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Digital course materials: a case study of the Apple iPad in the academic environment

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DIGITAL COURSE MATERIALS: A CASE STUDY OF THE APPLE IPAD IN THE ACADEMIC ENVIRONMENT

A dissertation submitted in partial satisfaction

of the requirements for the degree of

Doctor of Education in Educational Technology

by

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This dissertation, written by

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DEDICATION

We dedicate this research to our children: Brittney, Brock, Aviva and whoever else might come along. May you grow up in a world where we learn to best use the technology we are developing!

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We would like to thank Dr. Ray Gen for chairing our dissertation committee. He was patient when we needed him to be patient and responsive when we needed him to be responsive. We could not have done this without him.

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Finally, we would like to acknowledge that through the ups and the downs of this process, it has only made us appreciate each other more.

VITA

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Conference Presentations:

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Department Chair of Digital Imaging and Design Technologies 2000 - 2004
Texas State Technical College West Texas, Abilene, TX
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Springboard Communications, Inc. (Distance Education & Professional Development Specialist), Abilene, TX
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- Introduction to Multimedia (animation, image, video and audio editing for multimedia presentation development)
- Multimedia Courseware Development I (interactive course modules content and assessment creation)
- Photo Digital Imaging I (basic digital image creation and manipulation)
- Photo Digital Imaging II (advanced digital imaging techniques)
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Human Resources Officer in the United States Navy

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Responsible for administrative and manpower functions for 200 military and 500 civilian staff and faculty in a regionally accredited college supporting the Chief of Naval Operations' education, research, analysis, and gaming initiatives. Manpower expert responsible for organizational structure, billet management, all internal and external datacalls regarding manning downsizing and rolldowns, budget reconciliation, and regional and joint accreditation. As the Command Managed Equal Opportunity Officer, conducted command climate surveys to assess and improve working environment.

Student 2008 - 2009
Air Command and Staff College, Air University, Montgomery, AL

Training Officer 2006 - 2008
USS John C. Stennis
Responsible for the education and training of 3,300 Sailors. Pro-actively led the Training Department in delivering general military training for the entire crew, the shipboard indoctrination course with 800 annual student throughput, officer training, culture awareness training, shipyard safety training, as well as departmentally specific training for operations and maintenance in all areas of an aircraft carrier's operations. Innovative training coordinator who conducted onboard self-assessments of crew readiness with internal audit teams. Expertly executed a $1.5M travel budget for all travel, and brought over one hundred mobile training teams to the crew saving over $350K. Led the Educational Services Office that managed all aspects of semi-annual advancement exams for 1,200 Sailors, Navy College Program for Afloat College Education, CLEP and DANTES testing, college fairs, and tuition assistance. Successfully executed $1.0M refurbishment of onboard college classrooms and training complex that included sound protection and upgraded classroom technology. Personally responsible for leading the

USS John C. Stennis to be the #1 aircraft carrier in advancements, college enrollments and training readiness.

Administrative and Finance Mentor 2006 - 2006
Embedded Training Team with Afghanistan National Army, Kandahar Afghanistan
Responsible for advising and consulting on administrative guidance, policy making, personnel management and payroll functions of Afghanistan National Army for International Security Assistance Force (ISAF) Regional Command South headquartered in Kandahar. Also held duties as mentor to the Religious and Culture Officer.

Administrative Services Department Head 2003 - 2006
Naval Air Station Fallon, Fallon, NV
Responsible for administrative services office and manpower functions for 350 Sailors. As executive assistant to base commanding officer, superbly coordinated multiple diverse projects and tasks simultaneously. Diplomatically liaised with numerous state and DoD agencies and personnel to coordinate Congressional Joint Military Affairs Conferences. Protocol expert coordinating congressional visits. Conscientiously developed and executed organizational Capabilities Based Budget.

Course Manager and Instructor 2000 - 2003
Amphibious Warfare Indoctrination Course
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Proficiently provided course schedules, coordinated 25 instructors, managed administration needs of students and instructors, and evaluated student comprehension. Facilitated group exercises and role-playing in the staff planning process.

Teaching Experience:
Adjunct Professor 2004
Human Resource Management
Embry-Riddle Aeronautical University, NAS Fallon

Course Manager and Instructor 2000 - 2003
Amphibious Warfare Indoctrination Course and Expeditionary Warfare Staff Planning
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- Expeditionary Warfare Staff Planning role-play practical exercises

Certifications:
Senior Professional of Human Resources 2003
Society of Human Resource Management

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Conference Presentations:
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Papers:
An Evaluation of Navy Voluntary Education 2009
Thesis at Air Command and Staff College, Air University

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- Aircraft Carrier Inport Command Duty Officer 2006

Military Personal and Unit Citations:
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- Navy and Marine Corps Achievement Medal (x2)
- Navy Unit Commendation
- Navy Meritorious Unit Commendation (x2)
- Battle Efficiency Ribbon
- National Defense Service Medal
- Armed Forces Expeditionary Medal
- Kosovo Campaign Medal
- Afghanistan Campaign Medal
- Global War on Terrorism Expeditionary Medal (x2)
- Global War on Terrorism Service Medal
- NATO Kosovo Medal
- Navy Expert Rifleman Medal
- Navy Expert Pistol Medal (Sharpshooter)

ABSTRACT

The newness of the iPad device creates a phenomenon unique and unstudied in the academic environment. By merging the innovations of electronic text, e-reader, and multi-modal functionality, the iPad tablet device can act as an e-reader providing digital course materials as well as a range of other supplementary academic applications. This qualitative research study was designed to explore the how the use of a multi-modal tablet device affects the academic environment. It is the writers' assumption that an increased understanding will aid in the appropriate use of a tablet device to enhance learning.

The pilot program in this study included three master's level courses at a regionally accredited college. Data was collected from students through a student survey and focus group interviews and from the faculty through individual interviews. The data collected was coded and organized according to the research questions. Analysis of the findings was organized by way of the study's conceptual framework: (a) usability, (b) disparity between faculty and student perceptions, (c) personal and academic use of a multi-modal device, (d) impact on learning, (e) substitution of printed course materials with digital course materials, and (f) diffusion of innovation.

Through this research, it was concluded that the majority of students in this study perceived electronic course materials on an iPad in iAnnotate to be as good as or better than printed course materials, the multi-modal functionality of the Apple iPad augmented personal study and classroom learning, and the personal use positively contributed to academic use of the device. Also, faculty observing students in this study found the iPad had negligible effect on student participation, comprehension, or academic writing. Finally, both students and faculty preferred and recommended digital course materials for students on a tablet device. Recommendations are offered for iPad program

administrators, faculty and course developers, course content developers, and for future research.

Over the centuries, major shifts in literary technology have circled around usability, durability and ease of reproduction. The successful merging of these factors could diffuse this e-reader innovation and create the next advance in literary technology.

Chapter 1: The Problem

Introduction

This study sought to gain a better understanding of the e-reader phenomenon in the academic environment. The purpose of this study was to explore what could be learned from pilot program participant perceptions in regard to substituting traditional printed course materials with electronic course materials presented via iAnnotate on an Apple iPad. The knowledge gained from this research provides increased understanding and informs future incorporation of an e-reader device in higher education. Participants in this study included seven faculty members and 35 students who were involved in the pilot program at the Naval War College.

Chapter 1 outlines the problem and provides an overall framework for the proposed research. This chapter first provides insight into background and context of the study. Next, the problem statement, purpose of the study, and research questions are outlined with a general description of the approach to the research. An explanation of the researchers' background, significance of the study, and the definitions of common terms used throughout the research will follow this. Upon completion of this chapter, the reader will have a full understanding of the problem and the means by which it will be addressed.

Background and Context

In 1881, General Order 325 created the Naval War College in Newport, RI. The mission of this prestigious academic institution has been to provide the United States with an academic evaluation of nautical war fighting through peacetime and wartime for the last 125 years (*U.S. Naval War Collge illustrated history and guide*, 2010). During the 20th century, the academics evolved from war-gaming to analyzing the complex interconnection between naval operations and strategy, tactics, policy, logistics, and

military leadership. In 1914, the War College grew into a full time, in-resident Master's Degree program. This program confers a Master of Arts degree in National Security and Strategic Studies and was accredited by the New England Association of Schools and Colleges in 1991.

The appeal of electronic readers (e-readers) in an academic environment attracted the attention of the Naval War College, as it did for most other colleges and universities. To determine the interest in e-reader devices, the Naval War College surveyed their full time and distant learning students in July, 2010. At the time, 33% of the respondents had used an e-reader (*NWC tech survey comprehensive report*, 2010). Students were also asked about their interest in using an issued e-reader/tablet in lieu of printed materials. Seventy-seven percent were in favor, 13% had no preference, and 10% were opposed. Based on this input, the Naval War College decided to pursue a pilot program with an e-reader/tablet device.

The Naval War College selected the Apple iPad tablet device for a pilot program in three different courses. Now, in lieu of print course materials, all course materials were provided digitally within the iAnnotate application on the Apple iPad. These course materials were static documents—strictly a digital substitution for the original print materials. Appendix A shows the iPad and various screenshots of iAnnotate functions. The course facilitators also received an iPad pre-loaded with their course materials. There was no intent to change the pedagogical approach to the course by providing the course materials in a new medium. The inclusion of the Apple iPad at the Naval War College had the intended purpose of being an e-reader device.

The introduction of the Apple iPad unites the potential of three different areas of innovation: electronic text, electronic readers (e-readers), and multi-modal devices. However, the newness of the iPad device creates a phenomenon unique and unstudied. Schools around the world are planning different pilot programs to incorporate the iPad

tablet with little to no understanding of the effect it will have on the academic environment. The following is a brief description of electronic text, e-readers, and multi-modal devices.

At first, electronic text was simply a digital version of existing print text. Then it evolved and began to incorporate complimentary features that the electronic version afforded that were not available in print text. Hyperlinks could ease navigation throughout the text and search capabilities sped up the process of looking for a specific feature. As e-books developed, they could be read on desktop computers, laptops, personal digital assistants (PDAs), Palm Pilots, smart phones, e-readers, netbooks, or tablets. Most e-book research was conducted on desktop computers, looked at usable features and compared print text to digital text. Usability research identified the desire for hyperlinks, searchability, and increased content integration (Chu, 2003; Dominick, 2005; Mercieca, 2004; Nielsen, 2009; Noorhidawati & Gibb, 2008; Vernon, 2006). However, this same usability research recognized problems such as navigation, annotation tools, differentiation of multiple sources, ergonomics of looking at a computer screen, need for flexibility in spatial layout, and distraction by other features on the computer (Bell, McCoy, & Peters, 2002; Mercieca, 2004; O'Hara & Sellen, 1997; Vernon, 2006). The lack of a well-designed portable electronic reader also held back the interest in e-book improvement.

