordances of the digital technology?
6. Does the practice cater for a diverse student body?
7. Is the practice consistent with effective evaluation procedures for the assurance of graduate outcomes?
8. Is the practice sustainable?

Ng (2012) describes digital literacy through his model of three overlapping dimensions: cognitive, technical, and social-emotional. According to Ng, a digitally literate individual is able to operate technologies adequately, think critically, evaluate and create a cycle of handling digital information, and use technology responsibly. His study of undergraduates' digital literacy and technology use found that Millennials were generally able to use unfamiliar technologies but may be unaware of educational technologies upon arrival at a higher education setting. The three-part model (Figure 2), by viewing digital literacy as a comprehensive set of capabilities rather than simple technical functions, supports a much broader approach to understanding digital literacy.

Ng's (2012) study involved second-year participants taking a course that taught educational technologies and tools useful in completing college courses. He believed that students may arrive at university with social and personal technology skills yet may be

unprepared for educationally based technologies. His research showed separate skills from personal to educational use. The items noted as improved by the study treatment or course included presentation creation skills needed to create artifacts and verification of learning as well as a higher confidence using educational technologies in general. Ng found that students began the study assuming their skills were proficient and ended the study more prepared for educational technology and feeling they were more advanced.

Deakin University Digital Literacy Framework, Graduate Learning Outcome 3

This Framework articulates students' need to develop the ability to: access global information in many formats from diverse sources; critically analyse and evaluate sources; create new knowledge; and use appropriate technology to communicate information and connect with others in an academic environment. Digital literacy is socially situated so the Framework is designed for Unit Chairs to apply and explore the elements of Digital Literacy within the context of their disciplines and professional practice.

Elements of Digital Literacy	Foundation level	Proficient Level	Advanced Level
Find: search and navigate	• Identify a need for information to effectively accomplish a task; • Define the scope of the research required and determine key concepts and contexts; • Successfully locate sources from citation lists provided; • Research and accesses key sources of information in the subject area / context.	• Interpret a research question and develops an effective search plan to navigate to relevant information sources; • Demonstrate the ability to alter or refine searches to ensure results reflect the information need; • Demonstrate knowledge of information sources and employ judgement in selection.	• Demonstrate sophisticated use of search strategies required to retrieve comprehensive range of relevant resources; • Use advanced features of library databases to automatically generate regular search outputs e.g. alerting services, RSS feeds.
Use: think critically and analyse	• Recognise that the quality of information varies; • Aware of elementary evaluation criteria to avoid use of misleading knowledge resources.	• Apply appropriate criteria to evaluate reliability, relevance, accuracy and authority of information.	• Consistently demonstrate analytical skills in selecting accurate and relevant digital sources to support a contention or argument.
Disseminate: create, communicate and connect	• Recognise the importance of referencing and acknowledges the ideas of others in the work one creates; • Demonstrate an understanding of copyright requirements, information security and privacy and ethical use of information; • Select and use technologies to communicate in an academic environment.	• Consistently and correctly reference and acknowledge the work of others; • Keep systematic records of resources, using appropriate technologies to manage information; • Demonstrate an understanding of privacy, ethical and legal requirements and relate these concepts to the development of one's digital profile; • Understand the relevance of social media tools and use appropriately for enabling teamwork and collaboration; • Demonstrate the ability to produce subject-related knowledge artefacts using digital tools and resources; • Demonstrate collaborative production and sharing of digital content for study and research.	• Demonstrate advanced working knowledge of relevant bibliographic software tools; • Demonstrate capability to reflect and confidently create and share new knowledge; • Ethically curate and share knowledge in a variety of forms.

Figure 1. Deakin University Digital Literacy framework, graduate learning outcome 3. Guidance for faculty and instructional designers. Reproduced under Creative Commons License.

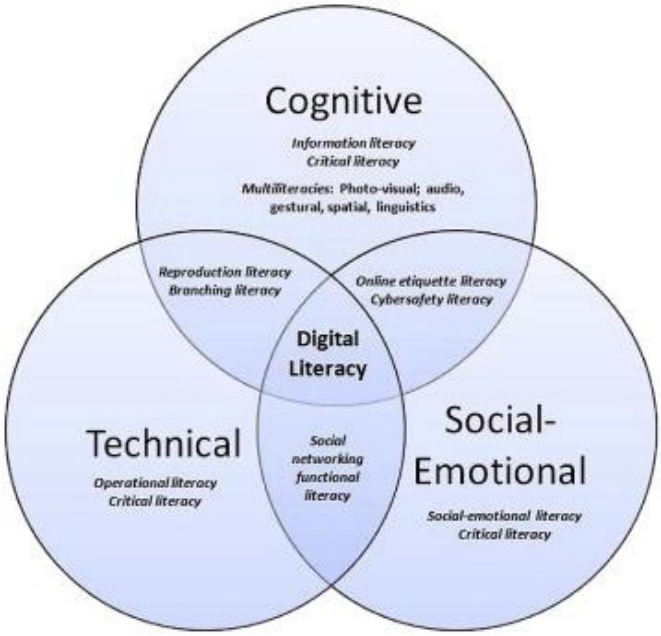

Figure 2. Digital literacy model. From "Can We Teach Digital Natives Digital Literacy?" by W. Ng, 2012, *Computers and Education,* Volume 59, Issue 3, p. 1067. Copyright 2012 by Elsevier. Reprinted with permission.

Student Satisfaction with Online Learning

Cole, Shelly, and Swartz (2014) found a higher rate of satisfaction with blended or partially online courses over those which were fully online. This study used an anonymous online survey accessed by email invitation with mixed methods analysis to survey both undergrad and grad students for three successive years in a business degree program. "Lack of interaction" was the most common reason given for dissatisfaction, while "convenience" was the most popular positive response. The second most popular responses in both satisfaction and dissatisfaction interestingly were liking or not liking the course structure and fitting or not fitting with their learning style. Some of the other factors affecting student satisfaction were around clarity in the course format and information, interactions with the instructor, and perceptions of the instructor's proficiency with the LMS or technology in general. A third of those dissatisfied with the fully online format said they did not like the lack of interaction with both classmates and

instructors, and some made statements of liking the blended approach better for this reason. While some study participants were dissatisfied with the LMS (Blackboard), this was not a significant deterrent. A study focused on cognitive overload by Kim and Frick (2011) agreed with Cole et al., through their literature review in revealing a strong motivation towards enrolling in an online course is convenience and schedule control (p. 4). Kim and Frick also noted that younger and less experienced students preferred live classrooms than their older cohorts.

In a study by Han, Nelson, and Wetter (2014) investigating medical students' technology and device use, contributors found multimedia, scheduling, communications, and collaborative tools, as well as learning management systems, to be highly useful educational technologies for learning. The authors did not find social networking tools, blogs, or gaming useful skill applications for learning in spite of Millennials' frequent and common use. Figure 3 indicates skills which are considered personal use, learning activities, or used for both.

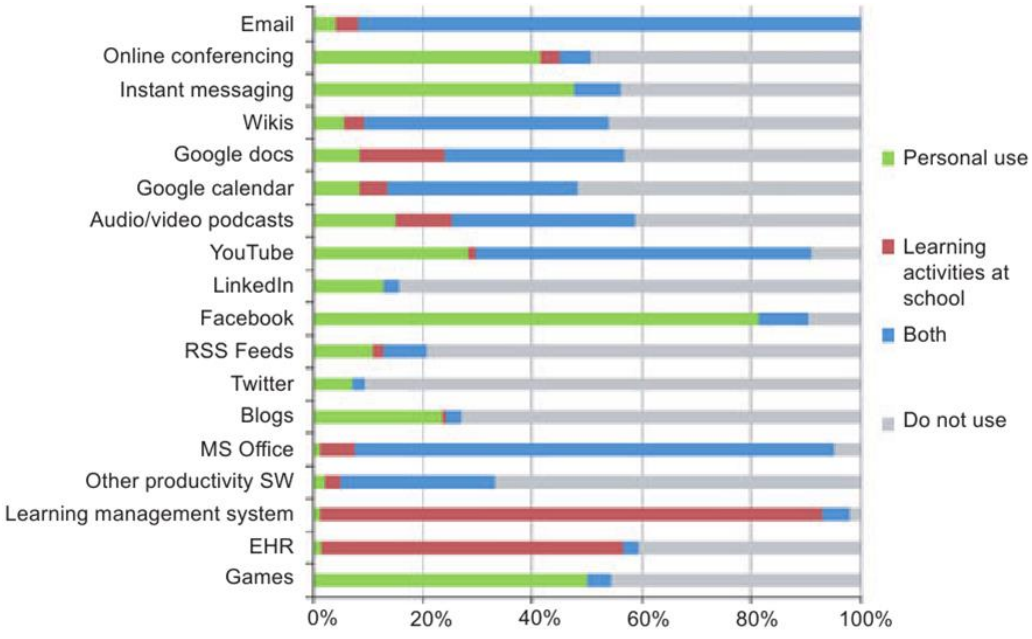

Figure 3. Students' usage of software technology. From "Medical Students' Online Learning Technology Needs," by H. Han, E. Nelson, and N. Wetter, 2014, *Clinical Teacher*, Volume 11, p. 17. Copyright 2014 by Wiley. Reprinted with permission.

Han et al., (2014) found a variety of devices used by their study participants and report some crossover for personal or educational uses in phones, desktop or laptop computers, and music players. Figure 4 describes the device use. The authors also investigated the time students spent performing basic functions and which devices used. Additionally, the authors asked participants whether they perceived themselves as early adopters of new technologies. The results follow in Figure 5.

Cheon, Lee, Crooks, and Song (2012) studied students' intention to adopt new technology for educational use and what they consider to be important factors in m-learning adoption, and about the relationship among those factors. They defined m-learning as a specific type of learning using mobile technology, which is similar to e-learning with the added characteristics of portability, instant connectivity, and context sensitivity. Further, they identified inherent features of m-learning as supporting four types of learning: (a) individualized, (b) situated, (c) collaborative, and (d) informal learning. Also noted is that mobile devices present challenges in the smaller sizes of screens, low-resolution displays, slow computing speeds, inadequate memory, and lack of standardization and comparability (e.g., iOS versus Windows or Android-based operating systems). Other drawbacks for mobile devices to be useful in education include graphic design for small screens, lack of input facilitation (keyboard), as well as the social issues with the use of a phone in class which may distract or hinder student concentration. While access to an LMS may present issues on small screens, other education-based functions might suit mobile devices very well; communications between instructors or students, receiving feedback on assignments, listening to podcasts, watching videos, and many other smaller tasks.

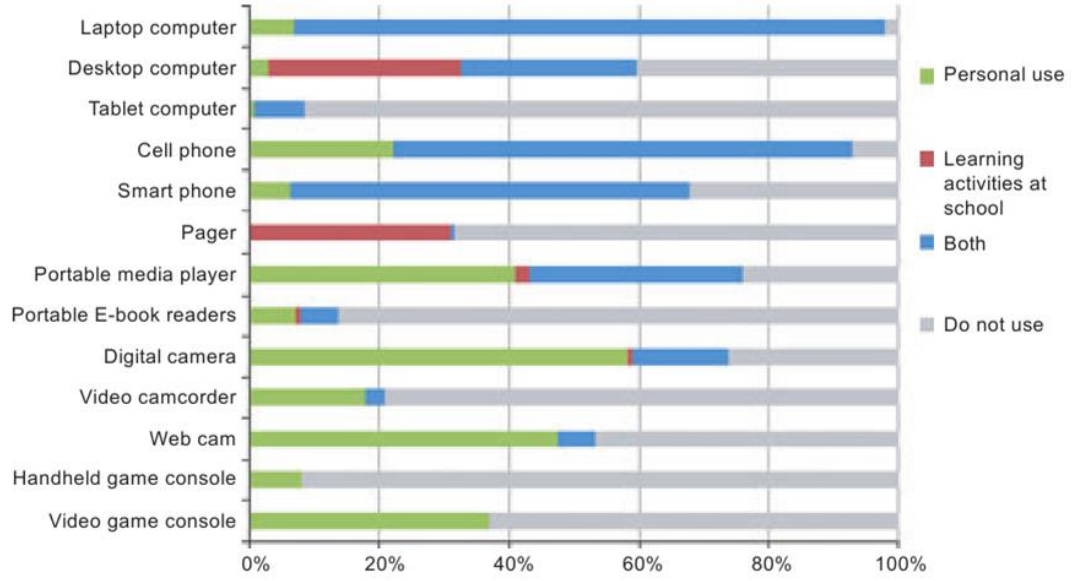

Figure 4. Students' usage of hardware technology for personal use (green), educational use (red) or both (blue). This graph is useful in identifying the devices Millennials use in their lives overall as the percentage of use suggests accessibility of each device type. For example, 98% of the participants use a laptop, while only 8% use a handheld game console. From "Medical Students' Online Learning Technology Needs," by H. Han, E. Nelson, and N. Wetter, 2014, *Clinical Teacher*, Volume 11, p. 17. Copyright 2014 by Wiley. Reprinted with permission.

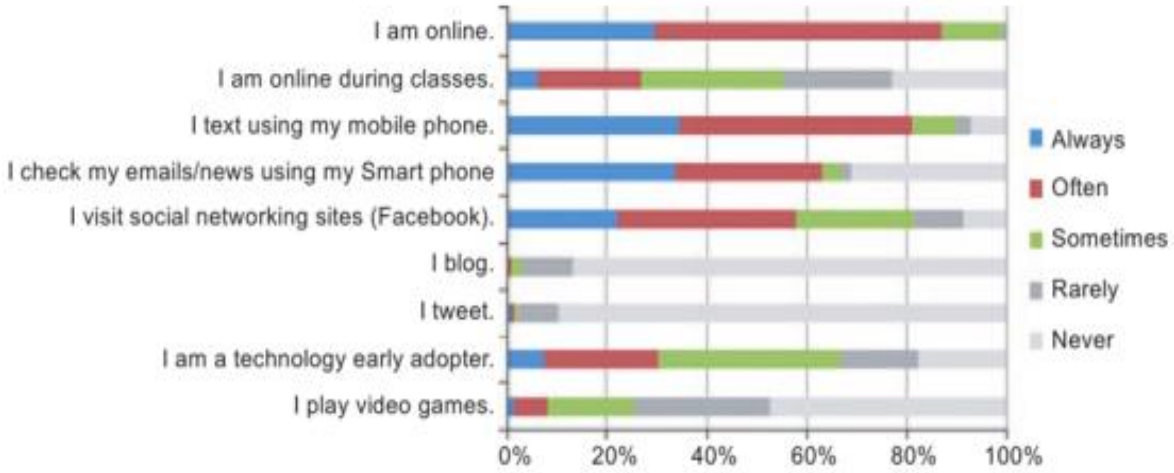

Figure 5. Students' online behaviors. The graph illustrates the time spent with technology for popular activities in 2014. From "Medical Students' Online Learning Technology Needs," by H. Han, E. Nelson, and N. Wetter, 2014, *Clinical Teacher*, Volume 11, p. 18. Copyright 2014 by Wiley. Reprinted with permission.

Cheon et al., advise that mere availability does not guarantee use of mobile devices. The article suggests there are few studies regarding student adoption of m-learning and no studies (as of 2012) considering student preferences of m-learning.

The Cheon et al., underscore the strong influence of faculty and their use of a new technology that effectively influences student adoption of technology. The results suggest that institutions and faculty choose new technologies which are perceived as easy to use and useful, but also those which faculty will become efficient with and adopt into their instructional design. What sets this study apart is that the authors asked students for their perceptions and attitudes instead of assuming either from other literature or studies using opinions from faculty. While the authors acknowledge the steep challenges of moving a pedagogical culture to a mobile format they support the implementation of m-learning use when appropriate and useful.

Millennials' Perceptions about Technology

Rhodes (2012), in a study aimed at Millennials reporting their preferred learning environment, states that "there is a current conflict between student preferences of how to learn and professors' preferences about how to teach" (p. 9). She reports that 72% of the survey participants marked the survey as "important" or "absolutely important" in regard to preference of traditional lecture-type courses, 57% for hybrid or blended courses, and only 48% marked a preference for online learning. Further, she found a strong trend of her business college population to prefer more traditional learning methods and delivery than the items indicating technology-based course design. She also found a significant difference between the popular attributes assigned the Millennials (being tech-savvy and preferring more technology), versus their own personal perceptions and preferences. Rhodes' conclusion listed many suggested strategies towards course design, none of which seem specific to any age college student and

more towards the use of technology to enhance traditional learning methods such as posting feedback more frequently and promptly, posting handouts and artifacts, providing grading rubrics, and being available to students and knowing their names. Many of the identified strategies included traditional classroom preferences, as well as those appropriate for m-learning application like increased communications.

In a qualitative study by Palmer, Boniek, Turner, and Lovell (2014), students were interviewed about their social interactions and the related technological tools used in the Fall term of 2009. The team found a strong trend to use specific devices for different needs. That is, the students used cell phone conversation for family, text for friends or cohorts nearby, computer accessed Facebook for friends far away, and computer accessed email for university communications (p. 289). They found the "students were concerned with wasting time" (p. 292) in the effort of using technology and keeping in touch often and had cautionary comments regarding increasing technology use in learning. Palmer et al., also acknowledged the rapid changes in available technology found in use at a university and suggested more frequent consideration to better direct and inform the institution on changes of technology. They concluded with this statement:

> Regardless of individual views concerning use of technology by undergraduate students, it is clear that modern technology is an imperative part of everyday communication for Millennial students. Therefore, it is also apparent that we need a continually improving understanding of students' use of and expectations regarding technology in university settings. By actively searching out how and why college students use technology in their daily lives, we can improve our ability as educators to understand how our students negotiate social connections while on campus. (Palmer, et al., 2014, p. 293)

In a study investigating mobile distance learning with smartphones and applications in higher education, Vázquez-Cano (2014) surveyed students about their perceptions of the use of smartphones as useful tools for learning. The study found that while roughly 70% of students found smartphones useful in accessing course-related information and interacting with learning related materials, 53% agreed that performing operations with a smartphone takes too much time in relation to academic purposes. Further, in the areas where convenience was a focus, the use of smartphones scores high with agreement of their being a useful tool, although students report only moderate or somewhat agreement that smartphones are effective in study use. A portion of the study looked at specific applications developed to support course interactions in specific courses. Students' responses were very positive on the usefulness of this application and the author encourages other designers and instructors to consider developing similar course-supporting applications. Vázquez-Cano concluded by acknowledging the many devices available to students (smartphones, tablets, laptops, PC's, etc.) and noting that some devices may be more used for specific purposes and designers should recognize that student use will vary, and future research should continue on the topic.

In a later study by Sevillano-García and Vázquez-Cano (2015), students were surveyed about digital mobile devices (tablets and smartphones) in use at three Spanish universities. The aim of the study was to examine technology use on the part of the faculty as well as the student as per the suggestion of needed skills by the European Union Commission report about the social dimension of education and training published in 2010. They found 61% of students believed digital mobile devices were useful towards the acquisition of competencies and learning activities. The researchers believe this rate would increase if more training and support were made available to faculty on the proper use of digital mobile devices in learning applications.

Further they recommend more communications between all stakeholders (students, faculty, administration) on issues concerning the use of digital mobile devices, and that course planning which includes the instruction of skills necessary to use the devices be included.

In the 2015 Rasmussen College study on digital literacy, a conflict was found in attitude towards usefulness of the Internet. More than half of the 2000 respondents admitted they find the Internet overwhelming, yet 68% said they cannot live without it. When looking at what Millennials perceive, they report "37% of those aged 18-34 found the Internet scary and 35% admitted they do not feel safe online" (p. 5). Further, Millennials are realizing the dangers of public exposure and 70% of Millennial respondents said they have changed their Facebook status to private, a rate considerably higher than older respondents (p. 5). Other data include learning that "one in 10 Millennials have not applied for jobs because they lack confidence in their skills" (p. 6), only 21% of all respondents claimed they have excellent computer skills, and 57% claimed to have "good" computer skills. When asked what is stopping them from improving their digital literacy, respondents gave the following reasons: "39% don't have time, 28% can't afford to take a course, 23% don't know where to go for help, 11% are embarrassed to admit their skills are poor, and 11% admit others help them instead" (p. 7). A complete report of the survey findings was unavailable.

Location and Participant Profile

Krannich (2013) describes the intermountain west as "including portions of Colorado, Idaho, Utah, Wyoming, and Montana and contains some of the nation's most rapidly expanding rural areas (portions of Colorado and Utah) … that have experienced sharp and sustained decline in the last 30 years" (p. 29). Furthermore, Krannich discusses the contrast of growth in larger city areas such as Boise, Idaho and Salt Lake City and Ogden, Utah and their increases in population.

He further discusses that rural communities like those common in eastern Idaho have continued to shrink in size and community offerings over the last 20 years (p. 61). The author suggests that with less growth rural communities are challenged to maintain their populations or provide services and infrastructures available in larger cities.

In rural areas such as eastern Idaho, challenges of connectivity come into play when computer tasks require file downloads, video streaming, collaboration programs, or other commonly used applications in formal education. In the eastern Idaho region, the challenges of sparsely populated territory translate to sparsely connected areas as only a few cell phone companies attempt to cover such broad areas with fewer paying customers. To demonstrate the challenges Figure 6 shows the top four cell phone company's 4G coverage of the intermountain west region in 2016 (Coverage maps, 2016).

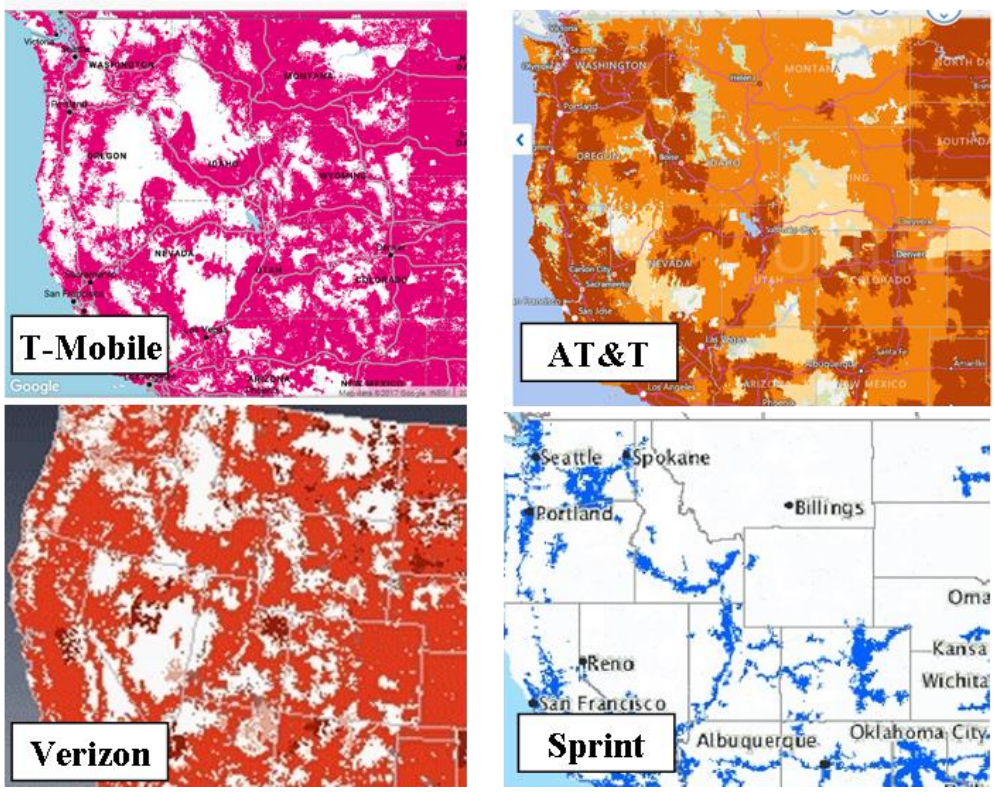

Figure 6. Cell phone coverage by major company of the Intermountain West in 2016.

In Faulkner's (2015) dissertation about distance learning, the challenges for universities to meet the Internet connection expectations while located in sparsely populated regions like the intermountain west are of high concern in instructional design. Faulkner states connectivity is poor in many rural areas limiting student access to applications needed for coursework or online meetings (p. 54). The poor connections and low broadband speeds cause universities to continue with satellite-fed distance learning programs to meet the needs of remotely located students who may otherwise be unable to use reliable Internet connectivity in their homes (p. 55).

This study aims to examine college students' use of technology and their preferences for technology devices and applications. With that in mind, it is relevant to survey students on their device and application choices as influences of location, broadband speed, and accessible connectivity may affect their choices in courses and delivery methods. Furthermore, the location of a university in a predominantly rural region influences the student demographics at this type of university.

Statistics describing the average undergraduate student attending the university in 2016 as provided by the university's common data set:

- 91% of enrollees are state residents prior to enrollment
- 89% do not live on campus and may commute, take distance learning or online courses
- 34% are 25 years old or older
- 23 is the average age of all full-time students
- 25 is the average age of all students, full and part-time

The university has three satellite campuses in the state and uses distance learning classrooms in all locations plus others and also supports the use of collaborative webinar

software such as Zoom to be used for online learning. With these factors in mind, the study instrument will ask participants for demographic information that also defines their connectivity, their choices of technology as affected by location, and influences towards course delivery.

Summary

Very few studies offer findings of surveys of Millennial-aged students' perceptions of the use of technology for learning applications leaving the voice of the learner seldom heard or considered in instructional design. Thus, prior to the study it was unclear what the technology device or application uses were in today's quickly changing world of concern with Millennial learners. Numerous articles report convenience being the number one attractant to increasing technology and online learning (Cole et al., 2014; Kim & Frick, 2011), yet, limited information is available stating improved learning is the primary reason Millennials choose the increased use of technology in formal education. Due to the scant articles seeking Millennials' feedback, it seemed prudent to ask the students for their perceptions and thoughts on the matter. Millennials are indeed different in that they have many choices available to them for education in current times: they may choose to self-educate through MOOCs or online programs such as Lynda and Excite, attend professional technical schools to learn trades and skills, or seek attendance at academic institutions. Also, in their choices are multiple mobile digital devices used to access learning that was not available even five years ago. Today's college student might enroll with only a tablet or a smartphone in hand and not make an investment in an expensive laptop, software, printer, webcams, or other hardware that were the standard a handful of years ago. Cost and portability are only two persuasive reasons to believe increasing technology use is desirable in formal education. However, instructional design is driven by factors other than convenience or cost and must also weigh input from their customers; the students, as well as administrative

interests, pedagogical and design theory, and endeavor to find the best application and design to suit these many purposes and stakeholders. As noted in Chapter II, studies examining technology and device use by Millennials are available, yet studies focused on their personal/social and educational technology use and preferences, appear to be scarce or thinly represented. This study contributes to a first-hand Millennial voice on their technology preferences.

CHAPTER III

Methodology

The purpose of this descriptive survey study was to describe (a) the relationship between Millennial college students' use of technology-based devices and applications in personal/social versus formal education environments and (b) their preferences of technology-based devices and applications in personal/social versus formal education environments. This chapter will describe the methodology utilized for the study that explored the stated purpose and research questions.

Research questions

1. What devices do college students choose for:
    a. personal/social use?
    b. formal education use?
2. What devices do college students prefer to use for tasks associated with:
    a. personal/social use?
    b. formal education use?
3. What are the preferences for technology use:
    a. in personal/social applications by college students?
    b. in formal education applications by college students?
4. What course delivery methods do college students prefer?
5. What online course features do college students prefer?
6. Is there a relationship between technology use by Millennial-aged college students and college students of other generations?
7. Is there a relationship between perception of technology by Millennial-aged college students and college students of other generations?

Research Design

This study used descriptive survey research to describe the attitudes, usage, and preferences of Millennial-aged college students about technology use in personal/social and educational applications. "Non-experimental survey research provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population" (Creswell, 2014, p. 13). The choice of using a survey follows the suggestions of Tingley (2014), when a respondent's prior knowledge or experience with an issue may have a large influence on their revealed preferences (p. 445). Further, Tingley notes the increased value in obtaining data generated by primary stakeholders (Millennial college enrollees) over opinions generated by secondary (faculty) or tertiary (administration) stakeholders (p. 449). As noted in Chapter 2, studies examining technology and device use by Millennials are available, yet studies focused on their personal/social and educational technology use and preferences, appeared to be scarce or thinly represented.

Population, sample and participant criteria. The participants in this study were college students 18 and older enrolled in the Fall semester (2017) at a rurally located university in the intermountain west. While the targeted population was the Millennial-aged student born between 1982 and 2005 (Howe & Strauss, 2007), one survey item (SQ21) aided in distinguishing the age of each participant in order to classify participants as Millennial or non-Millennial-aged.

Students attending the university come from a wide variety of locations including eastern Idaho, surrounding intermountain west states, as well as 38 U.S. States, and 52 countries. In the Fall of 2017 the student body had approximately 47% males and 53% females, totaling 12,653 enrolled students (About ISU, 2017). Participants in this study were enrolled in any of the 268 varying degrees or certificate programs offered from eight colleges within the

university.

Recruitment. Students were contacted through their university email via student announcements. The researcher received permission to forward: (a) a survey announcement, (b) the invitation with a live link for the survey, and (c) a follow-up reminder with live survey link, from the university Institutional Research Department to utilize the university announcement/emailing method for delivery. An initial announcement describing the study was distributed prior to the actual survey invitation as per Dillman, Smythe and Christian's (2014) suggested method of alerting participants of the forthcoming invitation. A second email contained a formal invitation to participate and a live link to access the study. Additionally, a third message containing a follow up reminder to take the survey was also distributed as per Dillman et al. (2014).

Instrument. In order to gather data to support the research questions, an online survey instrument containing 25 items was developed to address each specific research question. While an expert panel was not convened, several recognized experts whose questionnaires have been widely replicated are the basis for the instrument in the current study. The instrument questionnaire items were adapted from the instruments of these experts. The primary contributor is Kennedy who acknowledged that the questionnaire he and his colleagues advanced in 2008 has been cited, replicated, and applied extensively worldwide in studies cited in scholarly articles and presentations. Given the extensive prior application of the instruments upon which this study is built, the current instrument may be considered to have content validity. The results from the pilot study then confirmed the questionnaire would collect reliable data. These survey questions are listed and described in Appendix D.

The researcher's choice of a self-administered online survey is advised through Kreuter, Persser, and Tourangeau (2008) by recognizing that while self-administered questionnaires tend

to yield fewer reports than live interviewer-administered questionnaires, they show a desirable increase in accuracy. Thus, by targeting a specialized population of established computer users by virtue of the desired demographics of the study, using the very devices the study is focused on, the number of participants responding could have been higher than otherwise expected for Internet-based studies (Kreuter et al., 2008).

The study questionnaire asked for demographic information to determine the age of participants, particularly those born between 1982 and 2005 as per Howe and Strauss' (2007) identification of the Millennial as well as sex, race, home residence location category, university access method, broadband information, and tendency to adopt new technology. The responses of non-Millennial participants were used in the comparison analysis. Participants who reported that they were born after 1999 were automatically restricted from participating due to being under 18 years of age.

Additionally, participants were asked to choose preferred technology devices, skill descriptions, applications and features used most, preferences for formal education delivery methods, and to distinguish which devices and applications they prefer in personal/social versus formal education use.

For the purposes of this study personal/social use is described as an individual who uses the Internet for entertainment, home or recreational tasks, and who uses social networking sites such as Facebook, Twitter, or LinkedIn (Perrin, 2015). Buzzetto-More (2012) further describes social use as services or computer applications that support connecting people with tools for storing and presenting information as well as communicating, connecting, and interacting with others. While this description could easily be applied to technology use in formal education purposes, participants were given suggested common tasks such as contacting family or friends, online shopping, social network use, non-formal learning, or entertainment, to help guide their

understanding of the differences. Items 1 through 4 were marked for personal/social applications only. For the items about formal educational use, examples such as the use of an LMS, posting assignments, interacting with faculty and cohorts were given. Items 5 through 13 focused on technology use in university applications of education. To further aid in the distinction of personal/social versus formal education use the questionnaire used color and font emphasis to clearly label each resultant question.

Research questions 6 and 7 used Chi-square analytics to look for differences between age and their use and preferences for technology. Research questions are supported by one or more of the survey items as shown in Table 3.

Table 3

Alignment of research questions to survey items.

	Research Question	Type of statistic/test	Corresponding survey item(s)
1a.	What devices do college students choose for personal/social use?	Inferential statistics	1
1b.	What devices do college students choose for formal education use?	Inferential statistics	5
2a.	What devices do college students prefer to use for tasks associated with personal/social?	Inferential statistics	2
2b.	What devices do college students prefer to use for tasks associated with formal education?	Inferential statistics	6
3a.	What are the preferences for technology use in personal/social applications by college students?	Inferential statistics	4
3b.	What are the preferences for technology use in formal education applications by college students?	Inferential statistics	7, 8
4	What course delivery methods do college students prefer?	Inferential statistics	10, 11, 12
5	What online course features do college students prefer?	Inferential statistics	13
6	Is there a relationship between technology use by millennial aged college students and college students of other generations?	Chi-Square	3, 7
7	Is there a relationship between perception of technology by millennial-aged college students and other generations?	Chi-Square	9

Data Collection. The study utilized data collected from the online survey delivered via email to enrolled students at the university. The survey instrument was developed using the Qualtrics™ program, where the collection of the data is facilitated by an automated collector. Qualtrics™ produces downloadable spreadsheets and interfaces to allow the researcher to inspect and cleanse the data.

Permission to perform the survey was determined by the University Department of Research Outreach and Compliance, Human Subjects Committee. A message to this effect was included in the pre-survey announcement, the invitation letter, and the follow-up letter, as well as information describing how to access final survey results.

The Qualtrics™ survey was administered during the Fall semester using the Dillman's guiding principles for mail and internet surveys (Dillman, Smyth, & Christian, 2014). The time frame of the study spanned from the date of the initial emailed announcement to all currently enrolled students on October 26, 2017, emailing the cover letter and survey invitation on October 30, 2017, and emailing the reminder and survey link on November 13, 2017.

Variables. The types of variables found in the survey items were:

- Demographical information for age, sex, residence location, and broadband speed and connectivity from the student's study location
- Experience levels for year in school, types of courses taken, digital skill levels, and number of courses taken
- Familiarity information for available digital devices and use frequency
- Personal/social preference information regarding digital skills use, device choices, course features and formats
- Descriptive information of motivation for a participant to choose an online course and their preparedness at the time of their choice.

Pilot study. A pilot group to test the instrument was formed from university students from another local and rural university. Pilot participants were asked to take the draft survey and respond to questions about each survey item, its language and wording, and how well the item met the overall study intentions. Following the pilot trial, a live meeting was scheduled to discuss their suggestions and opinions. Pilot group suggestions were recorded and sorted, considered, and suggestions implemented within the guidance of the study advisor and committee.

Data Analysis

The survey instrument used closed-ended questions featuring the use of ordinal ranking, nominal, and Likert-type questions. The data were analyzed by applying several tests including use of statistical analysis, Chi-square, Cramer's V, and simple collections of descriptive data. Data were exported to SPSS for analysis, and then exported to Excel to create the tables for presentation. For questions supporting comparisons and correlations, Chi-square analysis was performed followed by Cramer's V to determine the effect size where needed.

Descriptive statistics and frequency tables were used to report data concerning participant demographics and their perceptions regarding technology use in personal/social and formal education. Frequency tables were also used in supporting research questions 1 through 5. Research questions 6 and 7 asked about relationships with technology and the age of the student (Millennial or non-Millennial-aged). Chi-Square tests of independence were performed to determine whether statistical significance was present using an alpha level of .05. As the survey items being tested were larger than 2x2, the post-hoc Cramer's V test was used to find the measure of effect on those found with statistically significant associations. As per Cohen (1988) the effect size when using degrees of freedom of 4 as needed in this study, is: (a) small effect =.05, (b) medium effect = .15, and (c) large effect = .25.

Summary

In the interest of learning more about technology used by Millennial-aged college students, the non-experimental survey design was chosen. The choice was influenced by the lack of available studies which surveyed Millennial students with regard to their preferences for devices and technology use in formal education and how their choices might direct instructional design. Through the use of an easily accessible and simple survey design this study gathered data on the use of technology for personal/social versus educational use, how Millennials use technology-based devices and applications, and their preferences of the technology used in formal education. The data were cleansed for incomplete records, tabulated and displayed in tables, and analyzed for descriptive statistical relationships. The complete results are displayed and discussed in Chapters IV and V.

CHAPTER IV

Results

The purpose of this descriptive survey study is to describe: (a) the relationship between Millennial college students; use of technology-based devices and applications in personal/social versus formal education environments and (b) their preferences of technology-based devices and applications in personal/social versus formal education environments. The research questions were:

1. What devices do college students choose for:

a. personal/social use?

b. formal education use?

2. What devices do college students prefer to use for tasks associated with:

a. personal/social use?

b. formal education use?

3. What are the preferences for technology use:

a. in personal/social applications by college students?

b. in formal education applications by college students?

4. What course delivery methods do college students prefer?

5. What online course features do college students prefer?

6. Is there a relationship between technology use by Millennial-aged college students and college students of other generations?

7. Is there a relationship between perception of technology by Millennial-aged college students and college students of other generations?

This chapter provides the results of the study. The chapter discusses the data collection process, demographic description of the participants, and how the analyzed data addresses the research

questions.

Participants

Two factors were used in determining participation in the study; the age of the participant being over 18 at the time of the survey and being currently enrolled at the participating university. All participants were currently enrolled (full or part-time) at a rurally located university in the Intermountain West region of the United States. As per the university public information office, 12,643 students received the survey announcement, invitation and reminder (10,688 undergraduates, and 1955 graduate students). According to the data received through Qualtrics™, 1521 (12.03%) students responded. Of those responding, 1281 (10.13%) provided completed questionnaires and met the requirements of age to participate. As per commonly used calculations to calculate sample size needed, the number of samples collected to assure a 95% confidence level has been met with a confidence interval of 2.6.

The participants ranged in age from 79.3% (1016) Millennials born between 1983 and 1999, 18.9% (242) Gen-X'ers born between 1960 and 1982, and 1.7% (22) Baby Boomers and older born before 1959. Note that due to the small number of Baby Boomers, the tests using Chi-Square analyses combined the Baby Boom and Gen-X sample participants into one "non-Millennial" age group to represent those born before 1983. The enrollment years in college reported by the participants were: 14.8% (190) freshmen, 15.2% (195) sophomores, 15.6% (200) juniors, 22.30% (287) seniors, 19.04% (245) graduate-masters, and 12.9% (166) graduate doctoral candidates. The race of participating students was 82.0% (1057) white/Caucasian, 4.5% (58) Asian, 2.9% (37) Hispanic, and 10.4% (134) other races or preferring not to answer. Of the 1281 participants, 31.9% (408) were male and 68.1% (872) were female. While this unexpected distribution of males and females is not representative of the general population of the surveyed university at the time of the study, the researcher felt there would not be any

negative outcomes due to this occurrence and went forward with the study. The university population ratio at the time the survey was administered was 47% males and 53% females. As per Sevillano-García and Vázquez-Cano (2015) and Akçayır, Dündar, and Akçayır (2016), sex is not a confounding issue in the use of digital mobile devices with Millennial-aged students. Participants were asked about the education legacy of their parents and grandparents and their position as to their own education. Reporting to be the first generation to attend college were 34.3% (439) participants, 38.7% (496) following one or both parents to college, 23.3% (298) following one or both parents and one or both grandparents to college, and 3.6% (46) followed one or both grandparents to college. See Table 4 for these results.

Table 4

Description of Participants Related to Year in College, Age, Sex, Race, and Educational Legacy (Results from Survey items SQ17, SQ21, SQ19, SQ20, and SQ18) (N=1281)

	n	%
Year in College		
Freshman (1st year)	190	14.8
Sophomore (2nd year)	195	15.2
Junior (3rd year)	200	15.6
Senior (4th or 5th year)	529	41.3
Graduate	166	13.0
Year Born		
Millennials (1983-1999*)	1016	79.3
Gen X (1960-1982)	242	18.9
Baby Boomer + (Before 1959)	22	1.7
Sex		
Female	872	68.1
Male	408	31.9
Race		
White	1051	82.0
Hispanic	37	2.9
Black/African American	21	1.6
American Indian/Alaska Native	18	1.4
Asian	58	4.5
Native Hawaiian/Pacific Islander	4	0.3
Other	54	4.2
Prefer not to answer	37	2.9
Education legacy		
First generation to go to college	439	34.3
One or both parents graduated from college	496	38.7
One or both grandparents and parents graduated from college	298	23.3
One or both grandparents graduated from college	46	3.6

* The birth years of 1983 through 1999 was used to restrict participation to only those 18 years or older as of October 2017.

The participants were asked to describe their residence location prior to enrollment and replied by answering that 62.1% (796) resided within a two-hour drive from the location of the

main campus, 24.3% (311) resided further than a two-hour drive yet lived inside the Intermountain West region of Idaho, Wyoming, Montana, Utah, and Nevada, while 10.4% (133) previously lived outside this region, and 2.8% (36) previously lived outside the United States. Participants described the size of their residence city as 23.6% (302) rural (2500 people in the immediate area), 32.7% (419) urban (2500 to 50,000 population), 30.4% (389) city (between 50,000 and 100,000), and 13.3% (170) coming from a large city of over 100,000 population. Current residences of the participants include 14.2% (182) living on campus, 62.5% (801) living off campus and commuting by driving, 6.7% (86) living off campus and commuting to a satellite campus or video-feed classroom, 11.2% (144) living off campus and accessing courses through fully online contact, 1.7% (22) living off campus and attending live webinar courses, and 3.2% (41) claiming "other." See Table 5 for complete results.

Table 5

Participants' Residence Distance and Type. (Complete results from survey items 22, 23, and 24.) (N=1281)

	n	%
Home prior to enrollment		
Near the main campus or within a 2 hour drive	796	62.1
Further than a 2 hours drive but inside ID, WY, MT, UT, and NV	311	24.3
Other U.S. state outside intermountain area	133	10.4
Other country	36	2.8
Prior home residence type		
Rural – less than 2500 people	302	23.6
Urban – between 2500 to 50,000 population	419	32.7
City – between 50,000 and 100,000 population	389	30.4
Large city – between 50,000 and 100,000 population	170	13.3
Home residence type during enrollment		
I live off campus and commute by driving	801	62.5
I live on campus	182	14.2
I live off campus and use fully online courses (no live meetings)	144	11.2
I live off campus and use webinars for live courses	22	1.7
I live off campus and commute to a satellite campus or nearby	86	6.7
Other	41	3.2

All participants were asked about the connectivity and broadband speed they utilize in their education to further define issues found in rurally-located campuses and study locations. Note that the questionnaire allowed for participants to "check all that apply" in the choices offered and thus the number of responses will not match the established number of participants of 1281. See Table 6 for the complete results.

Table 6

Complete Results for Survey Item 25: "From your preferred study location, please describe your connectivity and broadband speed." (N = 1281)

	Morning	Afternoon	Evening	12am-6am	N/A	Total
Time of day most used	20.82 (439)	29.54% (623)	44.05% (929)	4.74% (100)	.85 (18)	2109
	Fiber Optic	Wireless Satellite	Cable or DSL	3G/4G data plan	N/A	
Home connection type	6.66% 98	30.10 (443)	41.92% (617)	16.10% (237)	5.23% (77)	1472
	Campus WIFI - your devices	Ethernet	Computer lab- Campus computers	3G/4G data plan	N/A	
Campus connection type	56.52% (941)	3.60% (60)	18.44% (307)	11.65% (194)	9.79% (163)	1665
	Very fast	Fast enough	Could be better	Slow or limiting	N/A	
Satisfaction with connection speed	9.90% (134)	49.78% (674)	33.68% (456)	5.4% (74)	1.18% (16)	1354
	Rural	City	Dorm	Other	N/A	
Location	18.43% (244)	61.33% (812)	11.40% (151)	7.10% (94)	1.74% (23)	1324

Survey items 14, 15, and 16 were originally designed to determine the participant's technology skill levels by asking for their familiarity with specific software programs and applications, hardware use and experience, and operations of digital devices. See Appendix B for the survey instrument printing of SQ14, SQ15, and SQ16. The plan to identify the skill and knowledge level of the participant failed as there were not enough differences between the participants' self-reported skill levels making the veracity of the data suspect and of limited value. Thus, the data were not included in the results or the conclusion.