E-book research also took a close look at readers' preferences for print versus digital text. Even with the growing popularity of e-books, there is an enduring preference for print books (p-books). This preference derives from the aforementioned recognized problems with electronic text. Navigation being a primary issue, Brown elaborates with the following description of how people read print text:

> One of the key questions that haunts traditional readers who grew up with print on paper is the navigation issue. I characterize it this way: voracious readers of print on paper enjoy the serendipitous freedom as omnipotent navigators. They

> dominate the text, eagle-like in their overview, scanning at will any portion or section, leafing through pages, setting down to read at any point significant to mind and eye, randomly coursing through footnotes and bibliographic citations. They spatially map the text as they browse, flipping through pages and initiating concentrated reading at will from end to beginning or beginning to end. They recall the location of headings, photographs or significant text—upper right hand page, left side middle of the page, two-thirds through the width of the book at the bottom of the page—and they move back and forth with ease of recall through navigation channels that the technology of print books have seemingly embedded topographically in their brain. With the e-book or e-text on a screen, all these navigational aids are gone. (Brown, 2001, p. 393)

The design of print materials has been mastered after hundreds of years of development. This design includes typography and spatial layout intended to give the reader a chance to imprint on their memory the tangible features of a print text. Research shows that the majority of readers still prefer print over electronic text (Bell et al., 2002; Chu, 2003; Dominick, 2005; Mercieca, 2004; Noorhidawati & Gibb, 2008; O'Hara & Sellen, 1997; Vernon, 2006). Based on research up to this point, e-books have not provided a reading experience as productive or pleasurable as p-books.

The success of e-books is highly dependent on innovative e-reader technology. Similar to the research on e-books read on a computer screen, the e-reader research in the academic environment focused primarily on the usability of e-reader features. These studies identified the following desirable features of e-readers and their software: hyperlinks, annotation, note-taking, dictionary, search/find, portability and ease of use (Abram, 2004; Agee, 2003; Bell et al., 2002; Schcolnik, 2001; Simon, 2001a). However, very little is known about how the devices are used and their effect on the learning environment. The existing research was also conducted on dedicated e-readers and not multi-modal portable devices. The researchers were curious about whether additional features like email, web browsing, audio and video access, and supplementary applications change how students use the device in an academic environment. This study seeks to gain a better understanding of the use of Apple iPads in an academic environment.

Problem Statement

While it is important to find academic uses of e-reader technology, very little is understood about the substitution of printed course materials with digital course materials. Most modern pilot programs with e-reader devices have provided anecdotal feedback instead of rigorous academic research about what influence this will have on education. The iPad creates a new phenomenon within the academic environment by merging the innovations of electronic text, e-reader, and multi-modal functionality. The adoption of the iPad device has not been researched at all in an academic environment.

Although completely untested, schools and universities around the United States are greatly investing in the iPad tablet device in a variety of ways. Some schools provide a device as an incentive for registering to attend their institution. Other institutions are piloting programs where their libraries offer the device through a library lending system. Meanwhile, several schools are beginning to directly integrate the iPad with pilot programs in the curriculum. The spectrum of educational use ranges from using the iPad as an e-reader to full incorporation into curriculum, research, application development, and university support functions. Use of the iPad as an e-reader could be informed by earlier research using the Kindle. However, the additional functions available through the iPad make it a new entity worthy of preliminary investigation. This study confronted the phenomenon of replacing print text with digital text on an Apple iPad without fully knowing the implications of the substitution.

Statement of Purpose and Research Questions

The purpose of this study was to explore what could be learned from pilot program participant perceptions in regard to substituting traditional printed course materials with electronic course materials presented via iAnnotate on an Apple iPad. A better understanding of the functionality of the iPad in an academic environment

improves future efforts in the substitution of print materials with digital materials. To shed light on the problem, the following research questions were addressed:

1. How do students perceive reading course materials on an iPad using iAnnotate?
2. How do students perceive the use of the Apple iPad as an academic tool outside of assigned course readings?
3. Do students perceive that the multi-modal functions of the Apple iPad increase personal use, thereby increasing their academic use of the device?
4. Do faculty perceive any effects within the course from the replacement of traditional printed course materials with digital course materials?
5. Do both faculty and students recommend and/or prefer digital course materials on a tablet device?

Research Design Overview

With the approval of Pepperdine University's Institutional Review Board, the researchers studied the perceptions of both students and faculty when substituting traditional printed course materials with digital course materials within the iAnnotate application on an Apple iPad. This qualitative case study used data collection strategies of surveys and focus group interviews with students and interviews with faculty members. The details of the methodological approach for this research are discussed thoroughly in Chapter 3.

Assumptions

The researchers used four assumptions in this study. First, students and faculty do not have a personal iPad and both the iPad and iAnnotate application were new to them. This assumption was based on the newness of the device and if they were issued an iPad, they would not purchase a personal device until after the course. Also, due to the fact that students and faculty do not have a personal iPad, they used the issued iPad

for both academic and personal use. Second, students in all three courses had similar experiences with the Apple iPad. The course subject matter would not change the interaction experienced with the device. The data collected from the surveys would be treated the same regardless of which course the student was taking. Third, all students used both the iPad and a computer to complete the course requirements. The students were not provided with a word processing program on the device and would require the use of a personal computer with this software to complete academic assignments. In this capacity, this study did assume that the iPad would be treated as an e-reader, replacing printed course materials. Finally, faculty members are familiar with the course materials and not reading them on the iPad device as did the students. The faculty input for this research is based on their observations of how student use of iPads changed the academic environment. These assumptions were used for the duration of this study.

Researchers' Background

The researchers in this study have a unique combination of skills and experiences. One is an educational technologist with faculty and administration experience, and the other is an active duty military officer with an educational and training subspecialty. Researcher 1 (R1) has an extensive background in educational technology, particularly in finding low cost technological solutions to a variety of distance learning scenarios. Researcher 2 (R2) is a Human Resources Officer in the United States Navy whose positions as a training instructor, course manager, and aircraft carrier training officer provide her background knowledge in the education and training of Sailors. Both researchers have experience teaching at the undergraduate level in their specialty areas: new media design and human resources, respectively. Based on R1's technical experience, his research interests focus on the overall use of a multi-modal portable device in an academic environment. R2's experience with adult learning in a

military environment lends her research interest to identifying the potential challenges of converting from print text to digital text and the new processes involved in creating academic products. Combined, these researchers have contributed a unique merger of higher education credentials essential in understanding both the educational and technological aspects of this study.

Significance of the Study

This study is significant because it contributes to the existing research about e-reader devices in the academic environment. Results of this study could potentially show a trend in the increased diffusion of e-reader technology among students. The findings inform colleges about how the devices are used and address potential pitfalls prior to incorporating such a device into a course. This research also informs e-reader developers on the problems encountered while using e-readers in an academic environment. In addition, this study's feedback enlightens faculty on future use of a multi-modal device and possible adaptations of pedagogy to fully integrate the device's numerous functions and enhance learning. Finally, this study could show a trend in increased acceptance of e-reader devices replacing print text in the academic environment.

Definitions of Key Terminology Used in This Study

For the purposes of this study, digital and electronic will be used interchangeably with respect to text and course materials. Also for the purposes of this study, text in the print medium will be referred to as print text, print on paper, print books, and p-books. The following key terms are also used throughout this study:

Compatibility. The degree to which an innovation is perceived to fit within an individual's or group's respective life or structure (Rogers, 2003).

Complexity. An innovation's perceived degree of usability or ease of understandability

(Rogers, 2003).

Content Integration. Internal hyperlinks (within a document) and external hyperlinks to separate documents within the same file structure of digital course materials.

Differentiation. The ability to distinguish between one document and another document. This term applies to both print and digital materials.

Electronic book (e-book). An electronic software representation of a printed book (Smith, 2008).

Electronic/digital course material: Course material in the format of digital text.

Electronic ink (e-ink). Black and white particles suspended in a clear fluid that respond to an electric charge on an electronic paper display.

Electronic reader (e-reader). "A dedicated, specialized device solely used for the purpose of reading an electronic book or textbook" (Smith, 2008, p. 12).

Electronic text/digital text. Text displayed on an electronic device.

Electronic textbook. "An electronic version of a textbook presented in software form" (Smith, 2008, p. 12).

Hyperlinks. Links to locations within the electronic document or to external materials such as journals, news publications, or web sites related to the text (Allison, 2003; Smith, 2008).

Multi-modal device. Any electronic device designed to perform multiple primary functions.

Navigation. The ability to move within a document or series of documents. This term applies to both print and digital materials.

Observability. The degree to which an innovation can be observed or communicated to others (Rogers, 2003).

Portability. The quality of having all materials on one device and easily transporting those materials from one location to another.

Portable Document Format (PDF). A document format developed by Adobe Systems intended for sharing documents with text and graphics using any computer on any operating system (Smith, 2008).

Print manipulability. The ease of shifting from reading print-based documents while simultaneously writing a separate text (Sellen & Harper, 2003).

Print spatial flexibility. The ability to surround oneself with several print based texts simultaneously and arrange multiple texts in close proximity around oneself (Sellen & Harper, 2003).

Print tailorability. The ease of jotting down notes, highlights, and annotations with print on paper (Sellen & Harper, 2003).

Print tangibility. The physical experience of holding a book—seeing the size, cover, color, layout, navigation, how far along one is, or turning over a corner (Sellen & Harper, 2003).

Relative Advantage. The degree of perceived advantage an innovation has over its predecessors (Rogers, 2003).

Searchability. The ability to find specific terms or locations within a document or group of documents.

Single-modal device/dedicated device. An electronic device designed to perform a single primary function.

Tablet. A wireless, portable personal computer with a touchscreen as a primary input device using a stylus or finger.

Trialability. The degree to which an innovation can be experimented with (Rogers, 2003).