Research questions

Research question 1a. The first research question asks what devices college students

choose for personal/social use. Survey item one (SQ1) presented eight choices of devices and five possible answers in a Likert array including “Not used,” “Least used,” “Occasionally used,” “Frequently used,” and “Most used.” The eight possible devices included:

1. Smartphone with data connection (e.g., Androids, iPhone)
2. Cell phone without internet connectivity (for calls and text, photos)
3. Smartwatch with data connection
4. Digital Reader (e.g., Nook, Kindle)
5. Laptop/netbook/Chromebook (portable computer with keyboard and mouse)
6. Tablet (e.g., touch screen, no provided keyboard, iPad, Fire)
7. Desktop computer
8. Game or TV system with internet connectivity.

Of the 1281 participants, 68.9% (882) chose the smartphone with data connection as the most used device followed by 28.9% (370) choosing the laptop computer. Conversely, participants indicated the lowest use devices by 82.4% (1056) reporting they do not use a smartwatch and 72.5% (929) do not use digital readers. See Table 7 for complete results.

Table 7

Complete Results for Survey Item 1: Which devices do you choose to use on a regular basis for personal/social applications and how frequently? (N = 1281)

#	Device	Not Used	Least Used	Occasionally Used	Frequently Used	Most Used	Total
1	Smartphone with data connection (e.g. iPhone, Androids)	3.0% (39)	1.6% (21)	3.3% (42)	23.0% (295)	68.9% (882)	1279
2	Cell phone WITHOUT Internet Connectivity (for calls, text, photos)	66.5% (852)	6.1% (78)	10.5% (135)	11.6% (148)	5.1% (65)	1278
3	Smartwatch with data connection	82.4% (1056)	3.0% (38)	6.0% (77)	5.6% (72)	2.7% (35)	1278
4	Digital Reader (e.g. Nook, Kindle)	72.5% (929)	9.8% (125)	12.6% (162)	3.7% (47)	1.2% (15)	1278
5	Laptop, netbook, or Chromebook (portable computer with keyboard and mouse)	3.7% (48)	3.6% (46)	14.4% (185)	49.2% (630)	28.9% (370)	1279
6	Tablet (e.g. Touch screen, no provided keyboard, iPad, Fire)	47.9% (614)	12.6% (162)	18.7% (239)	14.6% (187)	5.9% (75)	1277
7	Desktop computer	37.0% (474)	18.1% (232)	20.3% (260)	13.9% (178)	10.5% (134)	1278
8	Game or TV system with Internet connectivity	40.7% (522)	11.9% (153)	20.6% (264)	18.7% (239)	7.8% (100)	1278

Research question 1b. The second research question asks what devices college students choose for formal education use. SQ5 presented eight choices of devices and five possible answers in a Likert array including “Not used,” “Least used,” “Occasionally used,” “Frequently used,” and “Most used.” The eight possible devices used the same established list found in survey item one and included: smartphone with data connection, cell phone without internet connectivity, smartwatch with data connection, digital reader, laptop/netbook/Chromebook, tablet, desktop computer, game or TV system with internet connectivity. The most used device was the laptop computer, followed by the smartphone and desktop computer as being frequently used. The least used devices were the smartwatch and cellphone without data. To look further into the issue of device use a Chi-Square test of independence was performed on the use of smartphones and laptop computers with student age. The Chi-square test showed a significant relationship between smartphone use and student age, X^2 (8, N=1281) = 38.854, p = .000, V=0.123, showing a medium effect size for Millennials using a smartphone for education over the non-Millennial-aged students. Student age and the use of a laptop computer, X^2 (8, N=1281)

= 31.718, p = .000, V= 0.111, showing a medium effect size for Millennials using a laptop for education over the non-Millennial-aged students. See Table 8 for the complete descriptive statistics.

Table 8

Complete Results for Survey Item 5: Which digital devices do you choose to use on a regular basis for formal education applications? (N=1281)

#	Items	Not used	Least used	Occasionally	Frequently	Most used	Total
1	Smartphone with data connection (e.g., iPhone, Androids)	9.7% (124)	18.6% (238)	37.9% (485)	26.2% (335)	7.5% (96)	1278
2	Cell phone WITHOUT Internet Connectivity (for calls, text, photos)	85.1% (1090)	8.9% (114)	4.0% (51)	1.6% (21)	0.2% (2)	1278
3	Smartwatch with data connection	92.2% (1181)	4.3% (55)	1.7% (22)	1.1% (14)	0.5% (6)	1278
4	Digital Reader (e.g., Nook, Kindle)	87.6% (1122)	6.1% (78)	4.3% (55)	1.3% (17)	0.5% (6)	1278
5	Laptop, netbook, or Chromebook (portable computer with keyboard and mouse)	4.1% (52)	2.6% (33)	8.7% (112)	21.9% (281)	62.5% (800)	1278
6	Tablet (e.g., Touch screen, no provided keyboard, iPad, Fire)	61.6% (789)	11.9% (152)	13.7% (176)	9.5% (122)	3.0% (39)	1278
7	Desktop computer	36.8% (472)	15.8% (203)	17.6% (226)	16.6% (213)	12.8% (164)	1278
8	Game or TV system with Internet connectivity	86.8% (1112)	7.4% (95)	3.2% (41)	1.7% (22)	0.5% (7)	1277

Research question 2a. This research question asked what digital devices college students prefer to use for tasks associated with personal /social applications. Survey item 2 presented the established list of eight devices: smartphone with data connection, cell phone without internet connectivity, smartwatch with data connection, digital reader, laptop/netbook/Chromebook, tablet, desktop computer, game or TV system with internet connectivity. Seven categories of tasks or activities were presented: (a) communications with friends and family, (b) online shopping, (c) social networking/blogs/posts, (d) creativity/working with photos or video, (e) casual learning and referencing (non-degree program and not job related), (f) news/weather/maps, (g) games/movies/entertainment. Smartphones were the overwhelming preferred digital device with the laptop computer

preferred for online shopping and creativity-related tasks. The less preferred digital devices were tablets, readers, smart watches, and cell phones without data. See Table 9 for complete results from SQ2.

Table 9

Complete Results for Survey Item 2: Choose which device you prefer to use for each of the listed personal/social uses (N=1281)

#	Uses	Laptop Computer	Desktop Computer	Tablet	Smartphone	Digital Reader	Smart-watch	Game or TV System	Cell Phone (no data)	N/A-Don't use	Total
1	Communications with friends and family	4.4% (56)	1.7% (22)	1.6% (20)	86.8% (1112)	0.1% (1)	0.2% (3)	0.0% (0)	5.1% (65)	0.1% (1)	1280
2	Online shopping	63.4% (812)	11.4% (146)	4.3% (55)	17.1% (219)	0.0% (0)	0.1% (1)	0.1% (1)	0.2% (2)	3.2% (41)	1277
3	Social networking (e.g., blogs, posts)	17.3% (221)	4.4% (56)	3.4% (44)	66.0% (845)	0.1% (0)	0.4% (5)	0.1% (1)	0.9% (11)	7.3% (93)	1277
4	Creativity - working with photos or video	46.7% (598)	19.2% (246)	2.0% (25)	20.1% (258)	0.2% (2)	0.5% (7)	11.1% (142)	0.0% (0)	0.0% (0)	1278
5	Casual learning and referencing (non-degree program, not job related)	49.1% (629)	9.8% (126)	7.0% (90)	30.7% (393)	0.6% (8)	0.1% (1)	0.3% (4)	0.2% (2)	1.8% (23)	1276
6	News, weather, maps	9.9% (127)	2.7% (35)	4.3% (55)	78.2% (1002)	0.0% (0)	0.3% (4)	1.4% (18)	1.2% (16)	1.6% (21)	1278
7	Games, movies or entertainment	25.3% (324)	6.2% (80)	6.5% (83)	11.4% (146)	0.0% (0)	0.2% (3)	46.0% (589)	0.5% (6)	3.5% (45)	1276

Research question 2b. This research question asked what devices college students prefer to use for tasks associated with formal education applications. Survey item 6 presented a list of eight devices: smartphone with data connection, cell phone without internet connectivity, smartwatch with data connection, digital reader, laptop/netbook/Chromebook, tablet, desktop computer, game or TV system with internet connectivity. Seven categories of tasks or activities were presented: (a) communications with faculty or cohorts, (b) creating course-related assignments, (c) course-related forums/blogs/posts, etc., (d) other course or school-related needs, (e) course-related referencing/research/study, (f) grades/school announcements and registration, (g) course access to materials (Moodle, Blackboard, etc.). See Table 10 for complete results of SQ6.

Table 10

Complete Results for Survey Item 6: Choose which device you prefer to use for each of the listed formal education uses (N=1281)

#	Uses	Laptop	Desktop	Tablet	Smartphone	Digital	Smart-	Game or	Cell Phone	N/A-	Total
1	Communications with faculty or cohorts	62.1% (796)	12.4% (159)	1.4% (18)	22.6% (289)	0.0% (0)	0.0% (0)	0.1% (1)	0.8% (10)	0.4% (5)	1278
2	Creating course related assignments	78.2% (1002)	18.0% (230)	0.8% (10)	0.8% (10)	0.1% (1)	0.0% (0)	0.2% (3)	0.2% (2)	1.6% (20)	1278
3	Course related posts (e.g., Forums, blogs)	75.4% (966)	14.0% (179)	2.3% (29)	5.0% (64)	0.1% (1)	0.2% (2)	0.2% (3)	0.2% (2)	2.5% (32)	1278
4	Other course or school related needs	76.0% (973)	14.5% (186)	2.8% (36)	5.4% (69)	0.3% (4)	0.1% (1)	0.1% (1)	0.2% (2)	0.5% (6)	1278
5	Course related referencing, research, study	77.5% (993)	17.1% (219)	2.2% (28)	2.0% (26)	0.2% (3)	0.2% (2)	0.0% (0)	0.3% (4)	0.2% (3)	1278
6	Grades, school announcements and registration	69.0% (884)	13.6% (174)	2.3% (30)	13.6% (174)	0.1% (1)	0.2% (2)	0.0% (0)	0.6% (8)	0.4% (5)	1278
7	Course access to materials (e.g., Moodle, Blackboard)	74.4% (953)	15.0% (192)	2.1% (27)	7.6% (97)	0.1% (1)	0.2% (2)	0.1% (1)	0.2% (3)	0.2% (2)	1278

Research question 3a. This question asked participants for their preferences for technology use in personal/social applications. Survey item 4 addressed this question using a Likert scale including "Never," "Rarely," "Occasionally," "Frequently," and "Most often." Five activity categories were presented: (a) written communications (emails, texts), (b) research and information gathering (e.g., news, weather, recreation), (c) creation of artifacts (e.g., photos, videos, writing), (d) using specific software to perform a function (e.g., banking, Excel, scrapbooks), and (e) interactions (e.g., Facebook™, Instagram™, blogging). The skills most frequently performed were written communications, and least performed were creating artifacts such as photos and videos. See Table 11 for the complete descriptive statistics of SQ4.

Table 11

Complete Results for Survey Item 4: Rank the personal/social skills or tasks you do most. (N=1281)

#	Items	Never	Rarely	Occasionally	Frequently	Most often	Total
1	Written communications (e.g,. emails, texts)	0.2% (3)	1.6% (23)	13.3% (171)	47.2% (604)	37.3% (478)	1279
2	Research and information gathering (e.g., news, weather, recreation)	0.9% (11)	10.1% (130)	37.7% (483)	41.7% (534)	9.4% (121)	1279
3	Creation of artifacts (e.g., photos, videos, writing)	7.5% (96)	30.1% (385)	39.3% (503)	19.9% (255)	3.1% (40)	1279
4	Using specific software to perform a function (e.g., banking, Excel, scrapbooks)	5.2% (67)	22.0% (282)	34.7% (445)	31.0% (397)	6.9% (88)	1279
5	Interactions (e.g., Facebook™, Instagram™, blogging)	5.5% (70)	11.2% (143)	18.3% (235)	37.2% (476)	27.7% (355)	1279

Research question 3b. This question asked participants for their preferences for technology use in formal education applications. Survey item 8 addressed this question by asking the participant to rank the formal education skills or tasks they do most by using a Likert scale including "Never," "Rarely," "Occasionally," "Frequently," and "Most often." Five activity categories were presented: (a) digital written communications (e.g., emails, texts, messaging), (b) online research and information gathering (e.g., library, journals), (c) creation of artifacts (e.g., presentations, photos, writing documents, assignments), (d) using specific software to perform a function (e.g., spreadsheets, CAD, language, Project), and (e) interactions (e.g., forum postings, blogging, Zoom/Skype). The most often performed tasks include written communications and research, with the least performed being digital interactions with others. See Table 12 for the complete data of SQ8.

Table 12

Complete Results for Survey Item 8: Rank the formal education skills or tasks you do most. (N=1281)

#	Items	Never	Rarely	Occasionally	Frequently	Most often	Total
1	Digital written communications (e.g., emails, texts, messaging)	0.7% (9)	6.0% (77)	24.6% (315)	45.3% (580)	23.2% (297)	1278
2	Online research and information gathering (e.g., library, journals)	1.7% (22)	7.5% (96)	32.8% (420)	40.3% (516)	17.5% (224)	1278
3	Digital creation of artifacts (e.g., presentations, photos, writing documents, assignments)	6.6% (85)	15.1% (194)	28.3% (362)	33.5% (429)	16.2% (208)	1278
4	Using specific software to perform a function (e.g., spreadsheets, CAD, language, Project)	11.0% (141)	22.8% (292)	31.5% (403)	24.9% (319)	9.5% (122)	1278
5	Digital interactions with groups (e.g., Forum postings, blogging, Zoom/Skype)	16.9% (217)	31.1% (399)	27.5% (352)	18.7% (240)	5.5% (70)	1278

Responses to survey items 4 and 8 were compared to identify any differences in frequency of using devices differently in personal/social versus formal education. The device use frequency for both personal/social and education use was very similar in the categories of written communications, research and information gathering, and use of special or unique software or programs. However, greater differences were noted in the category of creation of artifacts (including coursework) showing a much higher frequency of this category in education-related uses. Also notable is the difference in digital interactions with others, showing a much more active use rate for personal/social use over education-related uses. While this is not unexpected due to the large number of Millennials who use social media on a daily basis, it may also be affected due to the smaller number of students taking online courses where discussion boards/forums are popular. Seeing these differences prompted the creation of the graphs shown in Figure 7 to better demonstrate visually the differences in the frequency of each of the five categories for personal/social or formal educational purposes.

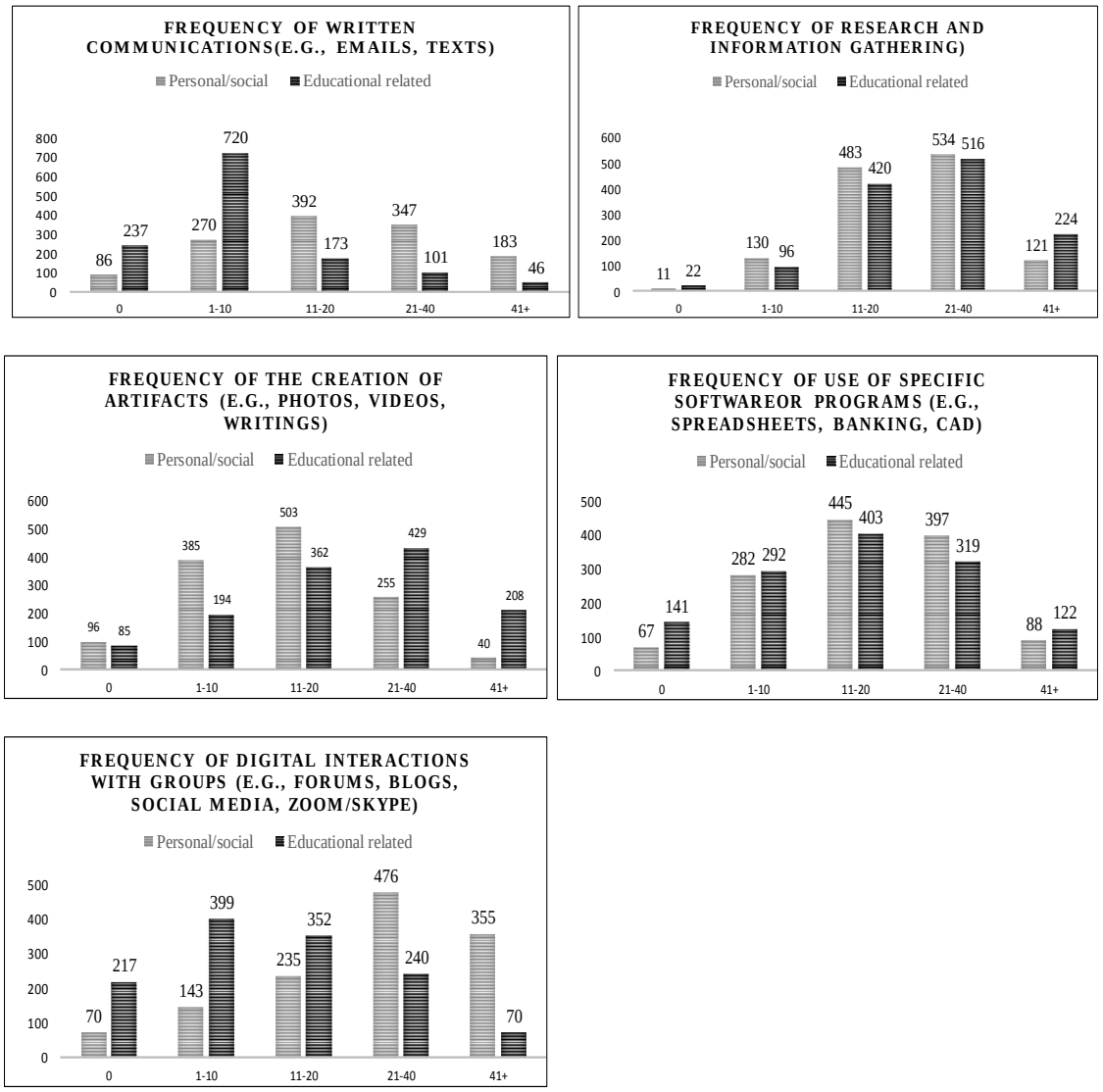

Figure 7. Comparisons of results of digital device use and frequency for personal/social versus formal education from SQ4 and SQ8. (N=1281).

Survey item 7 also addresses RQ3b by asking participants how many hours per week they use each device. The established eight digital devices were provided with a Likert-type matrix, where the participant could choose "0 hours," "1-10 hours," "11-20 hours," "21-40 hours," and "41 or more hours." The laptop is the highest used device in formal education, with smartphones and the desktop computer being the second and third choices respectively. The devices which seem to be rarely used are the tablet, the digital reader, smartwatch, cell phone

without data, and the TV or game system. Noticing the most frequently used items as the laptop and smartphone, a graph was created to visually demonstrate the use of both devices for educational use. This graph clearly shows the number of hours per week each device is used, making it clear that for most of the time used in educational-related applications, the laptop is the chosen device choice. See Table 13 for the complete data and Figure 8 for the comparison of frequency of use for only the laptop and smartphone.

Table 13

Complete Results for Survey Items 7: For formal education use only, how many hours per week do you use each device? (N=1281)

#	Question	0 Hours	1-10 Hours	11-20 Hours	21-40 Hours	41+ hours	Total
1	Desktop computer	40.8% (523)	38.0% (487)	10.2% (131)	8.7% (112)	2.0% (25)	1278
2	Laptop, Netbook or Chromebook	6.7% (86)	21.1% (270)	30.6% (392)	27.1% (347)	14.3% (183)	1278
3	Tablet (e.g., iPad, Fire)	72.5% (929)	20.3% (260)	3.8% (49)	2.3% (30)	0.7% (9)	1277
4	Digital Reader (e.g., Nook, Kindle)	91.2% (1168)	7.1% (91)	0.9% (11)	0.5% (7)	0.0% (0)	1277
5	Smart Phone with data connection	18.5% (237)	56.2% (720)	13.5% (173)	7.9% (101)	3.6% (46)	1277
6	Cell phone without Internet connectivity	91.1% (1167)	6.2% (79)	1.3% (17)	1.0% (13)	0.1% (1)	1277
7	Smart watch with data connection	94.7% (1213)	3.7% (47)	0.9% (11)	0.3% (4)	0.2% (2)	1277
8	Game or TV system with Internet connectivity	92.1% (1180)	5.0% (64)	1.4% (18)	0.8% (10)	0.4% (5)	1277

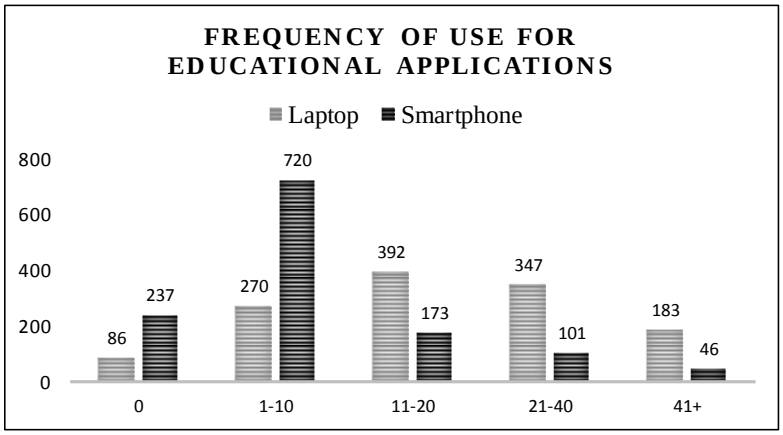

Figure 8. Comparison of frequency of use for the laptop computer and smartphone for educational applications as collected from SQ7. (N=1281)

Research question 4. Three survey items; SQ10, SQ11, and SQ12, support this research question in asking what course delivery methods college students prefer. Survey item 10 presented participants a list of six types of course delivery methods:

1. Face-to-face classroom course with supplemental materials provided in a website such as Moodle
2. Face-to-face classroom course (no online features)
3. Blended course with some scheduled face-to-face/live meetings and some self-directed online activities.
4. Fully online live course using a system like Zoom or GoToMeeting, with required set meeting times (synchronous).
5. Fully online course using a system like Moodle or Blackboard, no required set meeting times (asynchronous).
6. Interactive video live (face-to-face) course (video or live, set meeting times).

Using the six delivery methods, participants were given a Likert-scale for the number of each type of course the participant has experienced. The scale went from zero courses to 41 or more courses. The face-to-face classroom with supplemental online features, face-to-face without supplemental online features, and blended courses were the most frequently experienced course delivery methods. Interactive video live courses were reported to be the least experienced. While the frequency chart shows the face-to-face course types to be the types of courses most experienced, it is worthwhile to note that 79.3% of the study participants have experienced at least one online course(s). See Table 14 for the complete results to survey item 10.

Table 14

Complete Results for Survey Item 10: Choose the number of courses you have taken in each of the following delivery format types. (N=1281)

#	Question	0 Courses	1-10 Courses	11-20 Courses	21-40 Courses	41+ Courses	Total
1	Face-to-face classroom course with supplemental materials provided in a website such as Moodle	4.9% (63)	31.3% (401)	23.2% (297)	24.2% (310)	16.0% (205)	1277
2	Face-to-face classroom course (no online features)	22.0% (282)	47.8% (612)	13.1% (168)	9.8% (125)	7.0% (90)	1277
3	Blended course with some scheduled face-to-face/live meetings and some self-directed online activities	29.8% (382)	52.5% (673)	13.0% (166)	3.6% (46)	0.6% (8)	1275
4	Fully online live course using a system like Zoom or GoToMeeting, with required set meeting times (synchronous)	68.5% (877)	25.1% (321)	4.3% (55)	1.5% (19)	0.3% (4)	1276
5	Fully online course using a system like Moodle or Blackboard, no required set meeting times (asynchronous)	20.7% (265)	61.2% (784)	11.2% (144)	4.8% (61)	1.7% (22)	1276
6	Interactive video live course (video or live, set meeting times)	68.7% (880)	26.2% (336)	3.6% (49)	60.0% (8)	0.5% (6)	1276

Survey item 11 (SQ11) asked, "based on your preferred learning methods, which course delivery format is your favorite?" Participants were provided with the same six types of course delivery methods as listed in item 10 and offered in a Likert format a choice of "not acceptable," "less preferred," "neutral," "acceptable," and "favorite." The top three "favorite" and "acceptable" choices combined were: (a) face-to-face classroom with technology (88.8%), (b) face-to-face without technology (64.1%), and (c) blended face-to-face and online (45.5%), all choices which feature a live classroom component. When looking at the three choices of "least preferred" and "not acceptable" combined, participants ranked the course types in the following order: students make it clear that they do not favor the non-face-to-face choices in order of least favorite: (a) the webinar (62.8%), (b) interactive video (59.6%), and (c) fully online courses (37.8%).

To determine whether statistical significance is present for age and favorite course delivery format, the Chi-square test and Cramer's V were performed. SQ11-1, SQ11-3, and

SQ11-5 were found to be statistically significant. SQ11-1 represented a face-to-face classroom with supplemental materials provided on a website such as Moodle. The results of this test are, χ^2 (4, *N*=1281) = 34.3513, *p* = .000, *V*=.164 which demonstrate a medium to strong effect size for Millennials preferring a face-to-face classroom with technology over non-Millennial-aged students. SQ11-3 listed a blended classroom with some asynchronous course requirements as well as synchronous class meetings. The results for SQ11-3 are, χ^2 (4, *N*=1281) = 25.577, *p* = .000, *V*=.141, revealing a moderate to strong relationship exists for non-Millennials preferring blended course delivery more than Millennial-aged students. SQ11-5 asked participants if they preferred fully online courses. The results of this test are, χ^2 (4, *N*=1281) = 34.505, *p* = .000, *V*=.164 demonstrating a moderate to strong relationship existing for the preference of fully online course delivery by non-Millennial-aged students over this delivery method by Millennial-aged students. This result is significant to this study as the Millennials are assumed to prefer technology-based methods as per several authors discussed in Chapter II (Bracy, Bevill, & Roach 2010; Farrell & Hurt, 2014; Merlino, 2009; Prensky, 2001; 2009). See Table 15 for complete results.

Table 15

Complete Results for Survey Item 11: Based on your preferred learning methods, which course delivery format is your favorite? (N=1281)

#	Question	Not acceptable	Less preferred	Neutral	Acceptable	Favorite	Total
1	Face-to-face classroom course with supplemental materials provided in a website such as Moodle	0.9% (12)	4.8% (61)	5.5% (70)	31.7% (406)	56.9% (729)	1278
2	Face-to-face classroom course (no online features)	5.2% (66)	15.6% (200)	15.0% (192)	46.5% (596)	17.4% (223)	1277
3	Blended course with some scheduled face-to-face/live meetings and some self-directed online activities	4.4% (57)	21.7% (278)	28.2% (361)	38.6% (494)	6.9% (88)	1278
4	Fully online live course using a system like Zoom or GoToMeeting, with required set meeting times (synchronous)	23.0% (294)	39.8% (510)	21.0% (269)	13.8% (177)	2.1% (27)	1277
5	Fully online course using a system like Moodle or Blackboard, no required set meeting times (asynchronous)	12.7% (163)	25.1% (321)	17.7% (223)	29.6% (379)	15.0% (192)	1278
6	Interactive video live course (video or live, set meeting times)	23.9% (306)	35.7% (457)	24.0% (307)	14.4% (184)	1.9% (24)	1278

Survey item 12 asked participants to rate the items that mean the most to them when choosing a course format. They were given a list of 12 features or descriptions;

1. Schedule
2. Location
3. Uses lots of technology
4. Uses little technology
5. Appropriate delivery method (online or lecture) for the course topic
6. Live classroom
7. Fully online
8. Choice of instructor
9. Number of required textbooks
10. Recommended by another student

11. Recommended by adviser

12. Other.

Participants were given “not important,” “least important,” “neutral,” “important” and “most important” in a Likert format to rate each feature. By combining “most important” and “important” the top three choices are: (a) schedule (93.3%), (b) appropriate delivery method for the topic (77.5%), and (c) location (72.8%). The top three rankings with a combination of “not important” and “least important” are: (a) fully online (33.3%), (b) uses little technology (32.1%) and (c) uses lots of technology (29.9%) (See Table 16 for the complete data). Unfortunately, the personal preferences students have when choosing a course are not always relevant to the enrollment of a class as many other factors figure into the task of enrolling in a degree program class which may not offer many feature choices.

Participants were provided with a memo field to note "other" items that were important, and 101 of the 134 participants left a legible comment. Overwhelmingly the additional item reported was to note that the course was required in their chosen program or major (31). Comments included these additional written messages: (a) time and effort expectations for the course (19), (b) concerns about the instructor (15) and if they were rated, known to be interested, or have an acceptable teaching style, etc., (c) if the course content was of interest (9), (d) schedule requirements in concern of family and jobs (9), (e) appropriate delivery method to the course topic (4), (f) cost (3), (g) preference for face-to-face (3), and (h) eight individual statements with concerns for their distance to drive, and not having a choice as nothing else is available. One participant pointed out that during their undergraduate degree he or she preferred a live setting and now, in the graduate program, only online courses were offered.

Table 16

Complete Results for Survey Item 12: Rate the items that mean the most to you when choosing a course format (N=1281)

#	Items	Not important	Least important	Neutral	Important	Most important	Total
1	Schedule	1.2% (16)	0.5% (7)	3.9% (50)	39.9% (511)	53.4% (684)	1268
2	Location	4.8% (61)	3.9% (50)	16.8% (215)	46.6% (597)	26.2% (335)	1258
3	Uses lots of technology	14.5% (186)	15.4% (197)	48.9% (626)	15.5% (199)	3.7% (47)	1255
4	Uses little technology	16.2% (207)	15.9% (204)	55.9% (716)	8.0% (102)	0.9% (11)	1240
5	Appropriate delivery method (online or lecture) for the course topic	2.1% (27)	2.2% (28)	16.9% (216)	49.3% (632)	28.2% (361)	1264
6	Live classroom	5.6% (72)	7.3% (93)	28.3% (362)	38.1% (488)	18.8% (241)	1256
7	Fully online	21.4% (274)	19.8% (253)	32.5% (416)	14.4% (184)	9.3% (119)	1246
8	Choice of instructor	4.8% (61)	3.9% (50)	20.7% (265)	43.9% (562)	25.0% (320)	1258
9	Number of required textbooks	11.9% (152)	10.6% (136)	34.0% (435)	32.5% (416)	9.0% (115)	1254
10	Recommended by another student	6.5% (83)	7.0% (90)	27.6% (354)	45.7% (586)	10.2% (131)	1244
11	Recommended by adviser	4.0% (51)	3.3% (42)	24.4% (313)	50.4% (645)	15.4% (197)	1248
12	Other*						134

Research question 5. This research question aimed to discover which of the popular online course features were preferred by college students. Survey item 13 (SQ13) supports this research question and asked, "if you have completed a fully online or blended learning course using a system like Moodle or Blackboard, rate the course features and their usefulness towards learning." In a Likert scale format, participants were offered to rate 15 items: (a) accessibility of course assignments, (b) grading rubrics, (c) syllabus, (d) assignment examples, (e) discussion boards or forums, (f) assignment drop boxes, (g) linked reading materials, (h) wiki's (you contribute), (i) blogs, (j) collaborative group assignments, (k) chat rooms, (l) live class meetings, (m) podcasts, (n) instructor created materials like presentations or power points, and (m) written assignments.

Participants were asked to choose a rating from five Likert columns: "no experience," "least useful," "neutral," "useful," and "most useful." Combining the "most useful" and "useful" choices, these features are shown in Figure 9.

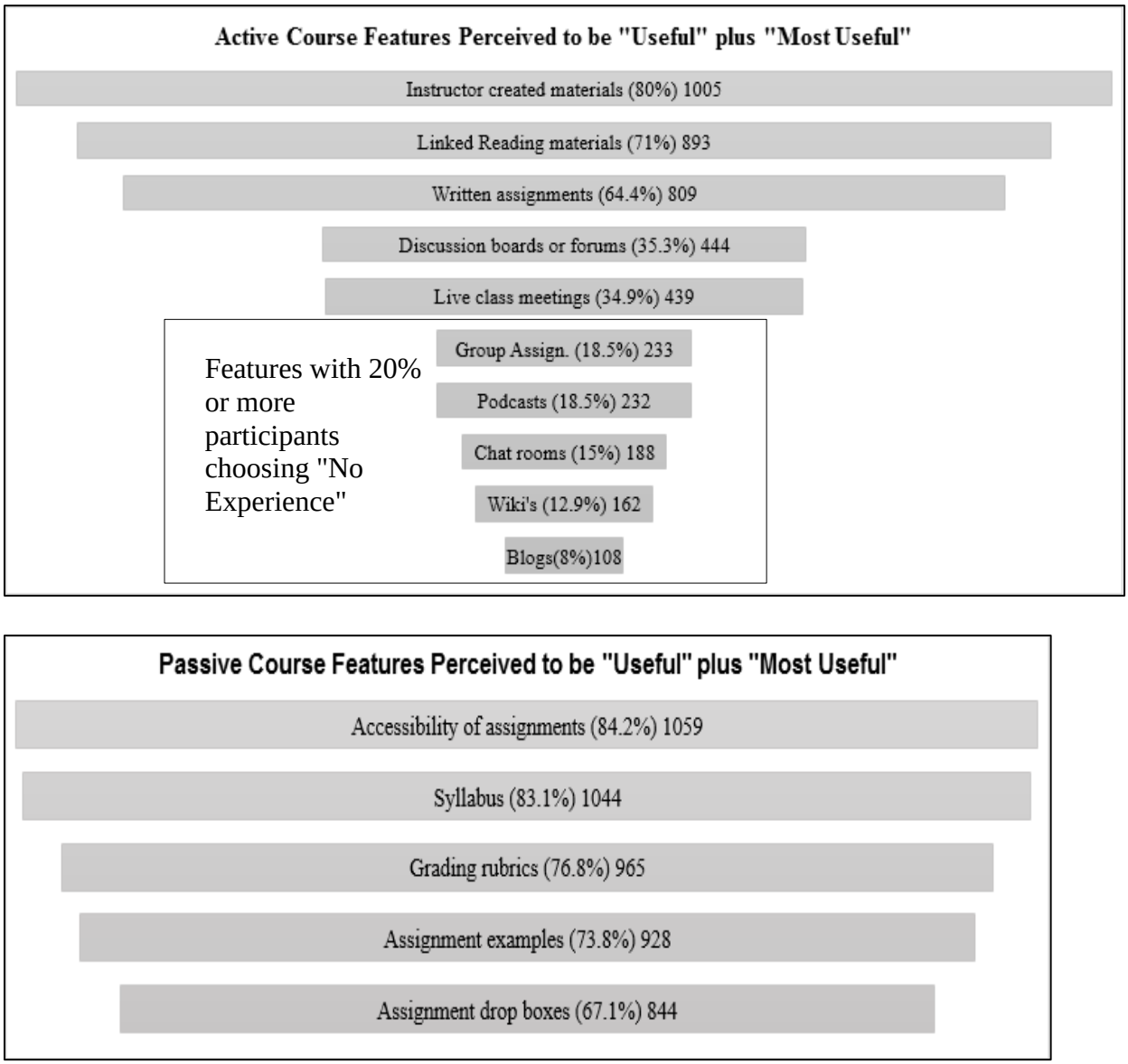

Figure 9. Hierarchical order of the online features ranked “useful” plus “most useful” to learning. Separated by active and passive features, showing the percentages of participant choosing “useful” or “most useful.” (N=1257)

The results indicate students found the tools needed to produce assignments and artifacts such as the accessibility of course assignments, syllabi, instructor-created materials, grading rubrics, assignment examples, linked reading materials, assignment drop boxes, and written assignments as the most useful and all scoring above 64%, suggesting the importance of

providing the student with the tools needed to learn in an organized manner and making them easily accessible. Participants ranked items "Least Useful" scoring below 36% to include discussion boards/forums, live class meetings, podcasts, collaborative group assignments, chat rooms, wiki's, and blogs. These results suggest activities which are supplementary to the main course assignments may not be perceived as useful to learning by some of the participants in this sample. The discussion board/forum is a popular online course feature that scored surprisingly low for usefulness. The Chi-square test and Cramer's V were performed to find a statistically significant relationship between age and discussion boards/forums preference. The result of this test is, χ^2 (4, N=1281) = 31.306, p = .000, V=.158, demonstrating a medium to large effect size showing non-Millennials find discussion boards/forums more useful towards learning than Millennial-aged students. The features which garnered 20% or more participants choosing "no experience" are: collaborative group assignments, live class meetings, wiki's, podcasts, and blogs. See Table 17 for full results from SQ13.

Table 17

Complete Results to Survey Item 13: "If you have completed a fully online or blended course using a system like Moodle or Blackboard, rate the course features and their usefulness towards your learning" (N=1281)

#	Items	No experience	Least useful	Neutral	Useful	Most useful	Total
1	Accessibility of course assignments	7.4% (95)	2.3% (29)	5.8% (74)	50.5% (647)	32.2% (412)	1257
2	Grading rubrics	7.5% (96)	3.7% (47)	11.6% (149)	54.6% (700)	20.7% (265)	1257
3	Syllabus	6.5% (83)	1.8% (23)	8.4% (108)	51.1% (654)	30.4% (390)	1258
4	Assignment examples	9.3% (119)	4.1% (53)	12.3% (157)	44.9% (575)	27.9% (353)	1257
5	Discussion boards or forums	9.4% (120)	29.4% (376)	24.8% (318)	26.1% (334)	8.6% (110)	1258
6	Assignment drop boxes	11.0% (141)	4.8% (62)	17.2% (220)	49.5% (634)	15.7% (210)	1258
7	Linked Reading materials	7.7% (98)	4.4% (56)	16.4% (210)	52.9% (678)	16.8% (215)	1257
8	Wiki's (you contribute)	40.1% (514)	19.5% (250)	25.8% (331)	10.8% (138)	1.9% (24)	1257
9	Blogs	45.0% (576)	23.2% (297)	22.0% (282)	7.1% (91)	0.9% (11)	1257
10	Collaborative group assignments	22.6% (284)	34.7% (444)	23.2% (297)	15.8% (202)	2.4% (31)	1258
11	Chat rooms	33.2% (425)	26.5% (340)	23.7% (303)	13.0% (167)	1.6% (21)	1256
12	Live class meetings	28.4% (364)	13.5% (173)	21.9% (281)	23.4% (300)	10.9% (139)	1257
13	Podcasts	44.3% (567)	12.6% (162)	23.2% (297)	15.5% (198)	2.7% (34)	1258
14	Instructor created materials like presentations or PowerPoints	7.3% (93)	2.7% (35)	9.8% (125)	47.6% (610)	30.8% (395)	1258
15	Written assignments	7.3% (93)	5.8% (74)	21.9% (281)	50.7% (650)	12.4% (159)	1257

Research question 6. This question examines the relationship between technology use and the ages of the student**.** Survey items SQ3 and SQ7 support this research question by establishing the frequency and hours per week devices are used, and also uses the participants' declared age from SQ21 to test for a significant relationship between technology and age.

The Chi-square test was performed on SQ3 for significance between device use and student age (Millennial or non-Millennial). The results show a significant relationship between the variables of digital device use and student age for five out of the eight listed devices. Student age and desktop computer use showed a significant relationship, χ^2 (4, N=1281) = 15.94, p =.0031, V = 0.1116, and a small to medium effect size for non-Millennials using desktops more than Millennial students. Student age and smartphone with data connection showed a significant relationship, χ^2 (4, N=1281) = 33.749, p = .000, V = 0.1625, and a medium to large effect size of Millennials using smartphones more than non-Millennial students for smartphone use. Student age and tablet use showed a significant relationship, χ^2 (4, N=1281) =

16.837, p = .002, V = 0.1147, with a small to medium effect size of non-Millennials using tablets more than Millennial students. Student age and cell phone (without data connection) showed a significant relationship, χ^2 (4, N=1281) = 13.326, p = .009, V = 0.1021, with a small to medium effect size of non-Millennials using cell phones more than Millennial students. Student age and game systems or TV use showed a significant relationship, χ^2 (4, N=1281) = 21.444, p = .000, V =0.1295, a medium effect size of Millennials using game systems more than non-Millennial students. The three digital devices that showed no relationship to student age were: the laptop, χ^2 (4, N=1281) = 7.1639, p = .127, the smartwatch, χ^2 (4, N=1281) = 4.0439, p =.400, and the digital reader which was not used enough to use the Chi-square test. Not unexpectedly, the laptop seems to be equally utilized by all age groups, and the smartwatch and digital reader are not used enough by any age student to note for this study. See Table 18 for results of SQ3.

Table 18

Complete Results for Survey Items 3: "For personal/social use only, how many hours per week do you use each device?" (N=1281)

#	Question	0 Hours	1-10 Hours	11-20 Hours	21-40 Hours	41+ hours	Total
1	Desktop computer	46.4% (595)	37.6% (482)	8.3% (106)	4.9% (63)	2.6% (33)	1279
2	Laptop, Netbook or Chromebook	7.0% (90)	42.0% (538)	29.2% (374)	15.5% (198)	6.2% (79)	1279
3	Tablet (iPad, Fire)	59.5% (762)	30.7% (393)	5.5% (70)	3.7% (48)	0.5% (6)	1279
4	Digital Reader (Nook, Kindle)	82.2% (1053)	15.8% (203)	1.2% (16)	0.5% (6)	0.0% (0)	1278
5	Smart Phone with data connection	4.5% (57)	16.6% (213)	27.4% (351)	28.3% (363)	23.0% (295)	1279
6	Cell phone without Internet connectivity	77.3% (990)	18.0% (230)	2.8% (36)	1.3% (17)	0.5% (6)	1279
7	Smart watch with data connection	85.5% (1095)	9.4% (120)	2.6% (33)	1.1% (14)	1.3% (17)	1279
8	Game or TV system with Internet connectivity	36.4% (466)	38.8% (497)	16.5% (212)	6.2% (80)	1.8% (23)	1278

The Chi-square test was also performed on SQ7 for the frequency per week of use for formal education use and examined for significance between device use and student age (Millennial or non-Millennial). Student age and frequency of use for a desktop computer showed a significant relationship: χ^2 (4, N=1281) = 59.9333, p = .000, V= 0.2218, with a large

effect size of non-Millennials using desktops considerably more than Millennial students. Student age and the smartphone showed a significant relationship: χ^2 (4, *N*=1281) = 35.099, *p* = .000, *V*= 0.166, showing a medium to large effect size for Millennials using smartphones for education applications more than non-Millennial students. Student age and tablet use showed a significant difference: χ^2 (4, *N*=1281) = 18.535, *p* = .000, *V*=0.1205, showing a medium to small effect size for non-Millennials using tablets more than Millennial students. Those digital devices showing no significant relationship between frequency of weekly use and student age are; the laptop χ^2 (4, *N*=1281) = 8.924, *p* = .063, the digital reader χ^2 (4, *N*=1281) = 3.165, *p* = .530, the cellphone without data χ^2 (4, *N*=1281) = 6.570, *p* = .584, the smartwatch χ^2 (4, *N*=1281) = 2.2439, *p* =.691, and the game system or TV χ^2 (4, *N*=1281) = 8.593, *p* = .378. The results were interesting in that the laptop seems to be used equally by all ages thus showing no significance between ages. The low use devices; smartwatch, digital reader, cell phone, and game system all seem to be outside of consideration for instructional designers due to lack of popularity for educational usage.