Summary

This introduction discussed the problem of replacing print text with digital text on an Apple iPad without fully knowing the implications of the substitution. The Naval War

College has selected the Apple iPad to act as an e-reader and with this decision came the convergence of three little-studied innovations: electronic text, e-readers, and multi-modal functionality. To investigate this phenomenon, the researchers conducted a qualitative case study with the students and faculty of the pilot program. This research informs faculty, institutions, and e-reader developers on how to improve the device for future adaptation in the academic environment. The following chapter will outline the literature that provides the foundation for this study.

Chapter 2: Literature Review

Overview

The purpose of this study was to explore what can be learned from pilot program participant perceptions in regard to substituting traditional printed course materials with electronic course materials presented via iAnnotate on an Apple iPad. First, this review will cover a history of the major evolutionary steps in literary technology. Each step forward in this technology expanded the usability and ease of production of reading materials—making reading more and more accessible to the population. Next is a discussion about the diffusion of innovation theory that explains the acceptance that occurred at each step. This leads to the development of the e-reader and a comparison of print text with digital text. This study will outline several features of modern e-readers and how the e-reader can be used in an academic environment. With this knowledge, the next section will examine the most popular e-reader models and their potential in the academic environment. A few pilot projects with the Amazon Kindle provide key information for the way forward for the successful use of e-readers in a course and many of these concerns are addressed with the iPad and iAnnotate application. This chapter concludes with a summary explaining the variety of ways that the iPad is being incorporated into the academic environment at colleges and universities around the country.

History of Literary Technology

Throughout the history of human civilization, literary technology has developed and continued to change in form. Oral traditions, clay, cuneiform tablets, papyrus, silk, parchment, vellum, paper, scrolls, books, print-on-demand and e-books are all part of a continuous stream of human technological change. Over the centuries, major shifts in

literary technology have circled around usability, durability and ease of reproduction. These forms of technology helped shape the various civilizations that used them. This section briefly describes the evolution of reading materials and printing.

For well over a thousand years, written history was documented using scrolls. Made of papyrus, parchment or paper, scrolls were designed to be rolled from one spool to another. The shift from scrolls to book format slowly developed after the invention of codex. Codex is the term used to describe the modern form of a print book with separate pages bound together inside a protective cover. The codex form pre-dates early examples of woodcut printing. In first century Rome, these bound pages of papyrus or parchment were widely used for personal notebooks, while more formal writings remained on scrolls. These notebooks of parchment could be washed off and reused, and were of great value (Roberts & Skeat, 1983). In the Bible, Paul writes a request to Timothy in 2 Timothy 4:13 (New Living Translation): "…bring my books, and especially the parchments." The translated term "parchments" is the Greek term *membranae,* a word commonly used at the time to describe notebooks made of parchment. Over time, the codex gained acceptance due to its usability features compared to the scroll. These inherent features included its transportability (compactness and durable covers), economy of the page (could write on both sides, recto and verso), and user friendliness (opened flat at any page). The Roman poet Martial praised the new codex form in the first century and it soon became the preferred format among first and second century Christians. By the fourth century, the form was commonly adopted in Western culture, replacing the wide use of scrolls (Roberts & Skeat, 1983).

The earliest surviving examples of what has become modern printing date back to woodblock or woodcut printing. Woodcut printing (xylography) describes a process where the areas not to be printed are carved away leaving behind a relief of the image to be printed. This left the desired image on the wooden surface to be covered by ink and

pressed onto cloth or paper lying on a flat surface to produce a print. The earliest surviving examples of the woodcut printing method are from China and date back to the Han Dynasty. One such example is a three color woodcut print of flowers on silk that dates back to sometime before 220 AD (Farrer, Rawson, Vainker, Whitfield, & Trustees, 1990). The earliest example of woodblock printing on paper is a Buddhist Dharani sutra dated between 650 and 670 AD (Pan, 1997). This form of printing eventually led to the first printed book in the form of a scroll, the Diamond Sutra, printed in 858 AD. This text is a central text of Indian Buddhism and was discovered in 1900 in a monastery near Duhuang, in Chinese Central Asia. It is currently located in the British Library in London ("Turning the pages," 2010).

In the 15th century, Johannes Gutenberg produced the first printing press with both great ingenuity and adaptation of existing technologies. As discussed earlier, printing, specifically woodblock printing, had been in use for some time. Gutenberg mechanized the process with his greatest contribution coming in the process of typesetting. Being a goldsmith, Gutenberg created standardized type pieces that were produced through a special hand mold that he invented. With standardized type, Gutenberg was able to mass produce letters that could be arranged and rearranged through typesetting. The process expeditiously formed words and pages of text and changed the written word forever (Childress, 2007).

Throughout Europe, Gutenberg's printing press quickly changed the landscape of both reproduction of texts and society as a whole. The increased production and availability of literary works quickly inspired the literacy of lay people. By the start of the 16th century, the demand for books was high and nearly 2,500 European cities had presses ("The infancy of printing," 1999; Kreis, 2004; Prickman, 2009). However, there was some resistance to the printing press technology. The transition from scribed text to the printed page was not at as smooth as one might think. A historical commentary

noted: “Many aristocrats of the late fifteenth century hired scribes to hand-copy printed books to manuscript form, so that they might be kept in their original format” (“The infancy of printing,” 1999, para. 7). However, the printing press ultimately became the new standard for written text for centuries to come. Although there have been incremental improvements in printing technology, the next major shift in literary technology did not occur until the development of electronic text in the 20th century.

The concept of an electronic library was first proposed by Vannevar Bush in 1945. The following passage describes his proposed method of storing knowledge in his own words:

> Consider a future device for individual use, which is a sort of mechanized private file and library. It needs a name, and, to coin one at random, "memex" will do. A memex is a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. (Bush, 1945, section 6, para. 4)

Bush envisioned the theoretical foundation of a digital storage for books. This “memex” concept sparked an idea that later became reality with the advances of computer technology.

In 1971, the Project Gutenberg advanced the concept of making digital material more accessible to readers (Project Gutenberg, 2010). The project lead, Michael Hart, started converting public domain material into digital format and made it available for free. The goal of the Project Gutenberg was, and is, to increase literacy by providing as much access as possible to literary works. His basic premise stated: “anything that can be entered into a computer, can be reproduced indefinitely”(Hart, 1992, “The Beginning of the Gutenberg Philosophy,” para. 1). From its inception to the present-day, the Project Gutenberg volunteers continue to convert public domain texts into digital format. At a minimum, texts are entered in the American Standard Code for Information Interchange (ASCII)—the most basic form of code that can be read on almost any device. Today,

Project Gutenberg has over 33,000 free e-books available to download on all computers and all of the most popular e-reading devices.

Each major advancement in literary technologies broadened the population of readers and made the written word more efficiently organized and replicated. However, the act of reading has stayed mostly the same. Each development required adjustments, like learning to read the codex of two pages side-by-side or learning to read typeset words instead of handwritten words. However, eventually the innovation became the new standard. The next section will explain how ideas and technologies transition from initial concept to mainstream acceptance.

Diffusion of Innovation Theory

Diffusion of innovation theory explores the spread of new ideas through a society. Everett Rogers began applying the theory in the 1950s and has continued to grow and refine it over his lifetime. To Rogers, innovation can be anything from an idea to an actual object that is new, or perceived as new, to an individual or group. In this literature review, such innovations include codex, printing press, and electronic text. Diffusion of innovation is defined as: “the process by which an innovation is communicated through certain channels over time, among the members of a social system” (Rogers, 2003, p. 11).

Rogers’ (2003) theory outlines four primary elements and five ideal types of adopters. The four primary elements of innovation diffusion are: innovation, communication channels, time, and the social system. Rogers categorizes those within the social system into five ideal types of adopters. The adopter types include: innovators, early adopters, early majority, late majority, and laggards. In addition, there is a sixth type of adopter that is not included in the ideal adopter types. This sixth adopter type is

the non-adopter, those who simply choose not to adopt the innovation at any point in time.

Individuals within each of the adopter types, including the non-adopters, go through the innovation-decision process. Rogers defines this process as:

> The process through which individual (or other decision-making unit) passes from gaining initial knowledge of an innovation, to forming an attitude toward the innovation, to making a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision. (Rogers, 2003, p. 167)

Innovations are not equivalent units in terms of adoptability. Characteristics of innovations affect whether they are adopted and the rate of adoption. Key characteristics include relative advantage, compatibility, complexity, trialability, and observability. Relative advantage refers to the degree of perceived advantage an innovation has over its predecessors. Compatibility is the degree to which an innovation is perceived to fit within an individual's or group's respective life or structure. Complexity is the innovation's perceived degree of usability or ease of understandability. The degree to which an innovation can be experimented with is trialability. If a great investment is required to experiment with an innovation, then it is less likely to be adopted. Observability defines the degree to which an innovation can be observed or communicated to others. Simply put the greater the visibility, the greater the adoption (Rogers, 2003). Combined, these primary factors determine the ultimate diffusion of innovation.

Development of the E-reader and E-book Market

E-reader development has evolved over several phases. In 1968, Alan Kay conceived the first e-reader device. He conceptualized a "Dynabook" for reading books that theoretically looked similar to a modern electronic tablet for reading. However, the very first e-reader to successfully reach the market was the Sony DD-8 Data Discman in 1991 (Doman, 2001). It was not until 1999 that a variety of first generation "E-books"

competed against each other in the market. These models/prototypes consisted of the GemBook, Glassbook, Libruis Millenium Reader, Everybook Dedicated Reader, Softbook, XLibris, and Nuvomedia's Rocket eBook (Doman, 2001; Schilit, Price, Golovchinsky, Tanaka, & Marshall, 1999). These devices were immediately followed by the second generation of "E-books" by the fall of 2000. The new "E-books" included the Franklin eBookMan, Gemstar/REB RCA 1100 and 1200, Korea eBook hiebook, goReader, and the Microsoft Reader (Tablet PC; Doman, 2001). Around 2000, the digital content of e-books also became more available. If consumers wanted a digital text option, they could choose to read from some of the aforementioned dedicated e-readers on the market, read on their personal computer monitor, or read on the small screen of a Palm Pilot or Personal Digital Assistant (PDA; Agee, 2003; Hage, 2006). Even with all of these options, the e-reading market was still small, limited, and complex.