Research question 7. This research question asks: "is there a relationship between perception of technology by Millennial-aged college students and college students of other generations?" Using SQ9 and SQ21, participants were asked to choose the best answer using the Likert scale of "strongly disagree," "disagree," "neither agree or disagree," "agree," and "strongly agree." to 12 statements about technology in general: (a) "I am online frequently every day," (b) "I am online during classes," (c) "I prefer texting over phone calls," (d) "I check my emails using my smartphone," (e) "I visit social network sites like Facebook frequently every day," (f) "I blog once a week," (g) "I tweet frequently every day," (h) "I easily accept and adopt new technology," (i) "I play video games online with others," (j) "I would rather be late than to forget my smartphone," (k) "I believe mobile learning is beneficial," and (l) "If someone

texts me I will answer them within minutes."

To determine whether a statistically significant association exists for age and perception of technology on the twelve items in this question, the Chi-square test and Cramer's V were performed. The results of the 12 tests are reported in order as follows: SQ9-1 stated, "I am online frequently." The results of this test are: χ^2 (4, *N*=1281) = 6.355, *p* = .196514, demonstrating no significant relationship. SQ9-2 stated, "I am online during classes." The results of this test are: χ^2 (4, *N*=1281) = 31.614, *p* = .000, *V*= 0.1573 demonstrating a medium effect size of Millennials being online during classes more than non-Millennials. SQ9-3 stated, "I prefer texting over phone calls." The results of this test are: χ^2 (4, *N*=1281) = 5.2808, *p* = .259, demonstrating no significance. SQ9-4 stated, "I check my emails using my smartphone." The results of this test are: χ^2 (4, *N*=1281) = 22.462, *p* = .000, *V*= 0.1326 demonstrating a medium effect size of Millennials using a smartphone to check emails more than non-Millennials. SQ9-5 stated, "I visit social networking sites like Facebook frequently every day." The results of this test are: χ^2 (4, *N*=1281) = 50.1348, *p* = .000, *V*=.198. This demonstrated a large effect size of Millennials using social networking sites more frequently everyday more than non-Millennials. SQ9-6 stated, "I blog once a week." The results of this test are: χ^2 (4, *N*=1281) = 2.781, *p* = .595, demonstrating no significance. SQ9-7 stated, "I tweet frequently every day." The results of this test are: χ^2 (4, *N*=1281) = 11.995, *p* = .017, *V*=.103. This demonstrated a small to medium effect size of Millennials tweeting frequently everyday more than non-Millennials. SQ9-8 stated, "I easily accept and adopt new technology." The results of this test are: χ^2 (4, *N*=1281) = 3.37, *p* = .500, demonstrating no significance. SQ9-9 stated, "I play video games online with others." The results of this test are: χ^2 (4, *N*=1281) = 30.5458, *p* = .000, *V*=.155. This demonstrated a medium effect size of Millennials playing video games online with others more than non-Millennials. SQ9-10 stated, "I would rather be late than to

forget my smartphone." The results of this test are: χ^2 (4, *N*=1281) = 4.2418, *p* = .374, demonstrating no significance. SQ9-11 stated, "I believe mobile learning is beneficial." The results of this test are: χ^2 (4, *N*=1281) = 15.667, *p* = .003, *V*=.111. This demonstrated a moderate effect size of non-Millennials believing mobile learning is beneficial more than Millennials. SQ9-12 stated, "If someone texts me I will answer them within minutes." The results of this test are: χ^2 (4, *N*=1281) = 8.127, *p* = .087, demonstrating no significance. The results for SQ9-11 were surprising as it is often believed that Millennials prefer mobile learning and the use of technology in education. See Table 19 for the complete results.

Table 19

Complete Results for Survey Item 9: How do you react to using technology in general? (N=1281)

#	Statements	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree	Total
1	I am online frequently every day	2.3% (29)	1.1% (14)	2.0% (25)	25.1% (321)	69.5% (890)	1280
2	I am online during classes	8.5% (109)	19.1% (245)	13.4% (171)	33.3% (426)	25.5% (327)	1280
3	I prefer texting over phonecalls	5.2% (67)	13.4% (171)	29.1% (373)	26.4% (338)	25.7% (329)	1280
4	I check my emails using my smartphone	4.8% (61)	2.7% (35)	3.1% (40)	36.2% (463)	53.0% (679)	1280
5	I visit social network sites like Facebook frequently every day	11.4% (146)	12.4% (159)	7.8% (100)	28.4% (363)	39.9% (511)	1280
6	I blog once a week	73.7% (943)	17.7% (226)	4.7% (60)	2.6% (33)	1.3% (16)	1280
7	I Tweet frequently every day	80.3% (1028)	12.0% (153)	3.4% (43)	2.8% (36)	1.4% (18)	1280
8	I easily accept and adopt new technology	2.3% (30)	9.8% (126)	24.8% (318)	42.1% (539)	20.7% (265)	1280
9	I play video games online with others	58.5% (749)	15.2% (194)	6.4% (82)	11.9% (152)	7.8% (100)	1280
10	I would rather be late than to forget my smartphone	23.2% (297)	27.1% (347)	18.0% (231)	22.1% (287)	9.1% (117)	1280
11	I believe mobile learning is beneficial	2.6% (33)	4.8% (62)	24.9% (319)	47.1% (603)	20.5% (19)	1280
12	If someone texts me I will answer them within minutes	4.4% (56)	15.2% (195)	29.8% (382)	36.6% (468)	13.9% (178)	1280

Summary

The descriptive survey data were analyzed and Chi-square tests for significant relationships and Cramer's V tests for effect size applied where concerns of student age and technology preferences were needed. A 25-question Qualtrics™ instrument was used to answer

seven research questions. The study analyzed data from 1281 completed instrument responses using Qualtrics™, SPSS, and Excel to record, analyze and test data, create tables and figures, determine significant relationships and effect size, to demonstrate results.

The results suggest Millennial-aged students in this sample prefer face-to-face learning delivery methods over methods without a live classroom component. Further, the results suggest a distinct difference in device choices between those used for personal/social versus educational applications. The complete results from the study are discussed more thoroughly in Chapter V.

CHAPTER V

Discussion

Introduction

This study explores Millennial-aged college students' use and perceptions of technology used in higher education. The purpose of this descriptive survey study is to describe: (1) the relationship between Millennial learners' use of technology devices and applications in personal versus formal education environments; and (2) the relationship between Millennial learners' preferences for technology devices and applications in personal versus formal education environments by Millennial-aged college students.

Following popular beliefs written in the early years of the turn of the twenty-first century about a generation deemed as "digital natives" who preferred increased technology use in education, feedback from students in this sample in 2017 suggest this may not be the case. An exhaustive literature search on the topic produced scant empirical research about the Millennial generation and their perceptions of technology or its use in current course delivery methods used in higher education. This study, therefore, aimed to answer some of the questions instructional designers may have when designing appropriate and useful instruction for the Millennial-aged college student. Using an online instrument of 25 questions, seven research questions were addressed.

The research questions.

1. What devices do college students choose for:
    a. personal/social use?
    b. formal education use?
2. What devices do college students prefer for tasks associated with:

a. personal/social use?

b. formal education use?

3. What are the preferences for technology use:

    a. in personal/social applications by college students?

    b. in formal education applications by college students?

4. What course delivery methods do college students prefer?

5. What online course features do college students prefer?

6. Is there a relationship between technology use by Millennial-aged college students and college students of other generations?

7. Is there a relationship between perception of technology by Millennial-aged college students and college students of other generations?

The purpose of this chapter is to provide discussion and conclusions of the study. The chapter opens with a summary of the results and interpretations addressing each research question, followed by recommendations for practice and future research, and the author's concluding remarks.

The instrument and sample. A Qualtrics™ questionnaire was distributed to the current enrolled students (12,643) of an intermountain west university in the Fall of 2017. Completed records were returned by 1281 (10.13%) participants. While the number of participants completing the survey seemed low at 10.13%, some researchers suggest otherwise. In one study seeking the participation of physicians belonging to a medical association, researchers received a 6.3% response rate when indications were to see four times that amount. "One of the most serious drawbacks of Web-based studies is their considerably smaller participation rates compared to paper-based studies even though Web-based studies are widely used to explore clinicians' knowledge, perspectives, and clinical practice (So et al., 2018). The low response

rate in academic studies has posed a serious concern of late as it has steadily dropped as per Dillman et al., (2014) who describes response rates to web studies as dismal. Dillman et al., suggests using mail or phone studies or attaching a financial reward ($5 to $10) to each invitation to encourage completion. Another possible cause of the low response rate could have been survey fatigue from the 25 items, many which were matrix-types with five to twelve items within each, which may have caused participants to not complete their survey record. The invitation stated to expect the survey to take 10 minutes, as per Dillman et al., (2014), this time frame is subjective to the potential participant's agenda. Another possible consideration as to the 10% response rate may have been in the timing of the survey in late October/early November when students are past the middle of a semester.

The data were collected and tested to use in descriptive statistics to describe student perceptions or used in Chi-square analysis to identify significance of a relation between the age of the student and the perception. If significance was found, Cramer's V was applied to identify the effect size. The results are reported and displayed in

Chapter 4. As per Cohen (1988) the effect size when using degrees of freedom of 4 as needed in this study, is: (a) small effect =.05, (b) medium effect = .15, and (c) large effect = .25.

The instrument was designed using a list of eight digital devices chosen to reflect a range of technology from older style devices such as a digital reader or a cell phone without internet connectivity, to more contemporary devices such as smartphones and laptops. The list included: (a) smartphones, (b) cell phones without data, (c) smartwatch, (d) digital reader, (e) laptop or netbook, (f) tablet, (g) desktop computer, and (h) game or TV systems with internet connectivity. This list was based on the list used in the Kennedy et al., (2008) study and was updated to reflect current devices used in 2017. The twenty-five-question survey used Likert-style choices, yes/no, or multiple-choice questions. The age groupings followed the suggested

generation ages of Millennials born between 1982 and 2004, (Strauss & Howe, 1991), and a grouping of non-Millennials (Baby Boomers and Gen-X) or those born prior to 1982. Most of the participants were Millennial-aged students (79.3%), however, enough of the other generations (20.6%) were represented to perform the tests looking for significance due to age.

The Results

Research questions 1 and 2. The research questions of 1a, 1b, 2a, and 2b aimed to identify which digital devices students prefer for personal/social or formal education use and the different tasks associated with each device. Four survey items supported this area of interest; SQ1, SQ2, SQ5, and SQ6. To identify which devices are chosen and how often they are used participants were offered the list of eight devices mentioned in the previous paragraph to be used with a list of seven categories of uses.

The results concerning the personal/social use of a device showed the "Most Used" device as a smartphone (68.9%) and the second "Most Used" is a laptop computer (28.9%). In contrast, participants chose the laptop as the "Most Used" device (62.5%), and the smartphone as the second "Most Used" for educational uses. These results present a distinct contrast in the preferred device between personal/social and education device choices and are in agreement with authors of studies that found differences between device use for social or personal use and those used in educational activities (Barnes & Jacobsen, 2014; Bennett et al., 2008; Gallardo-Echenique et al., 2015; Kirschner & van Merrienboer, 2013; Koutropoulous, 2011; Thompson, 2013; Vaidhyanathan, 2008; Waycott et al., 2010). Further, the study results show a distinct lack of use for five of the devices for educational purposes: tablet, cell phone, TV/game system, digital reader, and smartwatch, lessening the need for instructional designers to include them into design planning. All five of the low-use devices were reported to be "not used" by 61% to 92% of participants for education-based use.

Data from SQ2 and SQ6 demonstrate which devices students choose to perform specific tasks to answer RQ's 2a and 2b, asking which devices are preferred for tasks associated with personal/social or formal education use respectively. A contrast is notable with 86.8% using their smartphones for personal/social communications with friends and families and only 22.6% using them for education-related communications with faculty or cohorts. Further contrast is noted in 66% using their smartphones for personal/social networking while only 5% of students used their smartphones for the social-networking-like tasks for education (forums, blogs, etc.). Another difference is found in personal/social referencing and researching where 30.7% choose their smartphones, and only 2% use their smartphones in this manner for education purposes.

While these results clearly show a difference in the digital devices favored and used in specific manners, some of the difference is likely to be due to the much smaller screen of the smartphone, the slower computing speeds, and lack of a keyboard for smartphones. Cheon et al., (2012) found inherent challenges in using mobile devices including smaller screen size, lack of keyboard, slower computing speeds, inadequate memory and a lack of standardization. Cheon et al., suggested that even though mobile devices present challenges in some areas, other areas like brief communication interfaces (emails or messages) are very well suited for education use. While the smartphone may not be the device of choice for applications such as LMS interface or creation of assignment artifacts, use for checking grades, short forum posts, reading course announcements, and accessing calendars could be desirable to students already heavily using a smartphone for personal/social uses.

The sample participants choose the laptop computer for most of the applications associated with formal education. While the desktop computer ranked higher than the lower-use devices (e.g., tablets, digital readers) it was noted in the results for RQ's 6 and 7 that non-Millennial students used the desktop more frequently than Millennials. The reason for this may

simply be ownership and familiarity, as well as older students enjoying an established desk or office location for their dedicated study space. The portability of a laptop along with powerful computing speeds and Wi-Fi or 4G connectivity make the laptop an easy choice for most students regardless of age. In the end, designers concerned over students' use of mobile devices for all education-based applications may appreciate knowing the preferred screen size for the participant sample was the laptop or desktop computer garnering 62% or higher on all seven categories of tasks while the smartphone garnered favoritism of less than 20% for communications, and far lower rates for other activities related to education use.

For personal/social use the smartphone with 1112 (86.8%) choosing that device for communications and 845 (66%) making it their preferred device for social networking remains the favorite of the sample participants. Further, participants also preferred the smartphones for referencing and information including news and weather, maps, etc., with 1002 (78.2%) making the smartphone their clear choice. Designers may note the uses of smartphones for personal/social tasks similar in nature to those of the education-based uses.

As Chen, et al., (2015) learned, ownership of smartphones may be high, but their use in education was much lower than their study anticipated. Chen et al., felt this was due to a lack of digital literacy and noting students may be less adept in technology than believed. Their study also noted a lack of technology and technical support from the university in supporting mobile learning. Many factors concerning technology use in education contribute to device choice: instructional design to include mobile devices, the software and applications themselves being adaptable to the smaller screen sizes (e.g., communications portals, apps designed for school activity access), and the device hardware and its practical use for some applications for a limited screen size and lack of keyboard.

The sample participants were comprised of 68% females and 32% males which may add

consideration to the results in two categories of personal/social device activities: social networking and gaming. Considering the greater number of females with interests in Facebook or social media (Perrin, 2015), and the number of males (59%) over females (41%) interested in computer gaming (ESA, 2018), the researcher recognized the personal/social digital device uses for those two activities may not be representative of a more generalized population sample.

Research question 3. Research question 3a and 3b sought feedback on the preferences for more specific technology use for personal/social and formal education applications utilizing data from SQ4, SQ7, and SQ8. Survey items SQ4 and SQ8 provided a list of five categories of tasks utilized in both personal/social and educational application: (a) digital written communications, (b) research and information gathering, (c) creation of artifacts, (d) use of specific programs or software, and (e) digital interactions with groups or others. In a Likert-style matrix, participants rated the frequency of performance of each of the five categories of usage from "rarely" to "most often." (See figure 7 for the frequency of performance).

Unsurprisingly, the area of creation of artifacts was more frequently performed in relation to educational needs while interactions with others were more frequently used in personal/social applications. As the creation of coursework was included in the sub-category of creation of artifacts this activity should rank high as a task frequently performed for education purposes. In the sub-category of digital interactions, however, there was a much larger difference noted with a higher use of this category for personal/social (65%) than for education (24%). With the popularity of online learning and the high use of discussion boards and forums as a feature of LMS course structure, a higher ranking for interactions with others more frequently for educational applications such as discussion boards and forums was expected. However, using SQ10 as a reference towards the insight of the number of participants possibly enrolled in online courses, it is quite possible the sample participants would then not have a

high use for forum or discussion board postings (See Table 14 for the complete results to SQ10).

Survey item 7 asked for participants to choose the number of hours each week they used each of the eight devices for education-related use. They were given "hours per week" choices ranging from zero hours to 41 or more in a Likert matrix. Results showed a clear order of preference for digital devices and how many hours they are used in education. The laptop is the preferred and most used device, with the tablet, digital reader, smartwatch, and TV game system trailing well behind in hours used per week. The frequency of use for laptops versus smartphones used for education in this survey item indicates the same results as found in the results for research questions 1 and 2. Students prefer the laptop for education-related uses, and the smartphone for personal/social use regardless of the age of the student. The results speak clearly towards the continued design focus on full sized computer screens being needed in educational-based applications, with the smaller devices filling in on tasks not needing a full screen or a keyboard.

Research question 4. This research question aimed to determine which course delivery methods students prefer as another aspect of technology perceptions in higher education. Three survey items support this interest area: SQ10, SQ11, and SQ12. Participants were offered a list of six types of course delivery methods currently in use at the university used in this study:

1. Face-to-face classroom course with supplemental materials provided on a website such as Moodle
2. Face-to-face classroom course (no online features)
3. Blended course with some scheduled face-to-face/live meetings and some self-directed online activities
4. Fully online live course using a system like Zoom or GoToMeeting, with required set

meeting times (synchronous)

5. Fully online course using a system like Moodle of Blackboard, no required set meeting times (asynchronous)
6. Interactive video live (face-to-face) course (video or live, set meeting times)

In SQ10, participants were asked to state the number of courses in each delivery method experienced and were offered a Likert scale of five choices including: (a) zero, (b) 1-10, (c) 11-20, (d) 21-40, and (e) 41 or more courses. The results showed evidence that the sample of participants was experienced in all the types of delivery methods being discussed, with the exception of the Freshmen and Sophomores who had considerably less experience with interactive video or webinar courses over an already lower experience showing than for other methods. Further, the category of fully online courses had fewer participants reporting having taken more than 1-10 online courses.

The two choices for face-to-face classroom course delivery were the most frequently experienced: 1213 chose face-to-face with technology, 995 selected face-to-face without technology, 1011 chose fully online, and 893 reported taking blended courses. The webinar (401) and interactive video (398) courses were the least frequent delivery methods reported.

The results from SQ11 asked participants to choose their favorite course delivery method based on their own learning preferences. A Likert scale of "Not Acceptable," "Less Preferred," "Neutral," "Acceptable," and "Favorite" were used to identify which of the six delivery types they preferred. Not surprisingly the top three delivery methods were: live classroom with technology and without technology, as well as blended classes which clearly indicate students prefer live classroom interaction. The three least preferred methods included the webinar, interactive video, or fully online courses, all three delivery methods relying on technology for class interactions. (See Table 15 for the complete results.)

The face-to-face course with supplemental materials provided online with 56.9% choosing it as their favorite and 31.7% as acceptable. In stark contrast, the fully online course received only 15% "favorite" rankings and 29.6% ranking it as acceptable. The strongest rankings for a course delivery being not acceptable or less preferred was the interactive video live course, the webinar, and the fully online course, in that order. Notable is that while students clearly prefer live classroom course delivery, they also returned results distinctive in preferring a live classroom with the technology used to provide presentation or course materials through an online method, over choosing a live classroom without any online or technology features. Only 17.4% chose a live course without technology as their favorite, and 46.5% as acceptable, ranking this method as a distant second favorite. It was unexpected to note that fully online courses are not as favored, and more information seems warranted. An interesting finding was that the graduates found fully online courses as "Less Preferred" more often than participants in other year-in-school categories. The researcher chose to apply the Chi-square and Cramer's V tests to determine whether the student's age mattered in this outcome of course type choices. Chi-square and Cramer's V results confirmed that Millennials significantly prefer live classrooms over fully online, and non-Millennials are much more accepting of courses using online learning methods. In contrast to those believing Millennials or digital natives naturally prefer technology methodologies (Bracy, Bevill, & Roach 2010; Farrell & Hurt, 2014; Merlino, 2009; Prensky, 2001; 2009), other authors feel older students are better suited for the use of online learning due to work experience, ability to learn new applications, and being more self-reliant and motivated to learn to adapt to reach their goals (Ransdell, Kent, Gaillard-Kenney, & Long, 2011). The results of this survey item sparked interest concerning the age of the student and thus, a Chi-square test was done on each of the listed six course delivery methods. Significant relationships were found on three of the methods (SQ11-1, SQ11-3, and SQ11-5).

Cramer's V was also performed and found a medium to strong effect size for Millennials to prefer face-to-face classrooms over non-Millennials. Further, the results showed a medium to strong effect size for Millennials preferring blended classrooms over non-Millennials, again confirming the Millennial preference for live interaction. The results also showed a medium to strong effect size for fully online learning by the non-Millennials who preferred this method over the Millennials, again, showing preference for online learning by older students than those born after 1982. Lai and Hong, (2015) found those with a high digital literacy are not necessarily those who prefer online learning. Other authors found Millennials not as enamored of non-face-to-face methods as once believed (Barnes & Jacobsen, 2014; Bennett et al., 2008; Gallardo-Echenique et al., 2015; Kirschner & van Merrienboer, 2013; Koutropoulous, 2011; Thompson, 2013; Vaidhyanathan, 2008; Waycott et al., 2010).

To further explore the area of course preferences of Millennial age students, SQ12 asked participants to rate the items that mean the most to them when choosing a course format. Participants were given a list of eleven items and a memo field for noting other meaningful items. The list of 11 items included: (a) schedule, (b) location, (c) uses lots of technology, (d) uses little technology, (e) appropriate delivery method for the course topic, (f) live classroom, (g) fully online, (h) choice of instructor, (i) number of required textbooks, (j) recommended by another student, or (k) recommended by an adviser. The question used a Likert scale from "least important" to "most important." Participants chose: schedule (93.3%), "appropriate delivery method" (77.5%), and location (72.8%) as the three "Most Important" plus "Important" considerations to choosing a course. Students often use several variables when choosing a course and can sometimes have no options in course selection at all. (See Table 16 for the complete results.) The comments collected showed similar concerns of course selection with the instructor's skill and teaching attributes in mind, as well as recognizing that in most cases there

is no real choice but to take the courses offered or available at the time of registration. Several comments made it clear students did not want online courses but had no choice as their degree only offered online courses. One participant pointed out that their acceptance of online learning has changed from disliking it in their undergrad courses to accepting it in the graduate program. Other participant comments indicated a strong preference for face-to-face classes, while still others appreciated the flexibility of study schedules with online courses.

The results confirm research claiming there is more to the digital native student than simply liking technology. Gallardo-Echenique et al., (2015) found the Millennial-aged student may be less technology-savvy than their instructors —and may not be the ones demanding changes in instructional design or methodology. The results of this study add evidence to support the Gallardo-Echenique' assertion. Further, Bennett et al., (2008) warn universities could be overlooking a large proportion of their student base that is not as adept or fond of technology use in education as once assumed. Becker (2009) points out that digital applications such as video games and social networking sites are very user-friendly and allow participants to become successful immediately, whereas many educationally-based applications take more experience to use and understand. With the results from earlier research questions showing results of high digital device use for both personal/social and educational uses, perhaps Millennial students are not disliking the use of technology, but possibly not seeking self-directed study as much as non-Millennials. Or perhaps there are differences between Millennials and non-Millennials regarding how much time they dedicate to a course schedule for face-to-face classes versus asynchronous access to learning indicated by the high importance placed on "Schedule" being the number one concern in choosing a class format.

Research question 5: Research question 5 aims to explore instructional design choices by asking those who have taken a fully online course to rate the online course features which

are most useful towards their learning. Survey item 13 (SQ13) provided a list of 15 popular LMS features of both passive and active items: (a) accessibility of course assignments, (b) grading rubrics, (c) syllabi, (d) assignment examples, (e) discussion boards or forums, (f) assignment drop boxes, (g) linked reading materials, (h) wiki's, (i) blogs, (j) collaborative group assignments, (k) chat rooms, (l) live class meetings, (m) podcasts, (n) instructor created materials, and (o) written assignments. (Regrettably, quizzes, exams, or self-tests were inadvertently left out of the list of features.) In a Likert scale from "No Experience" to "Most Useful" results clearly voice participants' preferences as well as show their experience. The top three passive features (tools) they found "Most Useful" plus "Useful" combined, were the accessibility to course assignments (84.2%), syllabus (83.1%), and instructor-created materials (80%). The active features (learning activities) participants chose as "Useful" or "Most Useful" combined were: instructor created materials (80%), linked reading materials (71%), and written assignments (64.4%). See Figure 9 for more complete information.

Notable in the results from SQ13 was a gap of nearly 30% between discussion boards/forums (35.3%) and live class meetings (34.9%) showing these active features as being considered less useful towards learning. In examining the data with consideration to the year in school of the participant, it appears that the Freshmen and Sophomores show less experience with these two features, however, in the upper four school year levels (e.g., graduate doctorate, graduate masters, senior, junior), participants distinctly chose these features as "Least Useful." As both features are commonly used in fully online courses, it may be possible students are not experiencing well managed examples of either feature or that the features are being over-used. The area of online features, use, appropriateness, and careful management tend to be a challenging area for maintaining currency as student preferences change with various degree focuses, age of student, culture, and many more variables. It is an area needing more study from

primary sources to inform designers about what supports increased learning outcomes from the student's perspective.

The results of SQ13 also prompted a question about the age of the participant and their rankings. Therefore, Chi-square and Cramer's V tests were applied, and results indicate a medium to large effect size for non-Millennials to find discussion boards/forums as useful towards learning over Millennial-aged students, χ^2 (4, N=1281) = 31.306, p = .000, V=.158.

Notable results from this survey item are how highly the tool-like features which support the learner to complete assignments are rated towards supporting learning, over those features considered as active learning activities. Further, the selection of "accessibility to course assignments" being the number one choice speaks clearly of the usefulness of a well-organized course website that allows the student to work unencumbered. As Lane (2009) points out, each LMS brand uses different tools and features for a course design and by using only the provided default design, instructors or designers may be overlooking design choices which could produce a more appropriate and useful learning environment for student/customer in mind. Walker et al., (2016) also warns against the use of features or designs which might hinder learning, and instead, seeking out those features which truly support student success. Walker et al., also suggest more active research by all universities to continue to learn and change as needed to meet the needs of the learning outcomes desired. With so many items and features available, instructional designers must make hard choices to use the most appropriate features to best suit their customers; the student, the course program and each course instructor. In addition, as students indicate how important and useful the tools are in their online learning experiences, designers may wish to take additional time and efforts towards creating accurate and highly informative syllabi, grading rubrics, and assignment examples, all of which create an important contract between the instructor and student for the duration of the course. Instructional design

competes with other graphical interfaces in our world and designers must work to stay current on principles of design for viewer ease as well as learner functionality. Students expect modern and efficient layouts using a minimal effort to access materials and complete work making vital the attention to design detail as well as content. (See Table 17 for complete results of SQ13.)

Research question 6. Research question 6 examines the relationship between technology use and the age of the student using survey items SQ3 and SQ7, combined with SQ21 (age). The aim of this RQ is to find a relationship between the age of the student and the technology or digital devices they prefer. Survey item 3 (SQ3) asked participants to choose the frequency per week they used each of the eight listed devices for personal/social applications using the Likert scale of: 0 hours, 1-10, 11-20, 21-40, and 40 or more hours. See Table 19 for the complete descriptive statistics for SQ3.

The Chi-square test of independence was applied to SQ3 and SQ21 (age of student) to test for a significant relationship between the age of the student and their use of technology. The five digital devices which showed a significant relationship ($p < .05$) are: smartphones, desktop computers, cell phones without data, TV or game systems, and the tablet. The results of the Chi-squares and Cramer's V resulted in the smartphone and TV Game system to have a medium to large effect size of Millennials using those two devices more than non-Millennials. Conversely, the desktop computer, cell phone, and tablet showed a small to medium effect size for non-Millennials to use those devices more than Millennials.

The three devices showing no significant relation to student age were laptop computers, smartwatches, and digital readers. Not unexpectedly, the laptop is favored by all ages of college students, and the smartwatch and digital reader are not used enough by any of the participants to find a significant relationship one way or the other, due to age. See Table 19 for the complete results.

Additional exploration on this area of study was found in testing SQ7 and SQ21 asking participants to report on the frequency per week each device was used. The results show similar findings in that the desktop and tablet indicate non-Millennials prefer these devices more than Millennials, and smartphones are preferred by Millennials more than non-Millennials. Again, the laptop seems to be preferred by all ages of students, thus showing no significance to the age of the student. The low use devices: the digital reader, smartwatch, and game system, also show no significance, yet due to the lack of use, these devices seem to be inconsequential for use in educational course design. Designers are therefore reassured from these results that designing for full sized screens over smaller mobile screens appear to be preferred by all ages of students at this time.

Research question 7. The final research question aims to discover if there is a relationship between the age of the student and their perception of technology. Survey items SQ9 and SQ21 were used in a Likert-format for participants to rank their level of agreement to twelve provided statements regarding technology use in general (as opposed to specifically personal/social or education-based). Chi-square and Cramer's V tests were administered to each statement and are found in Table 20.

Table 20

Significant relationships and effect size of SQ9 statements and age of student. (N=1280)

	Statements	Signifi-cance?	Effect size	Millennials more than non-millennials?
1	I am online frequently every day	No		n.a.
2	I am online during classes	Yes	*V* =.157, Medium	Yes
3	I prefer texting over phonecalls	No		n.a.
4	I check my emails using my smartphone	Yes	*V* =.132, Medium	Yes
5	I visit social network sites frequently every day	Yes	*V* =.198, Large	Yes
6	I blog once a week	No		n.a.
7	I Tweet frequently every day	Yes	*V* =.103, Sm/Med	Yes
8	I easily accept and adopt new technology	No		n.a.
9	I play video games online with others	Yes	V=.155, Medium	Yes
10	I would rather be late than to forget my smartphone	No		n.a.
11	I believe mobile learning is beneficial	Yes	V=.111, Sm/Med	No
12	If someone texts me I will answer them within minutes	No		n.a.

Six of the twelve statements resulted in a significant relationship to the age of the participant. Notable is statement 11, asking for agreement to mobile learning being beneficial, and non-Millennials selecting this choice more positively than the Millennial participants. The other five statements showing a significant relationship are all positive of Millennials choosing to agree with the statements more frequently than non-Millennials. Of interest is that the sample Millennials report being online during their classes significantly more often than non-Millennials. What is not known is whether those students are online using tools for learning like taking notes using a cloud-based software such as Google Docs, or if they are performing a non-educational function such as postings on social media.

Dahlstrom et al., (2015) reported mobile digital devices created challenges in the classroom due to possible distractions found on the devices, the slowing down of campus

broadband speeds, and the challenge to the student to switch from one task to another effectively and not lose concentration in the class. A more scientific study by Watson and Strayer (2010) claims only 2.5% of the population is capable of multi-tasking and the others who believe they are, may only be switching between tasks, leading to lower focus, lower efficiency, and lower out-put. Judd (2016) found focused and supervised students only stayed on task for about six minutes before succumbing to distractions mainly supplied through digital devices. Unsupervised students averaged only 2.3 minutes or less if social networks were available. When Calderwood et al. (2016) asked students to predict the level of distraction and resulting performance detriments, most students underestimated the time loss of taking longer to complete a task, the lower performance levels due to lack of focus, and the lower grades being due to distractions.

By understanding the device use and experience levels of students, designers might integrate favored elements into instructional designs. For example, students are likely adept in using social media and a discussion board may be utilized in similar and familiar ways such as Tweeting or Instagram posts by allowing posts to more closely mimic classroom discussions with multiple brief inputs rather than required length essay-like postings. Students who know how to take and post photos might enjoy creating detailed photo or video presentations over a written paper as an alternative activity. Students who are capable of texting and searching may also have skills of quickly researching and referencing during a class exercise which might prove effective and engaging. Students may also benefit from using their search skills to find references in a scavenger-like exercise where they would compile information and share with cohorts through a forum-based exercise.

Recommended Practice

Recommendations for practice fall into three categories: recommendations for

instructional designers, instructors, and administrators.

Recommendations for instructional designers. In a departure from popular assumptions, the Millennial students in this sample prefer face-to-face instruction over all forms of online learning or remote/distance learning methods. Thus, the evidence of this study suggests to designers to know their audience's age and general demographics to determine the most appropriate delivery methods before designing instruction using technology-based methods. While Millennials from this sample are generally accepting of the use of technology, they chose traditional delivery methods such as lecture and face-to-face classroom methodology as their favorite course delivery methods. Additionally, many students entering higher education may not have the tools needed (e.g., self-discipline, maturity, experience, knowledge) to succeed in an asynchronous learning method and may need tutorials or for-credit courses to help guide them through the processes used. Careful attention to younger students and their skills and experience when entering technology-based course environments might reveal the need for additional learning about the use of the format prior to a course failure due to a lack of technology knowledge. Designers cannot assume a homogeneity of skill or understanding of technology use by any age student or class level.

The hierarchical list of online learning features provided in the results from Research Question 5 (Figure 9) offers insights into which features students find the most useful. Whether designing face-to-face classroom instruction or online supplemental sites or full courses, it is clear that students from this sample prefer a well-organized and operating LMS site that provides the tools they need most: accessibility to assignments, syllabi, instructor-created materials, rubrics, assignment examples, linked reading materials, drop boxes, and written assignments. It is also clear what the participants in this sample found least useful for their learning: discussion boards/forums, live class meetings, podcasts, group assignments, chat

rooms wiki's, and blogs. At first glance, the list of least useful features contains several learning activities and it is outside the scope of this study to understand the circumstances of these features being rated as least useful. With that, designers must make careful decisions as to the appropriateness of each design feature and use it appropriately while guarding against overuse as well as under-developed. For example; the list of highly-rated features includes several tools (e.g., rubrics, syllabi, assignment examples) and students will appreciate the time and effort needed to provide accurate and highly developed versions of these tools to provide answers about assignments, course requirements, grading information, and everything they need to be successful in a course. The designer and instructor must respect these tools as the important features students depend on and prepare them with care. Grading rubrics and syllabi are contracts between the instructor and the student and should be regarded as such from both parties. Additionally, designers may note that some of the less popular features for a Millennial may, in-turn, be highly regarded for non-traditional students. Careful thought as to the age of the audience comes into play in the design of all instruction choices. The results suggest students prefer courses designed to be as near to traditional live classroom experiences as possible with careful consideration by designers to utilize those features and components which are most suitable to this end.

Implementation of the use of familiar skills by Millennial students such as use of social media, texting, or use of photos, might also be useful in course design. Student experience and skill in personal/social uses may seem unrelated or not applicable in education-based applications. However, making use of technology-based skills may be a way to engage students by finding ways to use smartphones, texting, taking photos and posting, or by holding Tweet-like discussions instead of more involved essay-based forum postings. By meeting students where they are with skills and digital literacy, designers will create a welcoming and

comfortable environment for all ages of student in all forms of classrooms.

Results from this study confirm the laptop computer as the device of choice at the time of this report. With this information, designers can be reassured of design focus to be on full-sized screens as opposed to mobile devices. While some education-based activities (e.g., communications, referencing school announcements) may be suited to a smaller screen and no keyboard, students report use of a laptop as the preferred device for most coursework.

Also recommended for designers is to keep an open mind towards the feedback given by the Millennial generation of students. This study suggests much may be learned about the benefits of simply asking students about their preferences as shown in the comments regarding factors that influence course enrollment choices. Participants commented on the importance of instructor interaction and accessibility. Perhaps more reflexive interactions with instructors are something that is missing from technology-based delivery methods where students do not feel they have the opportunity to ask questions, hear others' questions, or just feel like they are not alone in the learning process. Designers may survey students during a semester to gain feedback and make beneficial adjustments in time to promote student success for that course. Asking what course features would support their learning might be very enlightening towards new innovation and methods.

Recommendations for instructors. Millennials from this sample appear to prefer face-to-face classroom courses. The results also show smartphones appear to be used for education less often than laptops. The results also show more social networking in participants' personal applications than for educational uses. By understanding the personal/social technology being used by students, instructors could implement methods which might be more suitable to the preferred devices which Millennial students may feel comfortable with. In studies mentioned in Chapter 2, authors wrote about different preferences between students and instructors and how

the age gaps were challenging when planning the use of technology. Many Gen-X and Baby Boomer-aged instructors have put a lot of time and effort into learning new methods and implementing technology into their classrooms and it is very likely the instructor may be more adept in technology than their students. By acknowledging the differences between generations and understanding preferences for technology versus actual skill with education-based technologies, instructors will have usable knowledge to teach more effectively.

Emerging technologies in classrooms will change in the coming years and soon instructors will be asked to use technology such as virtual reality, 360-degree presentation equipment, instant-feedback software, and more. Instructors who embrace new technologies and classroom activities will enjoy the engagement and active learning of students who will be delighted to use their skills and experience in new and innovative methods of learning. This researcher recommends that instructors seek out supportive education opportunities to learn about new classroom technologies to meet students half-way in supporting their educational success.

Recommendations for administrators. Administrators have a huge responsibility to plan curricula that will best suit the university customers: students, future employers of students, researchers, the supporting community, and faculty. Knowing that the age of the student may make a significant difference in how well received or beneficial a type of class is a large part of the planning process. In the search for applicable articles on the topic of technology in education, many articles were available that reported faculty and designers not having the administration's support to learn the skills and information needed to produce well-designed courses. The complaints stated teachers were expected to become instructional designers without education for the task, and designers were expected to know skills for cutting edge technology without having a chance to learn or experience those new technologies. Through the

results of this study reporting the differences between preferences for technology by Millennial students, administrators will have more information to support their task of planning for faculty education, and student choices. This researcher recommends that an institution wholeheartedly support instructors and designers to stay on the cutting edge of educational technology.

Recommended Research

As found in the literature review for this study, more or continued empirical and primary source research to learn as much as possible about the current university customer will always be needed. Further, it is beneficial to have research appropriate to a variety of regions as each university faces enrollment and success rates related to their unique regions. Too much of the literature on this study topic was anecdotal or tertiary and not all that helpful in learning first-hand what a Millennial student expects from their educational experience.

The replication of this study is recommended with a few minor changes. (1.) Add opportunity for clarification from participants as to why they may choose some items over others to help designers understand if small adjustments could be beneficial. (2.) Reduce the overall number of questions to lessen participant survey fatigue. (3.) Clarify experience levels for technology-based course and features.

Research into online course page design, LMS features and uses, and student usefulness to course designs is an area that is sparse and would greatly support instructional designers. By asking students to give feedback on their learning environment and experiences it may be possible to take more control over the pedagogy and learning methodologies needed in technology-based course design. Students should be asked for their input to bring out the kind of classroom experience most beneficial to their educational success and to support designers in choices where possible.

Research exploring distractions in online and face-to-face classroom environments could

support student education about study methods and strategies to promote higher quality learning experiences. With increased use of mobile devices distraction also increases leaving younger students wondering why they may be falling behind. This area of research may produce preparatory courses to help students understand how to increase focus and learning.

Also recommended is a study investigating for-credit courses which support the technology needed in higher education programs. With skills used in personal/social not easily transferring into education-based uses as well as differences in device use, institutions should be prepared to help students get a better start with educational technologies needed to attend classes. It would also be useful to establish a standardizable method of assessing digital literacy, device use, and overall skills related to use of technology in incoming students so those needing assistance would understand any weak areas.

Concluding remarks

Ralph Waldo Emerson said, "the secret in education lies in respecting the student." This study was based on respecting the Millennial student in his or her educational careers enough to ask about their perception of technology used in higher education. The results of the survey showed the Millennial-aged student is not as enamored of some technology uses in education as much as technologies used in their personal or social life. As this study adds to the body of literature that challenges the digital native canon, many more questions arise. It is possible with continued research that technology use in education will reach a desirable balance with a mix between the face-to-face engagement of a classroom and the efficient and flexible schedule benefits of technology use. One Millennial group has spoken in this study to offer designers the opportunity to note preferences and learn about the need to adapt course features to the learning preferences of the students.

It is time to think of our virtual world as a place we spend much of our time living and

start designing courses with exceptional visual and highly beneficial features in mind. The popular LMS's such as Moodle and Blackboard are very adaptable and flexible to different designs where research and exploration could produce greatly improved student outcomes as well as happier professors and administrators. Higher education is all about rigor, yet it is also all about innovation. Focusing on innovation is needed to bring instructional design and education face-to-face with the next generation.

REFERENCES

Aagaard, J. (2016). Mobile devices, interaction, and distraction: A qualitative exploration of absent presence. *AI and Society*, *31*(2), 223–231. doi:10.1007/s00146-015-0638-z

About ISU. (2016). Retrieved April 6, 2017, from http://www.isu.edu/about/

Akçayır, M, Dündar, H., & Akçayır, G. (2016). What makes you a digital native? Is it enough to be born after 1980? *Computers in Human Behavior, 60*, 435–440.

Allen, I., & Seaman, J. (2014). *Grade change: Tracking online education in the United States*. Retrieved from Babson Survey Research Group and Quahog Research Group website: https://www.onlinelearningsurvey.com/reports/gradechange.pdf

Anderson, M. (2015). *Technology device ownership: 2015*. Retrieved from *Pew Research Center* website: http://www.pewinternet.org/2015/10/29/technology-device-ownership-2015/

Asynchronous learning. (n.d.). In *Dictionary.com*. Retrieved from http://www.dictionary.com/browse/asynchronous learning.

Aziz, H. (2010). The 5 Keys to Educational Technology. Technological Horizons in Education *(THE) Journal (online version) September 16, 2010.* Retrieved from https://thejournal.com/Articles/2010/09/16/The-5-Keys-to-EducationaI-TechnoIogy on April 15, 2017.

Barnes, N., & Jacobsen, S. (2014). Millennials and learning styles: Out with the new and in with the old? *Proceedings of the Marketing Management Association*, Fall, 139.

American Psychological Association. (2010). *Publication Manual of the American Psychological Association* (6th ed., Kindle ed.). Washington, DC: Author.

Baron, B. (2006). Interest and self-sustained learning as catalysts of development: A learning ecology perspective. *Human Development, 49*(4), 193–224.

Baron, N. (2015). *Words onscreen, the fate of reading in a digital world*. New York, NY: Oxford University Press.

Becker, C. (2009). Student Values and Research: Are Millennials Really Changing the Future of Reference and Research? *Journal of Library Administration, 49*(4), 341-364. doi:10.1080/01930820902832454

Becker, K. (2010). The Clark-Kozma debate in the 21st century. In *CNIE 2010: Heritage matters: Inspiring tomorrow* (pp. 1–5). Saint John, Canada: Canadian Network for Innovation in Education. Retrieved from https://www.researchgate.net /publication/260105358_The_Clark-Kozma_Debate_in_the_21st_Century

Bennett, S., & Maton, K. (2010). Beyond the "digital natives" debate: Towards a more nuanced understanding of students' technology experiences. *Journal of Computer Assisted Learning*, *26*, 321–331. doi:10.1111/j.1365-2729.2010.00360.x

Bennett, S., Maton, K., & Kervin, L. (2008). The digital natives debate: A critical review of the evidence. *British Journal of Educational Technology*, *39*(5), 775–786. doi:10.1111/j.1467-8535.2007.00793.x

Biemiller, L. (2014). Colleges race to keep up with technology change. *Chronicle of Higher Education*, *60*(45), 1–4.

Bracy, C., Bevill, S., & Roach, T. (2010). The millennial generation: Recommendations for overcoming teaching challenges. In *Proceedings of the Academy of Educational Leadership, 15*(2), 21–25. Arden, NC: DreamCatchers.

Bower, M., Dalgarno, B., Kennedy, G., Lee, & M., Kenney, J. (2015). Design and implementation factors in blended synchronous learning environments: Outcomes from a cross-case analysis. *Computers & Education, 86,* 1–17.