Initially, both the hardware e-reader and the software e-book were referred to collectively as an "E-book"—but the separation of these two entities entails an important distinction. E-reader manufacturers and e-book publishers are directly linked in the slow development of the market. At first, very few books were made available in digital format, so even if e-readers were developed, consumers had limited material available to read. If the electronic text was made available, there were limited ways to read it other than a personal computer and other aforementioned devices. Ultimately, the combined low demand for e-books and e-readers held back the development process and stalled the market.

The release of the Sony LIBRIé e-reader in 2004 revealed the newly developed e-ink technology by E-Ink Corp, Toppan Printing, Sony and Philips. Upon release, the LIBRIé was described as "the world's first high-resolution electronic ink-based display module designed specifically for reading-intensive applications" (E-Ink, 2004, para. 1). While this new device advanced e-reader technology, there was a major gap in e-reader

development between 2002 and 2007 that affected personal, professional and academic potential use of the device. However, the new e-ink technology eventually inspired the next generation of e-reading devices.

Amazon launched the initial Kindle model with e-ink technology in 2007. With the Kindle, Amazon executed a successful business strategy by coupling their massive existing book sales with a user-friendly, easy-to-read e-reader device. Also revolutionary, the Kindle could load books directly through a cellular signal without the need for a computer. The surge in sales for the Kindle parallels the explosive growth in the e-book market. While the e-reader sales figures are not available, Figure 1 shows the dramatic increase in the e-book market that mirrors the increasing trend of e-reader sales. Amazon's mass marketing finally made electronic reading a cost-reasonable option for many consumers.

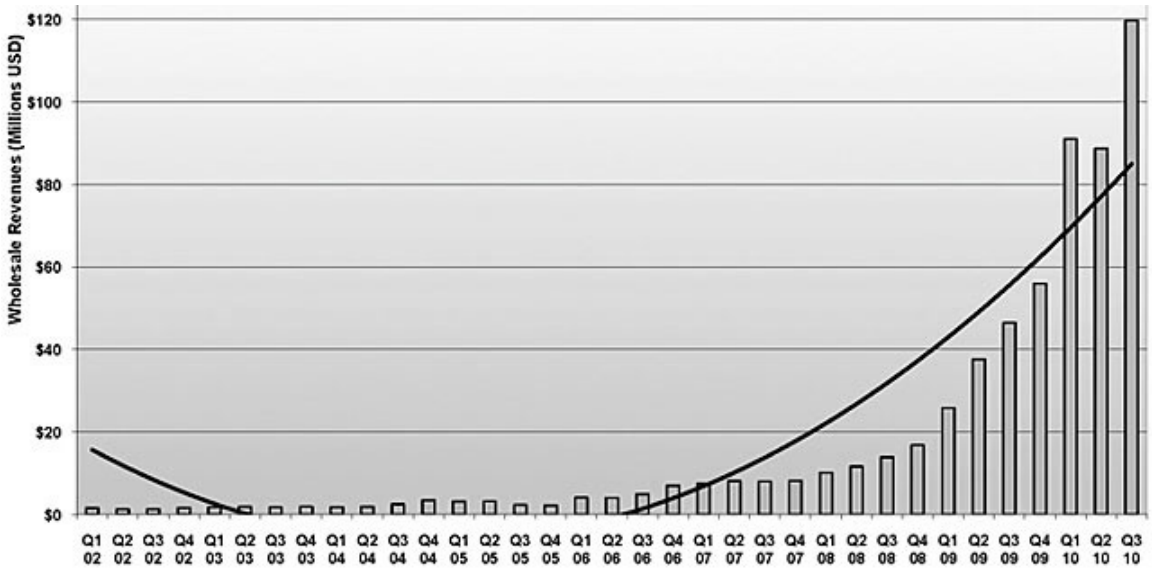

Figure 1. US Trade wholesale electronic book sales. 2010. From *US Trade Wholesale electronic book sales statistics, 2010.* Copyright 2010 by the International Digital Publishing Forum. Reprinted with the permission of the author.

The popularity of the Kindle attracted competitors in the market. Sony kept developing their Reader model series with e-ink technology and provided the most direct e-reader competition for the Amazon Kindle. Even with the high volume of Kindle sales, the Stanza reader application for the iPhone competed with the Kindle. In October 2008, the Stanza application actually surpassed sales of the Kindle e-reader (Greenberg & Abels, 2008). In October 2009, Barnes and Noble executed a similar strategy to Amazon and launched their own device, the Nook, which linked directly with their existing book-selling structure. In the meantime, Amazon continued to refine the Kindle with each update to the model. Prior to the launch of the Apple iPad, the Amazon Kindle carried over 65% of the dedicated e-reader market and Sony Reader covered most of the rest (Greenberg, 2010a).

The announcement of the iPad on January 27, 2010, ignited interest in a multi-modal tablet device that also served as an e-reader. As a tablet instead of a single-modal dedicated e-reader, the iPad does email, web browsing, maps with GPS, applications, and is fully compatible with software from iTunes and iTunesU. Similar to the Amazon business model, Apple concurrently launched their own online bookstore called iBooks. The Apple iPad went on sale in April 2010.

The iPad release had a dramatic impact on both the single-modal dedicated e-readers and on the launch of a new generation of tablet devices. Upon release, the high level of iPad sales caused the Amazon Kindle and Barnes and Noble Nook to engage in a price war. The price of both devices was lowered significantly in an attempt to compete against the multi-model iPad and each other. Sony's Readers have maintained their slightly higher price point and continue to offer a variety of models with a range of features. By November 2010, the Apple iPad had gained 32% of the e-reader market, the Amazon Kindle decreased from 68% to 47% of market share, while the Sony Reader held 5% and the Barnes and Noble Nook held 4% (Carton, 2010a). Additionally, since

the release of the iPad, the following tablet devices have also been released: Samsung Galaxy Tab, BlackBerry Playbook, HP TouchPad, Dell Streak, Sony Dash, LG G-Slate, and Motorola Xoom amongst others (Carton, 2010b; Mossberg, 2011). Similar to the iPad, these tablet devices bring multi-modal functionality to e-readers and the academic environment. Overall, the growing popularity of both e-readers and tablet devices will most likely perpetuate the investigation of their use in education.

Apple's iBooks online bookstore has had a similar impact on the e-book market. Although competitive for marketshare, the entry of Apple into the e-book market greatly increases the overall demand signal for publishers to make more of their content available digitally (Greenberg, 2010b). With the iPad sales starting in April, CEO Steve Jobs announced in June 2010 that 5 million e-books had already been downloaded through iBooks (Kolakowski, 2010). Although not a dedicated e-reader, this computed to about 2.5 books for each iPad already sold. To reiterate their own market share, Amazon announced on July 19, 2010, that for the previous month, of every 100 hardcover book purchased, Amazon had sold 180 Kindle e-books ("Amazon.com now selling", 2010). The earlier figure of e-book sales does not reflect the recent growth in either market during this timeframe.

The overall convergence of e-book availability and e-reader technology has laid the foundation for the societal shift from print text to digital text. Now that e-readers are cost-reasonable and more content is available, schools are investigating the use of these devices in the academic environment. However, there is a lingering question of whether students will accept the substitution of printed course materials with digital course materials. The following section discusses the comparison of print text and digital text.

Comparison of Print Text to Digital Text

Even with the growing popularity of e-books, there is an enduring preference for p-books. And when print course materials are replaced with electronic course materials, some students still feel the need to print some or all of the text. The research lists a variety of reasons for students needing/desiring to print portions of electronic text. These include having: “1) a paper copy for off-line/off-screen reading, 2) a paper copy that can be marked-up and annotated, 3) personal copy for future reference, and 4) paper copy that is portable” (Gibbons, Peters, & Bryan, 2003, p.11). This section takes a closer look at the evolving acceptance in the transition from print text to electronic text. Discussed below are the characteristics of print text, the design debate surrounding e-books, and the research of e-books in the academic environment.

Sellen and Harper (2003) list four basic affordances of print text: tangibility, spatial flexibility, tailorability, and manipulability. Tangibility refers to the physical experience of holding a book—seeing the size, cover, color, layout, navigation, how far along one is, or turning over a corner. Spatial flexibility describes the ability to surround oneself with several print based texts simultaneously and arrange multiple texts in close proximity around oneself. Sellen and Harper define tailorability as the ease of jotting down notes, highlights, and annotations with print on paper. Finally, manipulability addresses the ease of shifting from reading print-based documents while simultaneously writing a separate text. These functionalities of print provide a foundation of familiarity that all readers share in the comfortable use of print text—particularly in an academic environment. The transition to electronic text will need to address the ease of tangibility, spatial flexibility, tailorability, and manipulability that comes with print text.

The initial development of e-books sparked a debate about design—should e-books resemble p-books or should they have their own design characteristics? The

invention of hypertext associated with the growth of the World Wide Web opened the possibilities of e-books being more than linear text by incorporating internal and external hyperlinks. Usability expert Nielsen (1996) saw the potential for e-books to be developed as a new entity with the new medium in mind, but this was countered by the print book metaphor.

Catenazzi and Sommaruga outlined a digital text hyper-book model in 1993. To better explain the new concept, they utilized the print book metaphor that compared the new hyper-book to a simpler object with similar qualities. The purpose of using the metaphor is to increase public acceptance by decreasing the cognitive load of learning a new device (Landoni & Gibb, 2000). The hyper-book design kept the print book tools of orientation, navigation and personalization while adding benefits derived from hypertext like searching, hyperlinks and tracking history (Catenazzi & Sommaruga, 1993). Landoni and Gibb further explored the metaphor by looking at the details of how typography, legibility, and orientation cues could/should be translated into electronic format. They concluded that the e-book does not fit all kinds of text and should not be used if pages cannot be fixed or require scrolling, if there is only one page viewed at a time, if there is no longer a logical flow to the text, or if the table of contents or index is substituted with find/search functions. Basically, if it no longer resembles a p-book, it should not be called an e-book. Henke (1999, 2003) also analyzed the metaphor in multiple studies to see which features (print and electronic) users preferred in e-books. He found that while users liked print features such as the table of contents, they also highly rated the find/search feature. E-books today still have many classic p-book features.

On the other side of the debate are technology usability experts that argue that e-books should be designed with the new medium in mind. Neilsen (1996) argued that using the print book metaphor limited the potential for e-book development and relying on the metaphor would ultimately lead to poor design of e-books. Furthermore, e-books

could better integrate features like multiple windows, annotation tools, animation and sound if they were not dependent on the p-book metaphor (Shneiderman, 1998). The ongoing development of e-readers and e-books continue to refine adapted p-book features and are starting to integrate design features afforded by the new medium.

E-books read on computer screens have been researched more than e-reader devices. To date, little research addresses how pedagogy changes with e-books. In one study, students showed improved short-term retention when reading from print text compared to computer-displayed hypertext, but no difference was found between print and computer displayed linear text (Church, 2002). Otherwise, the majority of research explores the usable features of e-books and compares the preferences of print text to electronic text. For example, Allison's (2003) research found that e-textbooks had added value over print textbooks by adding internal and external hyperlinks. Chu's (2003) research reported the following user reasons for not using e-books: hard to read and browse, need for special equipment, and additional cost on the user's side. He also reported the following popular reasons for using e-books: around the clock availability and searchability. Also, most of the minimal research addresses the replacement of only one textbook—not multiple course materials. The aforementioned affordances of print text (tangibility, spatial flexibility, tailorability, and manipulability) apply more directly when there are multiple electronic course materials. Bell et al. (2002) researched multiple materials and reported another problem with e-books—they all look alike. There is no differentiation like size, cover art, or thickness that would be obvious to someone reading a p-book. The remainder of this section will cover the research comparing print and digital text.

O'Hara and Sellen (1997) conducted a study that compared print reading to reading on a computer screen. Research subjects were split into two groups; both read the same material and had to write a summary to show the use of multiple documents.

The two groups were examined regarding their use of annotation, movement within documents, and spatial layout. Both groups reported that the act of annotation and note-taking deepened their comprehension of the text. Those who read the print text stated that the annotation “provided a set of markings for later reference” and “as you underline something, you re-read the words, and this enforces it more” (p. 3). The respondents who read the electronic version reported that they did not electronically annotate nearly as much as they would if they had the print version. Some cut and pasted usable text into a note-taking document. With regard to movement within and between documents, the readers of the print characterized their movement with speed and automaticity due to the tangibility of the materials. They also noted the navigational benefit of “fixity of information with respect to the physical page” (p. 4). Those reading the digital text felt spatially constrained and unable to move with speed or flexibility between the documents. They also identified difficulties in assessing the length of the reading material or being spatially aware because they could not see an entire page at a time to get the same quality of “fixity of information”. Finally, O’Hara and Sellen tracked the spatial layout of using multiple documents. With the print readers/writers, the documents were physically organized with those referred to most/currently centered and on top. Those using only digital materials were most restricted by the limited view of the computer screen—practically allowing the use of only two documents at a time. For spatial layout, the print materials provided visualization of multiple documents with flexible and dynamic cross-referencing and supported the easy alternation between reading materials and writing materials. In conclusion, O’Hara and Sellen recommend improved digital annotation tools, improved navigation techniques, and improved support for flexibility in the spatial layout. These improvements in design would therefore improve the overall usability of digital text.

In 2004, Mercieca compared reading print text and digital text in a Master's level course. The digital materials were available on a personal computer through PDF, Microsoft e-book reader format, and online HTML format. Students perceived that the digital content did not add to the class; it was simply a new distribution medium. Compared to reading digital text on a computer screen, participants preferred the portability, ownership, and interaction with text (annotation and highlighting) as benefits of printed text. Of the PDF files, 100% were printed out and read from paper. Mercieca also identified two key criteria that would persuade students to switch from print text to digital text: cost and content integration. Students proposed that they would purchase digital text over print text if it were approximately one third the cost. Also, students preferred content integration—meaning the course materials were directly hyperlinked to digital text readings and additional resources that would add to the learning environment. Overall, this research showed a preference for print text and potential improvements for digital text.

Dominick (2005) researched undergraduate students use of an electronic textbook read on a computer in lieu of printed course materials. The data were collected and analyzed separately for each course. The majority of students found the software easy to use and the searching feature useful. However, even though the electronic text offered additional features and supplementary content, the students were still unsatisfied with reading electronic text. With each course analyzed separately, he found that a range of 47% to 84% of students preferred print textbooks to electronic textbooks.

In 2006, Vernon examined a college class that had its print textbook replaced by an online textbook to be read on the computer. For this study, although the course material was online, it was presented in layout and organization similar to print text. However, the digital format did provide additional supplementary information more readily. Each week, students were asked to document time spent reading, location

where reading took place, a description of associated activities, and feelings about the digital text. After five weeks, students stopped reporting that they were discovering anything new and data collection stopped at the eight-week mark. While the students did become more comfortable with online textbooks, by the end of the eighth week, 60.9% of the class had switched back to printing their texts for reading. With positive feedback at 18.3% and neutral feedback at 11%, the majority of students (70.7%) preferred paper text.

Vernon's (2006) research also provided student feedback on physical comfort and interface, time, study strategies and the study environment. Eleven percent of respondents reported eyestrain or headaches from reading on the computer screen. While some appreciated the online text and ability to read it whenever at a computer, others found it took longer to read, were distracted by email, or had to wait for computer access at a lab. Furthermore, while some appreciated the organized content, others did not like the inability to take notes or highlight, not knowing how much longer was left in a reading assignment, or their difficulty in focusing on concepts and reading information. Finally, students complained about the lack of flexibility when reading off a computer screen—not curling up with a textbook in a comfortable chair, or noisy library or computer labs providing distractions. With all of this input, the majority of negative feedback did not come as a result of the presentation media—it could be seen in the context of their lives (minimal time, fatigue, lack of computer access in general, lack of internet connectivity). Overall, students stated both pros and cons of the online textbook.

In 2008, Noorhidawati and Gibb researched how students prefer to use e-books. This study compared e-books with p-books in three categories: (a) fact finding (answering a specific question); (b) finding relevant content for a project, essay, or research; and (c) extended reading like a textbook or leisure book. Fifty-eight point five percent indicated the primary use was finding relevant content, while 16.2% used it for

fact finding and 20.8% used it for extended reading. Also, students were asked which book format they preferred for each task. Sixty-seven percent reported a preference of e-books for fact finding (17% preferred p-books and 17% had no preference). Fifty percent preferred e-books for finding relevant content (17% preferred p-books and 33% had no preference). Finally, 94% preferred p-books for extended reading—however 0% had actually used an e-book for extended reading. Ultimately, given the preferred use of e-books as searchable documents, Noorhidawati and Gibb recommend adding additional searchable features like a browsable book index, a browsable table of contents, and images of the book cover. The feedback on preferred use generated by their study is meant to inform future e-book design

Baker (2010) compared reading comprehension when students read on an e-reader (Amazon Kindle 2), on a small screen reader (iPod Touch), and print-based materials. In her experiment, she found that the medium did not matter when measuring reading comprehension of short passages on the different devices. She then compared this reading comprehension to the student's background and affinity to technology. She found that:

> the more uncomfortable a person is with technology and expertise in the requested task (in this case, reading), the more they cling to the belief that they will do better on traditional (paper) media – regardless of how well they actually do. This preference for "the devil you know" keeps people from being objective when evaluating their own performance and leads them to the erroneous conclusion that technology is more complex or difficult than it actually is. (p. 31)

Baker concludes that a student's increased comfort and familiarity with a device gave them confidence in their performance.

In July 2010, Nielsen (2010a) published the results of a study that compared the speed of reading on different devices. This research measured reading speed on a personal computer, printed book, Amazon Kindle, and the Apple iPad. The participants met all comprehension objectives, but read 6.2% slower than print on the iPad and

10.7% slower on the Kindle. Nielsen ultimately determined the results not statistically significant to conclude that reading is actually slower on an e-reader. However, a surprising finding indicated the participants found the reading of print more relaxing than reading electronic text.

In the end, print text continues to compete with digital text. The design of e-books continues to take maximum advantage of the p-book metaphor while integrating more and more non-p-book features. However, even with the additional features as well as the improved technology and design of e-books, the preference for print lingers. And yet, the research is starting to show an upward trend in acceptance and the beginning diffusion of e-books.

Deep Reading and Distraction

Reading has several different purposes. People can read for enjoyment, to self-inform, to keep up-to-date, to follow directions, or to fill out a form (O'Hara, 1996; Schilit et al., 1999). Students, however, read for other reasons: to learn, to prepare for discussion, to summarize, to solve or analyze a problem, to write and revise documents, and for research. To execute the various tasks of learning, students engage in deep reading. Deep reading goes beyond what is written; readers must to infer and think for themselves, as well as come to their own insights and conclusions (Wolf, 2010). This section will discuss deep reading and the potential for distraction.

Deep reading is a form of cognitive reading theory that requires the reader to "engage in an active construction of meaning, in which they grapple with the text and apply their earlier knowledge as they question, analyze, and probe" (Wolf & Barzillai, 2009, p. 34). Wolf and Barzillai liken the current transition from p-books to e-books and other forms of electronic media to ancient Greece's transition from an oral culture to a literary one. To Socrates, the threat came in the form of the written word. The rise of the

literary culture and its growing body of written works allowed the literate young to decode would-be knowledge without the life-long personal approach to the intellectual process of seeking, analyzing and internalizing it for their own. Thus, literacy would deprive them of what Socrates believed to be a true examined life of wisdom and virtue. This equates to the modern transition to e-books and the impact they may have on deep reading. Also, according to Wolf and Barzillai, the codex of the p-book itself plays a role in deep reading through its linearity and singularity of purpose. This aids in acquiring the readers full attention to participate in deep reading. However, deep reading can be disrupted by any number of distractions.

There are a variety of ways to interrupt the reading process and minimize deep reading. Similar to reading print text, external distractions from outside sources can disrupt reading. Examples of this include interruptions from people or noise in the environment. Even when reading print text, there is the paradoxical interruption that could come from technology—like looking up at a computer while reading print. Any interruption can cause the reader to switch tasks. Modern research shows that people switch simple tasks every three minutes and switch projects every ten and a half minutes (González & Mark, 2004). Switching tasks during print or electronic reading lowers the ability to immerse oneself in the text and engage in deep reading. However, reading from electronic text can offer a variety of distractions that could interrupt the reading process over and above the distractions that affect print reading.