Buzzetto-More, N. (2012). Social networking in undergraduate education. *Interdisciplinary Journal of Information, Knowledge, and Management, 7*(1), 63–90.

Calderwood, C., Green, J. Joy-Gaba, J., & Moloney, J. (2016). Forecasting errors in student media multitasking during homework completion. *Computers & Education, 94,* 37- 48.

Caruso, J., & Salaway, G. (2008). *The ECAR study of undergraduate students and information technology, 2008.* Boulder, CO. ECAR, Educause Center for Applied Research.

Chen, B., Seilhamer, R., Bennett, L., & Bauer, S. (2015). Students' mobile learning practices in higher education: A multi-year study. *Educause Review,* June. Retrieved in February 2016 from http://er.educause.edu.

Chen, Q., & Yan, Z. (2016). Does multitasking with mobile phones affect learning? A review. *Computers in Human Behavior, 54,* 34–42.

Cheon, J., Lee, S., Crooks, S. M., & Song, J. (2012). An investigation of mobile learning readiness in higher education based on the theory of planned behavior. *Computers and Education, 59*(3), 1054–1064.

Clark, R. (1983). Reconsidering research on learning from media. *Review of Educational Research,* 53(4), 445–459.

Chung, C., Ackerman, D. (2015), Student reactions to classroom management technology: Learning styles and attitudes toward Moodle. *Journal of Education for Business, 90*(4), 217–233. doi:10.1080/08832323.2015.1019818.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, New Jersey, Lawrence Erlbaum Associates.

Cohen, S. (1972). *Folk devils and moral panics.* London, England: MacGibbon & Kee.

Cole, M., Shelley, D., & Swartz, L. (2014). Online instruction, e-learning, and student satisfaction: A three-year study. *The International Review of Research in Open and Distributed Learning*, *15*(1), 111–131.

Coverage Maps. (2016). Cell phone company coverage maps, December 2016. Retrieved April 9, 2017, from http://www.cellularmaps.com

Creswell, J. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches*. London, England: Sage.

Dahlstrom, E., Brooks, D., Grajek, S., & Reeves, J. (2015). ECAR study of undergraduate students and information technology, 2015. *Educause Research Report.* December, 2015.

Deakin University (2016). *Deakin University digital literacy framework, graduate learning outcome 3*. Deakin University, Melbourne, Australia. Retrieved from Creative Commons website: http://creativecommons.org

Delimitation. (2017). In *English Oxford Dictionaries*. Retrieved February 15, 2017, from https://en.oxforddictionaries.com/definition/delimitationDigital. (2016). In *Merriam-Webster Online*, n.d. Retrieved from www.merriamwebster.com/dictionary/digital.

Dillman, D., Smyth, J., & Christian, L. (2014). *Internet, mail, and mixed-mode surveys: The tailored design method*. Hoboken, NJ: John Wiley.

Educational Technology (1969). Thesaurus of ERIC descriptors. Washington D.C.: U.S. Department of Education. Retrieved April 15, 2017, from https://eric.ed.gov/?qt=educational technology&ti=Educational Technology.

ESA, (2018). Essential facts about the computer and video game industry. *Entertainment Software Association.* Retrieved 4/14/18 from http://www.theesa.com.

Farrell, L. & Hurt, A. (2014). Training the millennial generation: Implications for organizational climate. *Journal of Organizational Learning and Leadership, 12*(1), 47–60.

Gallardo-Echenique, E., Marqués-Molías, L., Bullen, M., & Strijbos, J. (2015). Let's talk about digital learners in the digital era. *International Review of Research in Open and Distributed Learning*, *16*(3), 156–187.

Goodman, M., Sands, A., & Coley, R. (2013). *America's skills challenge: Millennials and the future—Millennials*. Retrieved from Educational Testing Service website: http://www.ets.org/s/research/30079/Millennials.html

Han, H., Nelson, E., & Wetter, N. (2014). Medical students' online learning technology needs. *Clinical Teacher*, *11*(1), 15–19. doi:10.1111/tct.12092

Hargittai, E. (2010). Digital na(t)ives? Variation in internet skills and uses among members of the "net generation." *Sociological Inquiry*, *80*(1), 92–113. doi:10.1111/j.1475-682X.2009.00317.x

Hawi, N., & Samaha, M. (2016). To excel or not to excel: Strong evidence on the adverse effect of smartphone addiction on academic performance. *Computers and Education*, *98*, 81–89.

Hlynka, D., & Jacobsen, M. (2009). What is educational technology, anyway?: A commentary on the new AECT definition of the field. Canadian Journal of Learning & Technology, 35(2), 9.

Horrigan, J. B. (2016). *Digital readiness gap*. Retrieved from Pew Research Center website: http://www.pewinternet.org/2016/09/20/digital-readiness-gaps/

Howe, N., & Strauss, W. (2007). The Next 20 Years. *Harvard Business Review*, *85*, 41–52.

Johnson, L., Adams-Becker, S., Cummins, M., Estrada, V., Freeman, A., & Hall, C. (2016). *NMC horizon report: 2016 higher education edition*. Austin, TX: New Media Consortium.

Jones, C., & Shao, B. (2011). The Net Generation and digital natives: Implications for higher education. *Higher Education Academy*, June, 1–53.

Judd, T., & Kennedy, G. (2011). Measurement and evidence of computer-based task switching and multitasking by "Net Generation" students. *Computers and Education*, *56*, 625–631.

Kennedy, G., Judd, T., Churchward, A., Gray, K., & Krause, K. (2008). First year students' experiences with technology: Are they really digital natives? *Australasian Journal of Educational Technology*, *24*(1), 108–122.

Kennedy, G., Dalgarno, B., Bennett, S., Gray, K., Waycott, J., Judd, T., . . Chang, R. (2009). *Educating the Net Generation: A handbook of findings for practice and policy*. Strawberry Hills, New South Wales: Australian Learning and Teaching Council.

Kim, K., & Frick, T. (2011). Changes in student motivation during online learning. *Journal of Educational Computing Research*, *44*(1), 1–23.

Kirschner, P., & van Merrinboer, J. (2013). Do learners really know best? Urban legends in education. *Educational Psychologist*, *48*(3), 169–183. doi:10.1080/00461520.2013.804395

Koutropoulos, A. (2011). Digital natives: Ten years after. *Merlot Journal of Online Learning and Teaching*, *7*(4), 525–538.

Kozma, R. (1991). Learning with media. *Review of Educational Research*, 61(2), 179–212

Krannich, R. (2013). A sociodemographic portrait of the Intermountain West. In R. S. Krannich, A. E. Luloff, & D. R. Field (Eds.), *People, places and landscapes: Social change in high amenity rural areas* (pp. 27–43). New York, NY: Springer. doi:10.1007/978-94-007-1263-8_3

Kreuter, F., Persser, S., & Tourangeau, R, (2008). Social desirability bias in CATI, IVR, and web surveys the effects of mode and question sensitivity. *Public Opinion Quarterly, 72*(5), 847–865. doi:10.1093/poq/nfn063

Lai, K., & Hong, K. (2015). Technology use and learning characteristics of students in higher education: Do generational differences exist? *British Journal of Educational Technology, 46*(4), 725–738. doi:10.1111/bjet.12161.

Lakhana, A. (2014). What is educational technology? An inquiry into the meaning, use, and reciprocity of technology. *Canadian Journal of Learning and Technology, 40*(3), 43.

Lane, L. (2009). Insidious pedagogy: How course management systems impact teaching. *First Monday*, *14*(10). doi:10.5210/fm.v14i10.2530

Learning management system. (n.d.). In *Dictionary.com*. Retrieved from http://www.dictionary.com/browse/learning-management-system

MacCallum, K., & Jeffery, L. (2013). The influence of students' ICT skills and their adoption of mobile learning. *Australasian Journal of Educational Technology, 29*(3), 303–314.

Margaryan, A., Littlejohn, A., & Vojt, G. (2011). Are digital natives a myth or reality? University students' use of digital technologies. *Computers and Education, 56*(2), 429–440.

Merlino, N. (2009). K*ey pedagogical strategies for millennial generation students in university business courses* (Doctoral dissertation). Available from ProQuest Dissertations and Theses database. (UMI No. 3370198)

Merlino, N., & Rhodes, R. (2012). Technology in the 21st century classroom: Key pedagogical strategies for millennial students in university business courses. *Journal of Supply Chain and Operations Management*, *10*(1), 113–120.

MOOC. (n.d.). In *Dictionary.com*. Retrieved from http://www.dictionary.com/browse /MOOC

Ng, W. (2012). Can we teach digital natives digital literacy? *Computers and Education*, *59*(3), 1065–1078.

Oblinger, D. (2005, September/October). Learners, learning, and technology: The EDUCAUSE learning initiative. *EDUCAUSE Review*, 66–75.

Palmer, B., Boniek, S., Turner, E., & Lovell, E. (2014). Undergraduates, technology, and social connections. *College Student Journal*, *48*(2), 281–296.

Perrin, A. (2015). *Social networking usage: 2005–2015*. Retrieved from Pew Research Center website: http://www.pewinternet.org/2015/10/08/social-networking-usage -2005-2015/

Petronzio, M. (2013, May 6). Don't leave college without these 10 digital skills. *Mashable.* Retrieved from http://mashable.com

Prensky, M. (2001a). Digital natives, digital immigrants. *On the Horizon*, *9*(5), 1–15.

Prensky, M. (2001b). Digital natives, digital immigrants, part II: Do they really think differently? *On the Horizon*, *9*(6). 1–6.

Prensky, M. (2009). H. Sapiens digital: From digital immigrants and digital natives to digital wisdom. *Innovate: Journal of Online Education*, *5*(3), 1–11.

Ransdell, S., Kent, B., Gaillard-Kenney, S., & Long, J. (2011). Digital immigrants fare better than digital natives due to social reliance. *British Journal of Educational Technology. 42(6),* 931-938. doi:10.1111/j.1467-8535.2010.01137.x.

Rhodes, R. (2012). Millennials report their preferred learning environment. *Decision Line*, *43*(5), 9–14.

Roblyer, M., & Knezek, G. (2003). New millennium research for educational technology: A call for a national research agenda. *Journal of Research on Technology in Education*, *36*(1).

Russo, T. (2013). Examining millennial characterizations as guidance for choosing classroom strategy changes. *International Journal for the Scholarship of Teaching and Learning*, *7*(2). 1–20.

Sevillano-García, M., & Vázquez-Cano, E. (2015). The impact of digital mobile devices in higher education. *Educational Technology and Society, 18*(1), 106–118.

Shrader, S., Wu, M., Owens, D., & Santa Ana, K. (2016). Massive open online courses (MOOCS): Participant activity, demographics, and satisfaction. *Online Learning, 20*(2), 1–18.

Small, G., & Vorgan, G. (2008). Meet your iBrain. *Scientific American Mind*, *19*(5), 42–49.

Smith, E. (2016). A real double-edged sword:'' Undergraduate perceptions of social media in their learning. *Computers and Education*, *103*, 44–58.

So, R., Shinohara, K., Aoki, T., Tsujimoto, Y., Suganuma, A., Furukawa, T. (2018). Effect of Recruitment Methods on Response Rate in a Web-Based Study for Primary Care Physicians: Factorial Randomized Controlled Trial. *Journal of Medical Internet Research, 20*(2), e28.

Strauss, W., & Howe, N. (1991). *Generations: The history of America's future, 1584 to 2069*. New York, NY: Harper Perennial.

Synchronous Learning Definition. (2013). *The glossary of education reform*. Retrieved February 12, 2017, from http://edglossary.org/synchronous-learning/

Tapscott, D. (1998). *Growing up digital: The rise of the Net Generation.* New York, NY: McGraw-Hill.

Taylor, P., Parker, K., Morin, R., Patten, E., & Brown, A. (2014). *Millennials in adulthood*. Retrieved from Pew Research Center website: http://www.pewsocialtrends.org/2014/03/07/Millennials-in-adulthood/

Teo, T. (2013). An initial development and validation of a Digital Natives Assessment Scale. *Computers and Education*, *67*, 51–57.

Thompson, P. (2013). The digital natives as learners: Technology use patterns and approaches to learning. *Computers and Education*, *65*, 12–33.

Thorndike, E. (1912). *Education: A first book*. New York, NY: The MacMillan Company

Tingley, D. (2014). Survey research in international political economy: Motivations, designs, methods. *International Interactions*, *40*(3), 443–451. doi:10.1080/03050629.2014.900614

Ubiquitous computing. (2017). In *Techopedia.com* Retrieved February 12, 2017, from https://www.techopedia.com/definition/22702/ubiquitous-computing

University of Tennessee, College of Information Sciences. (n.d.). Information and communication technology skills. Retrieved June 14, 2016 from http://www.sis.utk.edu/computing/ict

Vázquez-Cano, E. (2014). Mobile distance learning with smartphones and apps in higher education. *Educational Sciences: Theory and Practice*, *14*(4), 1505–1520. doi:10.12738/estp.2014.4.2012

Walker, D., Lindner, J., Murphrey, T., & Dooley, K. (2016). Learning management system usage. *Quarterly Review of Distance Education*, *17*(2), 41–50.

Watson, J., & Strayer, D. (2010). Supertaskers: Profiles in extraordinary multitasking ability. *Psychonomic Bulletin and Review*, *17*(4), 479–485. doi:10.3758/PBR.17.4.479

Waycott, J., Bennett, S., Kennedy, G., Dalgarno, B., & Gray, K. (2010). Digital divides? Student and staff perceptions of information and communication technologies. *Computers and Education*, *54*(4), 1202–1211. doi:10.1016/j.compedu.2009.11
.006

Vaidhyanathan, S. (2008). Generational myth: Not all young people are tech savvy. *Chronical of Higher Education*, *54*(4), B7–B9.

Yahya, S., Ahmad, E., & Jalil, K. (2010). The definition and characteristics of ubiquitous learning: A discussion. *International Journal of Education and Development using Information and Communication Technology*, *6*(1), 1–11.

APPENDIX A
Skill Levels for Personal/Social or Formal Educational Use (SQ 14, 15, 16)

	Proficient	Advanced
Hardware Related Skills	• Pairing Bluetooth devices to a smartphone • Setting up a new computer without help, including uploading new software and adding peripherals • Using a variety of operating systems such as Windows, Chrome, Linux, MacOS, iOS, Android, etc. • Used an MP3 or MP4 device, including playlist management and cloud storage • Set up and operate an entertainment system including DVD player, satellite receiver, streaming video service, audio service, etc.	• Created a Wi-Fi network including installation of the router • Managed computer security system including use of secure passwords, virus and firewall controls, privacy, and secure browsing settings • Installed components into a CPU such as additional RAM, additional USB ports and disk devices • Installed and managed an IoT item using a smartphone • Created code or made changes to a function or visual part of a website.
Software Related Skills	• Used collaborative programs such as ZOOM, Skype, Google Docs, or GoToMeeting • Completed a fully online course using a learning management system such as Moodle or Blackboard • Posted a course assignment using the drop box feature • Posted an attachment to a discussion board or forum posting • Created a formatted document using Word or WordPerfect or similar word processing software	• Used a document management software program such as OneNote, Qiqqa, Mendeley to manage articles • Created a multi-media presentation including narration, transcriptions, embedded video and audio, using Prezi, Jing, PowerPoint, or Presenter, etc. • Used specialized programs such as R, SPSS, AutoCAD, etc. • Used spreadsheet programs such as Excel including use of formulas and macros for calculations • Used word processing software to create an APA or MLA styled document including a table of contents, references, and citations.
Digital Device Related Skills	• Created and manage a Facebook (or other social media page) including managing privacy and security settings • Uploaded and used a variety of smartphone apps • Located and used more than 5 scholarly articles using a repository or university library system • Used a cloud storage system like Dropbox or Google Docs • Shopped and paid bills online	• Played online games with others such as League of Legends or Minecraft • Created and edited video clips for use in presentations • Set up a smartphone to send and receive email • Converted documents across platforms and software types such as pages to .docx, .docx to .pdf, .wpd to .doc, etc. • Used networked/collaborative tools across users and devices such as QuickBooks, Apple pay, Googledocs, Carbonite, Google Calendar

Note. Compiled from sources in the literature review (Deakin University, 2016; University of Tennessee, n.d.; Petronzio, 2013) to be used in the construction of a questionnaire item.

APPENDIX B
The Survey Instrument

Technology use and perception in higher education

Your use of digital devices and technology

The survey will ask questions about:

1. **Personal/social** use associated with casual, personal business, home and family related communications, entertainment, casual learning and web searching, etc.

2. **Formal education** use associated only with your degree program at ISU, related coursework and research, communications with the university, any class related communications, etc.

3. **You.** These answers will tell us about your age, sex, home locations and connection speeds, year in school, etc.

Thank you for your support by participating in this study.

S*ection 1 - Personal/Social technology use*

1. **Which devices do you choose to use on a regular basis for personal/social applications and how frequently?**

	Not used (2)	Least used (3)	Occasionally used (4)	Frequently used (5)	Most used (6)
Smartphone with data connection (iPhone, Androids, etc.) (1)	○	○	○	○	○
Cell phone WITHOUT Internet Connectivity (for calls and text, photos) (2)	○	○	○	○	○
Smartwatch with data connection (3)	○	○	○	○	○
Digital Reader (Nook, Kindle, etc.) (4)	○	○	○	○	○
Laptop, netbook, or Chromebook (portable computer with keyboard and mouse) (5)	○	○	○	○	○
Tablet (Touch screen, no provided keyboard, iPad, Fire, etc.) (6)	○	○	○	○	○
Desktop computer (7)	○	○	○	○	○
Game or TV system with Internet connectivity (8)	○	○	○	○	○

2. **Choose which device you prefer to use for each of the listed personal/social uses:**

	Laptop Computer (1)	Desktop computer (2)	Tablet (3)	Smart phone (4)	Digital reader (5)	Smart watch (6)	Game or TV system (7)	Cell phone (no data) (8)	N/A - Don't do (0)
Communications with friends and family (1)	○	○	○	○	○	○	○	○	○
Online shopping (2)	○	○	○	○	○	○	○	○	○
Social networking, blogs, posts, etc. (3)	○	○	○	○	○	○	○	○	○
Creativity - working with photos or video (4)	○	○	○	○	○	○	○	○	○
Casual learning and referencing (non-degree program, not job related) (5)	○	○	○	○	○	○	○	○	○
News, weather, maps, etc. (6)	○	○	○	○	○	○	○	○	○
Games, movies or entertainment (7)	○	○	○	○	○	○	○	○	○

3. **Select the frequency per week each device is used for personal/social use:**

	0 hours (0)	1-10 Hours (1)	11-20 Hours (2)	21-40 Hours (3)	41 or more Hours (4)
Desktop computer (1)	○	○	○	○	○
Laptop, Netbook or Chromebook (2)	○	○	○	○	○
Tablet (iPad, Fire) (3)	○	○	○	○	○
Digital Reader (Nook, Kindle) (4)	○	○	○	○	○
Smart Phone w/data connection (iPhone, Android) (5)	○	○	○	○	○
Cell phone without Internet connectivity (6)	○	○	○	○	○
Smart watch with data connection (7)	○	○	○	○	○
Game or TV system with Internet connectivity (8)	○	○	○	○	○

4. Rank the personal/social skills or tasks you do most:

	Never (0)	Rarely (1)	Occasionally (2)	Frequently (3)	Most Often (4)
Written communications (emails, texts) (1)	○	○	○	○	○
Research and information gathering (news, weather, recreation, etc.) (2)	○	○	○	○	○
Creation of artifacts (photos, videos, writing, etc.) (3)	○	○	○	○	○
Using specific software to perform a function (banking, Excel, scrapbooks, etc.) (4)	○	○	○	○	○
Interactions (Facebook, Instagram, blogging, etc.) (5)	○	○	○	○	○

Section 2 - Formal Education Technology Use

(University degree program use only)

5 **Which digital devices do you choose to use on a regular basis for formal education applications?**

	Not used (0)	Least used (1)	Occasionally used (2)	Frequently used (3)	Most used (4)
Smartphone with data connection (iPhone, Androids, etc.) (1)	○	○	○	○	○
Cell phone WITHOUT Internet Connectivity (for calls and text, photos) (2)	○	○	○	○	○
Smartwatch with data connection (3)	○	○	○	○	○
Digital Reader (Nook, Kindle, etc.) (4)	○	○	○	○	○
Laptop, netbook, or Chromebook (portable computer with keyboard and mouse) (5)	○	○	○	○	○
Tablet (Touch screen, no provided keyboard, iPad, Fire, etc.) (6)	○	○	○	○	○
Desktop computer (7)	○	○	○	○	○
Game or TV system with Internet (8)	○	○	○	○	○

6. Choose which device you prefer to use for each of the listed formal education uses:

	Laptop computer (1)	Desktop computer (2)	Tablet (3)	Smart phone (4)	Digital reader (5)	Smart watch (6)	Game or TV System (7)	Cell phone (no data) (8)	N/A Don't do (0)
Communications with faculty or cohorts (1)	○	○	○	○	○	○	○	○	○
Creating course related assignments (2)	○	○	○	○	○	○	○	○	○
Course related - Forums, blogs, posts, etc. (3)	○	○	○	○	○	○	○	○	○
Other course or school related needs (4)	○	○	○	○	○	○	○	○	○
Course related referencing, research, study (5)	○	○	○	○	○	○	○	○	○
Grades, school announcements and registration (6)	○	○	○	○	○	○	○	○	○
Course access to materials (Moodle, Blackboard, etc.) (7)	○	○	○	○	○	○	○	○	○

7. For formal education use only, how many hours per week do you use each device?

	0 Hours (0)	1-10 Hours (1)	11-20 Hours (2)	21-40 Hours (3)	41 or more Hours (4)
Desktop computer (1)	○	○	○	○	○
Laptop, Netbook or Chromebook (2)	○	○	○	○	○
Tablet (iPad, Fire) (3)	○	○	○	○	○
Digital Reader (Nook, Kindle) (4)	○	○	○	○	○
Smart Phone with data connection (iPhone, Android) (5)	○	○	○	○	○
Cell phone without Internet connectivity (6)	○	○	○	○	○
Smart watch with data connection (7)	○	○	○	○	○
Game or TV system w/Internet connectivity (8)	○	○	○	○	○

8. Rank the formal education skills or tasks you do most:

	Not used (0)	Least used (1)	Occasionally used (2)	Frequently used (3)	Most used (4)
Digital written communications (emails, texts, messaging, etc.) (1)	○	○	○	○	○
Online research and information gathering (library, journals, etc.) (2)	○	○	○	○	○
Digital creation of artifacts (presentations, photos, writing documents, assignments, etc.) (3)	○	○	○	○	○
Using specific software to perform a function (spreadsheets, CAD, language, Project, etc.) (4)	○	○	○	○	○
Digital interactions with groups (Forum postings, blogging, Zoom/Skype, etc.) (5)	○	○	○	○	○

Section 3 - Your preferences for technology use in education

Please answer the questions thinking of your average to good experiences in technology use in your education.