Both internal and external features of the technology have to potential to distract the reader. Internally, hyperlinks embedded into the electronic text can interrupt the reader's concentration. Instead of print text that follows a linear line, the reader has to contemplate the purpose of the hyperlink and decide whether to pursue the hyperlink or continue reading. The act of making a decision in the middle of absorbing written content disrupts the ability to fully focus on the intent of the material. Mark (2009) commented on

the duality of hyperlinks; “a hyperlink brings you information faster, but is also more of a distraction” (para. 4). The hyperlink feature commonly requested by e-book readers enhances learning by defining words through a dictionary, linking to explain a reference, or navigating faster around the text. However, this convenience can come at the cost of suspending the reading process and the cognitive reflection that comes with learning through reading.

Externally, electronic text hosted on a multi-model device like a personal computer, smart phone, or tablet, competes with the other applications on the device. A reader can temporarily lose focus and immediately switch to another task available on the device. At times, external distractions from the other functions on the device can pop up in front of the reader—like an email notification or appointment reminder. Sometimes these pop-ups do not go away until the reader stops reading and performs a function to eliminate the interruption. Aamodt (2009) stated “frequent task switching costs time and interferes with the concentration needed to think deeply about what you read” (para. 3). Also, research shows when someone jumps tasks, it takes an average of 23 minutes to return to the original task (González & Mark, 2004). This break from the original task of deep reading would also disrupt the construction of meaning gained through the process. Both the internal and external distractions can increase the time required for students to complete reading assignments.

Overall, the benefits of electronic text could pose a paradoxical threat to the process of reading. While the technology provides ample opportunity to augment the knowledge gained from the reading material, it can also hinder the ultimate depth in understanding. Also, every improvement in e-reader technology provides more and more “enhancements” to reading: enhancements that may also be viewed as distractions. The following section will review the technological features of e-reader devices.

Comparative Features of E-Readers

All e-readers share some universal qualities. E-readers' portability is often cited as a personal and academic benefit in comparison to carrying numerous heavy books. The price of e-books is almost always substantially lower than the price of p-books. Furthermore, most people appreciate the option of having a paperless book because of environmental concerns. However, there are numerous factors that distinguish one e-reader from another. The following section will discuss different options in e-reader screen types, interfaces, portability and reading features, accessibility, prices and levels of connectivity, and digital features and navigation.

Screen type. A primary visual distinction of e-readers is the type of screen the reader looks at. There are two types of screens: e-ink and LCD. Electronic ink (e-ink), synonymous with electronic paper displays, is a surface where black and white particles suspended in a clear fluid respond to an electric charge. This charge shows between 8 - 16 shades of grey on the page to reveal text or black/white/gray photos. This technology most closely resembles reading print text. Similar to a printed page, it can be read in the direct sunlight, but a light is required to read in the dark. A primary complaint of e-ink is the lack of a color display. Most e-readers incorporate e-ink technology.

Other platforms utilize a type of LCD screen. This screen counters the one primary complaint of e-ink—this screen has a color display. However, the LCD screen has to be backlit with fluorescent or LED backlight. This backlighting takes additional battery power so that the device would need to be charged more often. The florescent backlight requires the most power, but recent improvements introduced an LED backlighting to improve battery life. Also, an LCD screen with In-Plane Switching (IPS) widens the viewing angle of the screen while at the same time claims a higher contrast ratio. The backlighting can make the device difficult to see in direct sun, but it can be

read in the dark. Overall, e-ink and LCDs have pros and cons and a preference for one or the other is up to the individual reader.

Interface. E-readers offer a variety of interfaces: buttons, touch-screen, or multi-touch screen. In some models, manual buttons navigate the menu options, provide the keyboard, and page advance. Other models use a touch screen for navigation, scrolling, writing, or page advance. In conjunction with the touch screen is the possible addition of a stylus to navigate or write notes. Finally, multi-touch offers all touch functions with the addition of zooming (including ability to change font sizes), rotating, scrolling, and others depending on the application in use. Finally, a touch on-screen keyboard option provides a method of typing that disappears when using the document as an e-reader. This virtual on-screen keyboard maximizes the reading area for the reader.

Portability and reading features. Comparing the physical dimensions of an e-reader includes device size, weight, screen size, and ability to change reading perspective from portrait to landscape. Portability describes the overall size and weight of the device. In an academic setting, this is typically compared to how many print textbooks a student would carry. Of equal importance is how heavy the device is to hold over a long period of time. Generally speaking, the lighter the device is, the better. More deluxe e-reader models possess a larger reading area, however, the larger reading area requires a larger screen and battery which in turn increases the weight of the device. An additional reading option on most models is the ability to read in either portrait or landscape mode. This feature can happen automatically when one rotates the device or it must be shifted manually.

Accessibility. In June 2009, the National Federation of the Blind (NFB) and the American Council of the Blind (ACB) filed a lawsuit against Arizona State University regarding their pilot of the Kindle DX in a college course. The device's inability to be fully used by blind students violated both the federal Americans with Disabilities Act and the

Rehabilitation Act of 1973 (Case 2:09). The lawsuit was settled out of court in January 2010, and served as a message that all e-readers, if used in an educational setting, must be accessible by all students. On June 29, 2010, the United States Department of Justice and Department of Education jointly published a letter to college and university Presidents reiterating the results of the lawsuit and mandating compliance in the future (Perez & Ali, 2010).

Price of device and connectivity. Dedicated e-readers and tablets will be analyzed in this review of popular platforms. Dedicated e-readers have a substantially lower price point than the tablets. In a price war, the price of both the Amazon Kindle and the Barnes and Noble Nook have dropped to the point where they do not make money on the e-reader, but only on the e-book sales that come with it (Gomes, 2010). This business model, commonly known as the “razor/razor blade” model, is similar to the video game console industry. An additional price determination involves the connectivity options of the device. Most all models come with Wi-Fi connectivity and the additional option of a cellular data 3G connection. A differentiating factor is also the requirement of a service plan to use the Wi-Fi/3G or limited 3G service for respective device bookstores.

Digital features, annotation and navigation. Digital features, annotation and navigation facilitate the usefulness of an e-reader device. Digital features refer to incorporated electronic access to a dictionary and text search capability while annotation includes highlighting, underlining, and note-taking. All of the devices in this review provide a version of these options. Navigation features aid in the awareness of text placement and movement. For example, a table of contents can be hyperlinked to chapter headings for ease of movement within the text. Reading length can be measured by pagination or location. Documents in PDF format maintain their original page numbers and reading progress follows the original pagination. More and more

documents created for electronic text are now organized with location information instead of pagination. The location is presented as two digits—the first being the location within the text and the second is the total number of location points. By using a location number, the electronic text can be viewed in any font size or orientation and can still be referred to with a common indicator. A progress bar along the bottom of the screen can give the location information. This provides a visualization for progress through the book.

This section discussed the different options in e-reader screen types, interfaces, portability and reading features, accessibility, price of device and connectivity, and digital features and navigation. A solid understanding of e-reader features lays the foundation for the upcoming discussion of e-reader research and current types of e-readers.

E-reader Research in the Academic Environment

Minimal research exists about the use of e-readers in the academic environment due to the slow development of devices. Similar to the research on e-books read on a computer screen, the e-reader research primarily focuses on the usability of e-reader features and how the devices are used. This section reviews the available relevant research on e-readers.

Simon conducted two studies with undergraduate students and the Rocket eBook in 1999 and 2000 (2001a, 2001b). In the first study, Simon polled students at the beginning of the course to evaluate the learning curve required to use the device and at the end of the semester to see how the e-readers were used. He reported that students had little to no difficulty setting up the e-reader. Next, he reported the times and places students used their e-readers. Seventy-five percent of students reported that having an e-reader increased the number of locations they read lecture notes to include while, traveling/commuting, at work, at home and during recreational activities. However, while the number of locations did increase, the amount of time spent reading did not. Students

listed advantages of the e-reader as portability, storage capacity, backlit screen, dictionary, and bookmarking features. Disadvantages noted included poor display of visuals and inability to display animations. The respondents also stated a desire for pagination over scrolling, longer battery life, and improved writing interface and complained about the lack of page headings, difficulty reading the screen and the e-reader being a little too heavy to comfortably read in bed at night. In the end, Simon concluded that for the most part, students used their e-readers in a manner similar to printed course materials and that it "did not affect how students read, but did increase the number of places they studied" (2001b, p. 5).

With the same group of students, Simon (2001a) asked additional questions regarding students' e-reading habits and their use of e-reader features. Simon built off of Weardon's earlier research regarding the reported importance of the following e-reader features: glossary lookup, bookmarking, highlighting, and annotation. He reported a comparison of Weardon's reported importance of a feature to his students' actual usage of those features. For example, according to Weardon, students reported glossary lookup importance of 87.3%, but Simon's students actual usage was 65%. The bookmarking feature showed a similar discrepancy of reported importance at 84.4% to actual usage of 55%. Highlighting features had a reported importance of 71.7% with usage at 50% and annotation had a reported importance of 64.5% with usage at 40%. This information shows the "fickleness gap"—where students report importance, but actual usage is 20-30% less. Simon also reported that 100% of students would recommend using an e-book in college courses to a friend and 95% wished other courses offered an e-book option. He finally concluded that once e-readers "can successfully reproduce familiar features they [students] have come to expect from the printed medium, they can begin to look toward enhanced utility" (Simon, 2001a, p. 5).

Early in e-reader development, Schcolnik (2001) researched strategies for e-reading, types of materials read, and characteristics e-readers should have. Her study polled early adopters of e-readers on user preferences in reading for information and reading for pleasure. The strategies for e-reading include: annotation, consulting marked sections, cross-referencing with other materials on the e-reader, cross-referencing with materials in other media, looking back at previous pages, using the dictionary, paging forward or backward, searching with Find, skipping around, taking notes on paper, underlining/highlighting, using hyperlinks, using list of references, and using the table of contents. Paging was the most used strategy when reading for both information and pleasure. When reading for information, the table of contents, search with Find, hyperlinks and bookmarks were sometimes used. Annotation, cross-referencing materials and taking notes on paper were hardly ever used. When reading for pleasure, paging was also the most used strategy with the table of contents and search with Find used sometimes.

Schcolnik (2001) also examined different navigation modes for presenting text material: page-by-page (paging) or scrolling. Ninety percent of polled users preferred paging in the portrait layout. E-reading for pleasure was exclusively linear. The table of contents was the most important feature of e-text—followed by hyperlinks, illustrations, page numbers, headings, and highlighted words. On the e-reader itself, users highlighted legibility, portability, easy navigation, ample storage and ease of use as important attributes. Seventy-eight point nine percent preferred reading on a dedicated e-reader compared to a computer screen. “Ninety-six percent disagree with the statement that the e-reader makes them lose the context of what they read, and more than 70% feel they can both deep read and skim with their e-reader” (pp. 58-59).

Bell et al. (2002) report on student recommendations in a study conducted of the Gemstar/REB RCA 1100 e-reader. After using the e-reader, student feedback included a

desire for color, animation, interaction with content, access to professor-created content, ability to take notes, and ease of loading. This study also revealed that most content converted to digital format was not educational in nature, making adaptability to the classroom inapplicable. They also discovered a problem with colleges not having the technical expertise to trouble-shoot technical problems with e-readers in a timely manner.

Agee (2003) reported on the potential of students using the Gemstar/REB RCA 1100 e-reader and e-books. In schools, the combined efforts of a teacher, librarian, and technologist could advertise the potential e-readers. The e-reader technology would entice a younger generation to use the device and as a result, read more literature. By advertising the benefits of e-books, he could ultimately encourage students to read more literature. He primarily focused on the availability of free digital content from the public domain available through the Gutenberg Project, the Electronic Text Center at the University of Virginia, and the Internet Public Library. He also addresses the requirement of technical support from within the school system to help with usability issues like downloading files. Agee wants all to understand the role e-books can play in setting the foundation for a lifelong love of reading.

In 2004, Abram responded to the stall in the e-reader market in his article "eBooks: Rumors of Our Death are Greatly Exaggerated." He examined the potential of e-readers from a library perspective instead of from the stalled consumer perspective. Librarians focus on good collections, special access, and quality information. Abram outlined the following primary user preferences of e-readers:

The Good:

- The ability to search
- Easier hyperlinked access through the index and table of contents
- Easier hyperlinked access through footnotes and bibliography
- Selected and updated quality collections or libraries of reference books
- Always with you, always ready, accessibly remotely

- Space saving

The Not So Good:

- Inability to loan/transfer your e-books
- Requirement for technological infra-structure
- Screens that can be difficult in terms of size and resolution
- Access devices, most of which are multipurpose, so you compete for access
- Battery life
- Device ergonomics
- Digital rights management issues that are not yet fully determined (Abram, 2004, p. 15)

These issues illustrate the starting off point for the next generation of e-readers at the time.

The stall in e-reader development prevented additional research about the academic use of the device. The launch of the Kindle for personal use in 2007 re-ignited the inclination of adapting e-readers to the academic environment. This earlier research outlined the desirable features of e-readers and potential for improvement and application. No academic research has yet been published on the Kindle, but feedback regarding its use in an academic environment will be discussed in the following section.

Current Types of E-readers

The growing popularity of the Amazon Kindle and arrival of the Apple iPad are catapulting e-readers into the mainstream. The following section will compare these five e-reader models: Amazon Kindle 3/Kindle 3 DX, Apple iPad, Sony Reader PRS-650, Barnes and Noble Nook, and Entourage eDGe. These were the primary e-reader devices available at the start of the study. For personal use, the Sony Reader, Kindle, Nook, and iPad carry almost all sales (Greenberg, 2010a), and for academic use, schools have or are piloting the Amazon Kindle, Apple iPad, or Entourage eDGe. This section compares the technical features of these five models followed by a discussion of the Amazon Kindle and the Apple iPad in education. The Sony Reader, Barnes and Noble Nook, and Entourage eDGe will only be covered briefly due to minimal information

available about their use in the academic environment. Most e-reader studies have focused on the Kindle and iPad, which will be covered in more depth. See Table 1 for a more detailed comparison of these e-reader devices.

Table 1.

Comparison of E-reader Devices

	Apple iPad 16GB	Amazon Kindle 3 / Kindle 3 DX	Barnes & Noble Nook	Sony Reader Touch Edition / Daily Edition	enTourage eDGe
Wi-Fi Price	$499	$139	$149	$229 Touch Edition PRS-650	$549
Wi-Fi + 3G Price	$629	$189 / $379	$199	$299 Daily Edition PRS-950SC	NA
Weight	24 oz (1.5 lbs)	8.5 oz / 18.9 oz	11.6 oz	7.58 oz / 8.99 oz	48 oz (3lbs)
Dimensions	9.56" x 7.74" x .5"	7.5" x 4.8" x .34" 10.4" x 7.2" x .38"	7.7" x 4.9" x .5"	6.63" x 4.75" x .41" 7.87" x 5.04" x 0.38"	10.75" x 8.25" x 1"
Screen size	9.7	6" / 9.7"	6" + 3.5" LCD	6" / 7"	9.7" eInk & 10.1" LCD
Screen Type	LED backlit LCD with IPS	eInk Pearl	eInk Vizplex	eInk Pearl	eInk & LCD
Screen Color	Full color	16 shades of gray	16 shades of gray + color touch LCD	16 shades of gray	8 shades of gray & color LCD
E-reader file formats supported	iBook ePub PDF HTML TXT RTF DOC eReader (.pdb) [1] Kindle (.azw) [1] Nook (ePub) [1] Mobipocket [1] FictionBook [1] DjVu [1] Tome Raider [1] Open eBook [1]	Kindle (AZW) ePub PDF TXT PDF DOC Unprotected Mobipocket PRC HTML	ePub PDF PDB	ePub PDF ePub Adobe DRM PDF Adobe DRM BBeB TXT RTF DOC	ePub PDF TXT RTF DOC HTML
Interface	Multi-touch	Manual buttons	Manual buttons & touch LCD	Touch & stylus	Touch & stylus
Storage	16GB	4GB	2GB	2GB	4 GB
Battery Life [2]	10 hrs (full use)	Up to 30 days / 2-3 weeks (with wireless off)	Up to 10 days (with wireless off)	Up to 2 weeks / up to 27 days (75 min. daily use with wireless off)	4 hrs full use (both screens) 16 hrs - eInk only 6 hrs - LCD only

(continued)

	Apple iPad 16GB	Amazon Kindle 3 / Kindle 3 DX	Barnes & Noble Nook	Sony Reader Touch Edition / Daily Edition	enTourage eDGe
Computer Requirement	For initial registration and OS updates	None	None	For content from outside of Sony's Reader Store	None
ePub Adobe DRM[3]	Yes[1]	No	No	Yes, but requires Win PC or Mac	No

[1] Requires additional software
[2] Battery life estimates are manufacture reported and are not based on standardized measurement.
[3] Common library e-book format.

AmazonKindle 3/Kindle 3 DX. Due to its popularity and novelty, the Kindle became attractive to schools, which began investigating its use in the academic environment. Several schools piloted the Amazon Kindle as an e-reader with mixed results. The following colleges conducted a pilot program: Arizona State University, Case Western Reserve University, Darden School of Business at University of Virginia, Pace University, Princeton University, Reed College, University of Arizona, University of Washington, University of Virginia, and Houston Community College (Foresman, 2010). Consistent with benefits of e-readers, portability and decreased cost of e-books were seen as common benefits (Lee, 2009; Marmarelli & Ringle, 2010; D. Rowlett, personal communication, Septemer 14, 2010). Also, the e-ink is easy on the eye, highly legible, and people could read for the same amount of time as print or longer than on an average computer screen (Cliatt, 2010; Lee, 2009; Marmarelli & Ringle, 2010). For humanities type classes, where course reading consisted primarily works of literature read in a linear fashion, the device was found to be a good fit (D. Rowlett, personal communication, Septemer 14, 2010). Some of these works were also part of the public domain and free to the students. Students liked the text-to-speech feature where they could listen to course readings at times when they could not physically pick up the e-reader (e.g., driving, cooking, etc.; Marmarelli & Ringle, 2010; D. Rowlett, personal communication, Septemer 14, 2010). This flexibility resulted in additional time spent

reading. Reed College's Kindle pilot reported that battery life, durability, paper savings, and over-the-air connectivity for downloading personal reading material as additional benefits of using the Kindle in the academic environment (Marmarelli & Ringle, 2010). This pilot also saw the benefit to having a single-function device that was less distracting to both teachers and students than a laptop during class time and, as a result, enhanced participation.

The majority of feedback about using the Kindle in the classroom was negative. Cliatt (2010) reported Princeton's students' top five suggestions for improving e-readers:

- improving the ability to highlight and annotate PDF files
- improving the annotation tools
- providing a folder structure to keep similar readings together
- improving the highlighting function
- improving the navigation within and between documents on the reader (including having more than one document open at the same time for comparison; para. 18).

Additionally, common feedback was that the Kindle is "clunky and slow" (Lee, 2009, para. 4). It took too long to flash from one page to the next and some found the flash feature distracting. This has been improved in the updated model, however, the linear nature of the paging continues to make flipping back and forth between non-linear pages a persistent navigational issue (Martinez, 2010). The non-standardized file types, rudimentary highlighting, and annotation tools were additional complaints. The Kindle was not found to be a good device for science classes which benefit greatly from color charts, graphs, or pictures that are only black and white on the Kindle (D. Rowlett, personal communication, Septemer 14, 2010). Mentioned previously, a lawsuit was brought against the Kindle in Arizona due to accessibility issues and the suit was dropped with Amazon's good faith effort that future devices would have improved accessibility. Additionally, the Kindle is limited in an academic environment due to restricted access to e-books through the Amazon website. Similar to Princeton's pilot,

the Reed College Kindle study also revealed the labor intensive difficulty in formatting PDFs, difficulty with getting modified materials to the Kindle, lack of a file system, and difficulty referring to texts in class—particularly multiple texts (Marmarelli & Ringle, 2010). However, of greatest concern was the appearance of passive reading resulting from the insufficient tools and a diminished grasp of complex academic concepts.

Princeton's pilot program was launched to "help determine if e-readers could help reduce the use of paper at the University without adversely affecting the classroom experience" (Cliatt, 2010, para 6). In addition to the earlier positive and negative feedback reported, Princeton tracked how much the students printed course materials. Of note, the students had other access to materials because they could not print directly from the Kindle. The research found that in three different programs the students with e-readers printed considerably fewer pages than those without e-readers. In a diplomacy course e-reader students printed an average of 962 pages to 1,826 for non-e-reader students (47% less). In a policy course the ratio was 762 to 1,373 (45% less) and in a classics course the ratio was 570 to 1,508 (62% less). While the e-reader did not eliminate printing, it did substantially reduce it.