9. How do you react to using technology in general? Choose the best answer:

	Strongly disagree (1)	Disagree (2)	Neither agree or disagree (3)	Agree (4)	Strongly agree (5)
I am online frequently every day (1)	○	○	○	○	○
I am online during classes (2)	○	○	○	○	○
I prefer texting over phone calls (3)	○	○	○	○	○
I check my emails using my smartphone (4)	○	○	○	○	○
I visit social network sites like Facebook frequently every day (5)	○	○	○	○	○
I blog once a week (6)	○	○	○	○	○
I Tweet frequently every day (7)	○	○	○	○	○
I easily accept and adopt new technology (8)	○	○	○	○	○
I play video games online with others (9)	○	○	○	○	○
I would rather be late than to forget my smartphone (10)	○	○	○	○	○
I believe mobile learning is beneficial (11)	○	○	○	○	○
If someone texts me I will answer them within minutes (12)	○	○	○	○	○

10. Choose the number of courses you have taken in each of the following delivery format types:

	0 Courses (0)	1-10 Courses (1)	11-20 Courses (2)	21-40 Courses (3)	41 or more Courses (4)
Face-to-face classroom course with supplemental materials provided in a website such as Moodle (1)	○	○	○	○	○
Face-to-face classroom course (no online features) (2)	○	○	○	○	○
Blended course with some scheduled face-to-face/live meetings and some self-directed online activities (3)	○	○	○	○	○
Fully online live course using a system like Zoom or GoToMeeting, with required set meeting times. (synchronous) (4)	○	○	○	○	○
Fully online course using a system like Moodle or Blackboard, no required set meeting times. (asynchronous) (5)	○	○	○	○	○
Interactive video live (Face-to-face) course (Video or live, set meeting times) (6)	○	○	○	○	○

11. Based on your preferred learning methods, which course delivery format is your favorite?

	Not acceptable (1)	Less preferred (2)	Neutral (3)	Acceptable (4)	Favorite (5)
Face-to-face classroom course with supplemental materials provided in a website such as Moodle (1)	○	○	○	○	○
Face-to-face classroom course (no online features) (2)	○	○	○	○	○
Blended course with some scheduled face-to-face/live meetings and some self-directed online activities (3)	○	○	○	○	○
Fully online live course using a system like Zoom or GoToMeeting, with required set meeting times (synchronous) (4)	○	○	○	○	○
Fully online course using a system like Moodle or Blackboard, no required set meeting times (asynchronous) (5)	○	○	○	○	○
Interactive video live course (video or live, set meeting times) (6)	○	○	○	○	○

12. Rate the items that mean the most to you when choosing a course format?

	Not important (1)	Least Important (2)	Neutral (3)	Important (4)	Most important (5)	N/A (0)
Schedule (1)	○	○	○	○	○	○
Location (2)	○	○	○	○	○	○
Uses lots of technology (3)	○	○	○	○	○	○
Uses little technology (4)	○	○	○	○	○	○
Appropriate delivery method (online or lecture) for the course topic (5)	○	○	○	○	○	○
Live classroom (6)	○	○	○	○	○	○
Fully online (7)	○	○	○	○	○	○
Choice of instructor (8)	○	○	○	○	○	○
Number of required textbooks (9)	○	○	○	○	○	○
Recommended by another student (10)	○	○	○	○	○	○
Recommended by adviser (11)	○	○	○	○	○	○
Other, explain: (12)	○	○	○	○	○	○

13. If you have completed a fully online or blended learning course using a system like Moodle or Blackboard, rate the course features and their usefulness towards your learning:

	No experience (1)	Least useful (2)	Neutral (3)	Useful (4)	Most useful (5)
Accessibility of course assignments (1)	○	○	○	○	○
Grading rubrics (2)	○	○	○	○	○
Syllabus (3)	○	○	○	○	○
Assignment examples (4)	○	○	○	○	○
Discussion boards or forums (5)	○	○	○	○	○
Assignment drop boxes (6)	○	○	○	○	○
Linked reading materials (7)	○	○	○	○	○
Wiki's (you contribute) (8)	○	○	○	○	○
Blogs (9)	○	○	○	○	○
Collaborative group assignments (10)	○	○	○	○	○
Chat rooms (11)	○	○	○	○	○
Live class meetings (12)	○	○	○	○	○
Podcasts (13)	○	○	○	○	○
Instructor created materials (14)	○	○	○	○	○
Written assignments (15)	○	○	○	○	○

Section 4 – Demographics

14 **Choose the best answer to the following statements regarding your skill level with hardware:**

	No/Don't know (1)	Yes (2)
I have created and set up my own Wi-Fi network, including installation of the router (1)	○	○
I have successfully managed my own computer security, such as secure passwords, virus and firewall controls, privacy settings, and secure browsing settings (2)	○	○
I have successfully installed components into my CPU such as additional RAM or additional USB or disk devices (3)	○	○
I have successfully installed and managed more than one IoT device using my Smartphone (4)	○	○
I have made changes to or created code to make function or visual changes to a web page (9)	○	○
I have successfully paired bluetooth devices to my smartphone (5)	○	○
I have successfully set up a new computer without help, including uploading new software and adding peripherals (6)	○	○
I have used a variety of operating systems including more than two of the following: Windows, Linux, Chrome, MacOS, iOS, Android, etc. (7)	○	○
I have used and managed an MP3 or MP4 device, including creating playlists and cloud storage (8)	○	○
I have installed and operated an entertainment system including equipment such as a DVD player, satellite receiver, video streaming system, audio service, etc. (10)	○	○

15. Choose the best answer to the following statements regarding your skill levels with software:

	No/Don't know (1)	Yes (2)
I have successfully used collaborative programs such as ZOOM, Skype, Google Docs, or GoToMeeting (1)	○	○
I have completed a fully online course using a learning system such as Moodle (2)	○	○
I have successfully posted my course assignments using a drop box feature (3)	○	○
I have posted an attachment on a discussion board or forum (4)	○	○
I have used Word to create a formatted document (9)	○	○
I have successfully used document management programs such as OneNote, Qiqqa, and Mendeley to manage articles (5)	○	○
I have created a multi-media (narrated and transcribed, with sound or embedded video) presentation using Prezi, Jing, PowerPoint, etc. (6)	○	○
I have used programs like R, SPSS, AutoCAD, etc. (7)	○	○
I have used Excel to create a spreadsheet that uses formulas or calculations (8)	○	○
I have created an APA or MLA type of formatted document including table of contents, references and citations. (10)	○	○

16. Choose the best answer to the following statements regarding your digital device skill levels:

	No/Don't know (1)	Yes (2)
I have played online games with others (such as League of Legends or Minecraft) (1)	○	○
I have created and edited video clips to use in multimedia presentations (5)	○	○
I have set up my smartphone to receive and send email (6)	○	○
I have successfully converted documents across platforms and software types such as .pages to .docx, .docx to .pdf. .wpd to .doc, etc. (9)	○	○
I have successfully used networked/collaborative tools with others and multiple devices, such as Quickbooks, Applepay, Googledocs, Carbonite, GoogleCalendar (10)	○	○
I have created and managed my own social media (Facebook, LinkedIn, etc.) page including using the privacy and security settings (2)	○	○
I have uploaded and use a variety of smartphone apps (3)	○	○
I have located and used more than 5 scholarly journal articles using a repository or online university library site (4)	○	○
I have successfully used a cloud storage system like Dropbox or GoogleDocs (7)	○	○
I have shopped and paid bills online (8)	○	○

17. **Currently what year in college are you?**

- ○ Freshman (1st year) (1)
- ○ Sophomore (2nd year) (2)
- ○ Junior (3rd year) (3)
- ○ Senior (4th and 5th year) (4)
- ○ Graduate school - Masters (5)
- ○ Graduate School - Doctorate (6)

18. **Choose which generation college student you represent?**

- ○ I am the first generation to go to college (1)
- ○ One or both parents graduated from college (2)
- ○ One or both grandparents AND parents graduated from college (3)
- ○ One of both grandparents graduated from college (4)

19. **What is your sex?**

- ○ Female (1)
- ○ Male (2)

20. **What is your race?**

- White (1)
- Hispanic (8)
- Black or African American (2)
- American Indian or Alaska Native (3)
- Asian (4)
- Native Hawaiian or Pacific Islander (5)
- Other (6)
- Prefer not to answer (7)

.

21 In what year were you born?

- 2000-2005 (0)
- 1994-1999 (1)
- 1983-1993 (2)
- 1960-1982 (3)
- 1940-1959 or earlier (4)

22. Describe your home residence prior to enrollment:

- ○ Near ISU: Twin Falls, Pocatello, Idaho Falls or within a 2-hour drive (1)
- ○ Outside the ISU area (more than a 2-hour drive) and within the Intermountain area: central, western or northern Idaho, Wyoming, Montana, Utah, Nevada. (2)
- ○ Other U.S. State outside Intermountain Area - Specify: (3) _____
- ○ Other Country - Specify: (4) _____

23. Choose the best answer to describe your home residence prior to enrollment:

- ○ Rural - Less than 2500 people in the immediate area (1)
- ○ Urban - Between 2500 to 50,000 population (2)
- ○ City - Between 50,000 and 100,000 population (3)
- ○ Large City - Population over 100,000 (4)

24. Choose the best answer:

- ○ I live on campus (1)
- ○ I live off campus and commute by driving (2)
- ○ I live off campus and commute to a satellite campus or nearby video-feed classroom (3)
- ○ I live off campus and use fully online courses (no live meetings) (4)
- ○ I live off campus and use webinar for live courses (5)
- ○ Other (6)

25. From your preferred study location, please describe your connectivity and broadband speed:

Time of day most used (1)	☐ Morning (1)	☐ Afternoon (2)	☐ Evening (3)	☐ 12am-6am (4)	☐ N/A (5)
HOME connection type (2)	☐ Fiber Optic (1)	☐ Wireless Satellite (2)	☐ Cable or DSL (3)	☐ 3G/4G data plan (4)	☐ N/A (5)
CAMPUS connection type (3)	☐ Campus Wi-Fi-your devices (1)	☐ Ethernet (2)	☐ Computer Lab-ISU computer (3)	☐ 3G/4G data plan (4)	☐ N/A (5)
Satisfaction with connection speed (4)	☐ Very fast (1)	☐ Fast enough (2)	☐ Could be better (3)	☐ Sow or limiting (4)	☐ N/A (5)
Location (5)	☐ Rural (1)	☐ City (2)	☐ Dorm (3)	☐ Other (4)	☐ N/A (5)

(End of survey)

APPENDIX C
Survey Announcement, Invitation and Follow-Up

1.) Email Announcement of the upcoming study (emailed 10/26/17):

Hello,

My name is Lennia Machen and I am a doctoral candidate at Idaho State University. As part of my doctoral studies, I am conducting research investigating preferences for, and the use of, technology in education.

In a few days you will receive an invitation and live link to the online study. If you are 18 or older and enrolled for the 2017 Fall semester then you can help me collect data for this study in two ways:

- **Complete the survey** that takes only 10-15 minutes by clicking or copying the link in the invitation.
- **Spread the word** to friends who are also enrolled and encourage them to take the survey also.

The online survey is completely anonymous. You will not be asked to provide any identifiers such as name, contact information, etc. inside the survey itself. Simply give your honest replies to the questions asked.

As a thank you for completing the survey, **you will be eligible to enter a drawing to win one of twenty-five $20 gift cards.** At the end of the survey you will be offered a link to take you to a separate collector to make this drawing possible. Only your name and email address will be needed to enter the drawing and this information will not be used in any other way.

Thank you very much for your time and support!

Lennia Machen
Doctoral Candidate
Department of Education, Instructional Design
Idaho State University
Adviser: Dr. Karen Wilson Scott, Department of Education

2.) Email invitation and link for the survey (emailed 10/30/17):

Hello,

As per an earlier message, I am seeking your help in collecting data for my doctoral research study and hoping you will share your views concerning your preferences for, and the use of, technology in education.

If you are 18 or older and enrolled for the 2017 Fall semester then you can help me collect data for this study in two ways:

- **Complete the survey** that takes only 10-15 minutes by clicking or copying the link below.
- **Spread the word** to friends who are also enrolled and encourage them to take the survey also.

The online survey is completely anonymous. You will not be asked to provide any identifiers such as name, contact information, etc. The only identification needed is to honestly answer the questions of current enrollment and age.

As a thank you for completing the survey, **you will be eligible to enter a drawing to win one of twenty-five $20 gift cards.** At the end of the survey you will be offered a link to take you to a separate collector to make this drawing possible. Only your name and email address will be needed to enter the drawing and this information will not be used in any other way.

Thank you very much for your time and support!

Lennia Machen
Doctoral Candidate
Department of Education, Instructional Design
Idaho State University
Adviser: Dr. Karen Wilson Scott, Department of Education

THE SURVEY LINK: _____

3.) Email follow-up and reminder for the survey (emailed 11/13/17):

Hello,

If you have already participated in the survey as per an earlier message, thank you for your help and good luck in the drawing!

If you have *not* yet participated, I am reminding you today that there is still time to take the survey and enter the drawing.

INFO ABOUT THE PROJECT:

I am seeking your help in collecting data for my doctoral research study and hoping you will share your views concerning your preferences for, and the use of, technology in education. If you are 18 or older and enrolled for the 2017 Fall semester then you can help me collect data for this study in two ways:

- **Complete the survey** that takes only 10-15 minutes by clicking or copying the link below.
- **Spread the word** to friends who are also enrolled and encourage them to take the survey also.

The online survey is completely anonymous. You will not be asked to provide any identifiers such as name, contact information, etc. The only identification needed is to honestly answer the questions of current enrollment and age.

As a thank you for completing the survey, **you will be eligible to enter a drawing to win one of twenty-five $20 gift cards.** At the end of the survey you will be offered a link to take you to a separate collector to make this drawing possible. Only your name and email address will be needed to enter the drawing and this information will not be used in any other way.

Thank you very much for your time and support!

Lennia Machen
Doctoral Candidate
Department of Education, Instructional Design
Idaho State University
Adviser: Dr. Karen Wilson Scott, Department of Education

THE SURVEY LINK: _____

APPENDIX D:
The Survey Instrument: Alignment with Research Questions and Sources

Survey Question	References	Descriptions	RQ#
1. Which devices do you choose to use on a regular basis for personal/social applications and how frequently?	This question is inspired from Kennedy et al., (2008), and from Margaryan et al., (2011). Both studies used lists of devices so students could choose those which they use or prefer. For this study in 2017, some devices were recognized as no longer used, thus newer devices were substituted. Example: Palm Pilots replaced with Smartwatch. Kennedy, G., is currently Pro Vice-Chancellor (Education Innovation), Melbourne Centre for the Study of Higher Education, University of Melbourne, 159 cited the 2008 study, with 5 other articles on this data and topic, plus 5 conferences on this topic, the report was published in the Australasian Journal of Educational Technology 2008 and by the Australian DOE. Dr. Kennedy granted permission to use the study in 2016.	Independent variable, or dependent if considerations are given to ownership or broadband connectivity and speed.	1a
2. Choose which device you prefer to use for each of the listed personal/social uses:	The items listed in the drop downs are repeated from questions 1 and 2. This question was inspired by the Kennedy et al., (2008) study. In addition, Pew (2015), used the similar categories in their survey to find usage for smartphones.	Independent or dependent variable - depending on needs; ex. job tasks.	2a
3. Select the frequency per week each device is used for personal/social use:	This question was inspired by the Kennedy et al., (2008) study as well as the Margaryan et al., (2011) study, they used a question which asked for time/frequency of device use and also made note of the age of the participant for comparrison.	Independent or dependent variable - depending on experience and preferences as well as needs to use for work, education, etc.	6

4. Rank the personal/social skills or tasks you do most:	Kennedy et al., (2008) asked participants to rate the tasks by frequency. In the Margaryan study (2011), they asked for time/frequency of device use.	Descriptive. Independent or dependent variable - depending on experience and preferences.	3a
5. Which digital devices do you choose to use on a regular basis for formal education applications?	The question is found in Kennedy, (2008), where participants were given a longer list of devices and not to separate between personal/social or education uses.	Independent variable, or dependent if considerations are given to ownership or broadband connectivity and speed.	1b
6. Choose which device you prefer to use for each of the listed formal education uses:	The question is found in Kennedy, (2008), where participants were given a list of devices along with tasks and asked to report the frequency	Independent or dependent variable - depending on needs; ex. job tasks.	2b
7. For formal education use only, how many hours per week do you use each device?	Kennedy et at., (2008) asked participants to identify usage by offering a Likert matrix from between “several times a day” to “once or twice a year” to report frequency.	Independent or dependent variable - depending on experience and preferences as well as connectivity	3b

8. Rank the formal education skills or tasks you do most:	The list is found in the Kennedy, (2008), and similar questions are found in Margaryan et al. (2011)	Independent or dependent variable - depending on needs; ex. job tasks.	3b
9. How do you react to using technology in general? Choose the best answer:	This question was inspired by the Kennedy et al., (2008) study as well as the Margaryan et al. (2010) study where participants were sorted out by age and compared to their technology use. Russo, (2012) also used similar statements to identify preferences for technology	Descriptive. Independent or dependent variable - depending on experience and preferences.	7
10. Choose the number of courses you have taken in each of the following delivery format types:	The list of possible course types came from the ITRC (R. Faulkner, Manager) The question was inspired by the Kennedy et al., (2008) study where they asked for participants to report their course type experience	Descriptive. Independent or dependent variable - depending on experience, schedule and preferences.	4
11. Based on your preferred learning methods, which course delivery format is your favorite?	Kennedy et al., (2008), asked participants to rate how useful each technology is or would be to them in their learning. Therefore, this question was inspired by that question.	Independent if choice is not due to other factors. Dependent if schedule and preferences are key	4

12. What are the features that mean the most to you when choosing a course format?	Most of these items come from Cole et al., (2014), and the inspiration came from Kennedy et al., (2008) in asking about choices in the use of technology in courses.	Independent or dependent due to factors like cost, preferences, schedule	4
13. If you have completed a fully online or blended learning course using a system like Moodle or Blackboard, rate the course features and their usefulness towards your learning:	This question uses the most commonly used LMS features as per the ITRC. By comparing the Moodle features list to the Blackboard list, the common features were noted to create this list. In the Kennedy et al., (2008) study participants were asked to report the usefulness of technologies and tools commonly used in course design.	Descriptive. Independent or dependent variable - depending on experience, schedule and preferences.	5
Demographics			
14 Choose the best answer to the following statements regarding your skill level with hardware:	Created from the Deakin University (2016) list, the University of Tenn. (n.d.), and the Petronzio (2013) article.	Descriptive. Independent or dependent variable - depending on experience and preferences.	Demographic profile
14 Choose the best answer to the following statements regarding your skill level with software:	Created from the Deakin University (2016) list, the University of Tenn. (n.d.), and the Petronzio (2013) article.	Descriptive. Independent or dependent variable - depending on experience and preferences.	Demo-graphic profile

14 Choose the best answer to the following statements regarding your skill level with digital device skill levels:	Created from the Deakin University (2016) list, the University of Tenn. (n.d.), and the Petronzio (2013) article.	Descriptive. Independent or dependent variable - depending on experience and preferences.	Demo-graphic profile
17. Currently what year in college are you?	The intention to ask for this information came from the Kennedy et al., (2008) study and the wording came from suggestions in the Survey Monkey site as to the correct way to ask about school year	Independent	Demo-graphic profile
18. Choose which generation college student you represent:	Hargittai, et al., (2010) discussed the educational legacy for students today and asked them if they were the first generation to earn a degree as this may influence technology use and device availability	Independent	Demo-graphic profile
19. What is your sex?	As directed: this wording is copied from the US Census 2017 Community Census Questionnaire	Independent	Demo-graphic profile
20. What is your race?	As directed: this wording is copied from the US Census 2017 Community Census Questionnaire	Independent	Demo-graphic profile

21. What year were you born?	The years were grouped as per Howe and Strauss (2007) and their definition of generations	Independent	Demo-graphic profile, RQ 6 and 7
22. and 23. Describe your home residence prior to enrollment at ISU? Dropdown List includes: RURAL - populations less than 50,000; CITY - populations 50,000 to 100,000; LARGE CITY - population over 100,000	The US Census defines "Rural" as less than 2500 people, "Urban" as 2500 to 50,000. After that, there are no clear definitions. They have no new writings on this and most is from around 1950. The definitions for "City" and "Large City" came from U.S. Geological.gov as a way to define city size on maps. Additionally, Faulkner 2015 discusses the issues associated with rural broadband use and this question was added after talking with Ryan about the importance in understanding possible hinderances to broadband use in rural communities which may affect technology-based course delivery methods.	Independent	Demo-graphic profile
24. What is your current residence in relation to the campus?	Reference: Horrigan (2017) PEW questionnaire asked location from where they took their courses. These items are based on those in the PEW study, but are customized to fit options offered at this university	Independent or dependent variable - depending on experience and preferences, device availability and broadband connectivity	Demo-graphic profile
25. From your preferred study location, please describe your connectivity and broadband speed:	In the PEW reports participants are asked about access to the internet and data plans for their connections. Also influenced by Faulkner, (2015).	Independent	Demo-graphic profile