The Kindle's evolution in the consumer market has made it a stepping-stone for the comparable progress of e-readers in academics. In the end, the device was intended for personal and individual use and it has not yet answered all of the demands by students and institutions. Overall, the device was not recommended by other students for academic use even with its benefits of portability and low cost of use (Lee, 2009; Marmarelli & Ringle, 2010; Martinez, 2010; D. Rowlett, personal communication, Septemer 14, 2010).

Apple iPad. The Apple iPad is a multi-modal device that can function as an e-reader. The creators of the iPad seemed to have had the e-readers complaints in mind when designing the e-reader application. The LCD screen is full color and backlit by

LEDs that gives it a longer battery life. Overall, the size and weight are bigger than a dedicated e-reader, which has its pros and cons. On the positive side, the large screen size is easier to read and has no visual distractions like buttons (Budiu & Nielsen, 2010; Nielsen, 2010b). It also has an on-screen touch keyboard that disappears when not in use in order to maximize reading area. However, the LCD screen type may not be as natural on the eyes as e-ink and could cause eye fatigue faster. The glossy screen is also highly reflective and shows fingerprints because of the all-over touch surface (Blodget, 2010). In addition, due of the large touch surface area, there can be a problem with "accidental activation"—where users "touch things by mistake or make a gesture that unexpectedly initiates a feature" (Budiu & Nielsen, 2010 p. 7). While the iPad is portable with all reading materials in one central location, another common complaint falls under Abram's (2004) device ergonomics—basically the device is considered too heavy to hold for an extended period of time (Blodget, 2010). This could affect how long a student spends reading his/her assignments. Overall, these technical features support the multi-functionality of the device.

As a multi-modal device, the iPad has additional applications beyond an e-reader. The iPad can do email, web browsing, and over 200,000 other applications. The iPad also has applications for basic functions like photos, calendar, address book, and iTunes audio and video files. It does have a note-taking application called Notes, however Notes lacks advanced formatting features. Apple's word processing program Pages and spreadsheet program Numbers can be added to the platform to increase its academic use. Finally, any feature can be switched from portrait to landscape orientation automatically by simply rotating the device. There is a screen-lock to disable this feature and hold the existing profile. All of these features are accessible to students who use the device for academic purposes.

Concurrent with the launch of the iPad is the launch of iBooks—Apple's online bookstore. Apple partners with publishers Harper Collins, Haschett, MacMillan, Penguin, Simon and Schuster and Random House for publishing iBooks. Applications for both the Kindle and Nook allow iPad users to acquire books through the other platforms' e-bookstores. The iPad has the ability to display most common e-reader formats and all books sold through iBooks are in the widely used common ePub format. In addition, with an additional application, the iPad does have a way of displaying formats that use the Adobe DRM which is used for library e-book lending.

A book from iBooks has some major features that make it appear more like reading a print book. First, the book has a page turning effect every time a reader turns a page giving the illusion of physically turning the page. Second, when the device is rotated to landscape mode, a book is displayed with the two pages side by side like the codex of the tangible book. Also, digital bookmarks can be added—like dog-earing a page of a physical book. Colored highlights can be placed over text and post-it notes can capture thoughts in the margins. Unlike a physical book, the brightness, font size and a dictionary are all immediately accessible for ease of reading. Also, instead of page numbers, the location number is given on the progress bar at the bottom of the page as well as the number of pages remaining the in chapter. On the whole, the e-reading functions of the iPad have been designed to simulate many of the physical characteristics of print reading.

In addition to the aforementioned concerns of weight and screen sensitivity, the iPad has a significant limitation to its use in the academic environment. Currently, iPads are unable to play Flash files or Java Script natively. The benefit of having a platform that can link to internet sources is partially cancelled out when certain content cannot be viewed on the iPad. Overall, the iPad has many positive features that expand its use in

the educational environment. How the iPad is incorporated into higher education will be discussed in greater detail in a following section.

iAnnotate application on the iPad. The iAnnotate application on the iPad provides annotation tools not inherent on the iPad for PDF files. The Amazon Kindle pilot at Princeton University noted five top suggestions made by students that are addressed by using the iAnnotate application. Three of the suggestions addressed annotation tools, one requested a file structure, and one expressed a desire to navigate between documents and having more than one open at a time (Cliatt, 2010). The iAnnotate application by Aji addresses all of these with the exception of linking between two documents. It allows for annotations in the form of highlighting, underlining, free-form drawing, text notes, and bookmarking. Also, file structure is added through its PDF library with folders. In addition, multiple documents can be open simultaneously utilizing tabs to switch between them. Individual documents and the full library of PDFs can be searched. Finally, documents can be transferred onto and off of the device in a number of ways (Aji, 2010). Of note at this time is that iAnnotate fails Americans with Disabilities Act (ADA) compliance by not supporting the iPad's built-in screen reader. However, the features it does add to the iPad make it a compelling addition, addressing many of the suggestions brought forth by the Princeton University and Reed College's Kindle study.

Other e-readers. The Sony Reader PRS-650, Barnes and Noble Nook, and Entouage eDGe have limited/minimal academic applications reported to date. This section will briefly discuss the most distinguishable features of each device. The Sony Reader PRS-650 utilizes the latest in e-ink technology with a touch screen. Its size and weight are comparable to other dedicated e-readers on the market—though it is priced slightly higher because it does not follow the razor/razor blade business model. The positive factor of this device is the ability to read ePub Adobe DRM and PDF Adobe DRM. To date, this is the most commonly used format that libraries use for the lending of

e-books. In general, this e-reader was not designed for academic use and has not been studied in an academic environment.

Barnes and Noble launched their Nook e-reader in October 2009. The Nook's unique two-screen design has a reading screen of e-ink and a LCD navigation screen underneath. All supported file formats can be downloaded directly to the unit without the need for a computer. However, this device was also not designed for academic use and has not been studied in an academic environment.

The Entourage eDGe is a new combination of netbook/e-reader hybrid called a dualbook. This folded platform design has an e-ink e-reader with stylus on one side, while the other side is a color LCD touch screen. The combination is meant to provide the best of both e-ink and LCD in one device. However, the use of prior generation technology for each and a difficult to use interface, does not lend to ease of use (Stern, 2010). This platform has been designed with educational use in mind and has been marketed to schools. Houston Community College conducted a pilot program with this product in the fall of 2010 (D. Rowlett, personal communication, Septemer 14, 2010).

iPad Incorporated into Higher Education

With the introduction of the multi-faceted iPad, higher education is exploring new ways to adopt e-reader technology. However, the way colleges and universities have chosen to incorporate the iPad is as varied as the many uses of the device itself. Some schools provide a device as an incentive for registering to attend their institution. For example, Northwest Kansas Technical College provides iPads for their entire undergraduate population. Seton Hill University and George Fox University offer all freshmen the choice between an iPad or MacBook laptop when they start school (Foresman, 2010; Truong, 2010). However, after one semester, the George Fox University program announced that none of the students who opted for the iPad instead

of the laptop found the iPad fulfilled all of their academic computing needs (Kolowich, 2010). Reports from the University of Maryland at College Park and Seton Hill University conclude that the iPad is used as more of a content consumption device for web browsing, emails, accessing a college's learning management system, or e-reading. Early feedback from these programs is that the iPad is better used as a complement to a laptop, not a replacement of a laptop computer. Other institutions are piloting programs where their libraries offer the device through a library lending system. For example, North Carolina State University has iPads available for four-hour loans (Foresman, 2010). Students in both incentive programs and library lending programs report they still prefer a laptop with full keyboard and word processing for writing papers (Kolowich, 2010). Several schools are beginning to directly integrate the iPad with pilot programs in the curriculum. The spectrum of educational use ranges from using the iPad as an e-reader to full integration into curriculum, research, application development, and university support functions.

Incorporating the iPad into curriculum creates an assortment of new opportunities within the academic environment. The most basic incorporation of the iPad into a course is as an e-reader. Introducing an iPad as an e-reader acclimates the faculty and students to the device without the need to adapt their pedagogy as well. At the beginning of the course, students are issued an iPad for their use. The iPads come pre-loaded with course content or students can download their books at a reduced cost. The following schools piloted an iPad in the classroom program in the fall of 2010: Abilene Christian University, Arizona State University, Oklahoma State University, University of Maryland, University of Southern California, Reed College, Indiana University, Houston Community College, and University of the Incarnate Word.

Reed College conducted research using iPads with iAnnotate software as an e-reader in an upper-division course (Marmarelli & Ringle, 2011). The report comments on

the strengths and weaknesses of the iPad and compares iPad results with the results from their previous Kindle study. As strengths, students praised the responsive touchscreen and were satisfied with the legibility of the text with only one complaint of eye strain from the backlit LCD screen. Additional benefits included the battery life (compared to using a laptop for class), durability, and paper savings. The ability to quickly switch between several functions allowed students to look something up on the web without "interrupting the flow of conversation" in the classroom (Marmarelli & Ringle, 2011, p. 3). The iAnnotate software worked well for switching between texts, searching and navigating within texts, and highlighting and annotation—particular features found lacking or insufficient on the Kindle. Teachers also appreciated the low profile of the iPad compared to a laptop because it diminished the physical and psychological barrier between teacher and student (Gronke, 2010).

The research at Reed College also found some weaknesses of the iPad for supporting academic work. Drawbacks included PDF distribution and syncing and the lack of an overall iPad filing system. Also, the quality of scanned PDFs had a dramatic impact on the successful use of annotation tools. The keyboard was seen as the greatest shortcoming for academic work and students did not use it for in class note taking or writing papers. Overall, this study found many benefits of using the iPad in the academic setting, but also identified areas where additional improvements could be made.

The iPad's versatility offers additional functionality that alters the learning environment. Duke University's Global Health Institute is conducting a pilot where medical students will conduct field medical work and chart results for locations around the world (Schaffhauser, 2010a). Meanwhile, the University of the Incarnate Word's Masters of Business Administration Program will utilize the basic iPad functions as well as real-world business applications and cloud storage of databases (Schaffhauser,

2010b). Finally, some schools have a more inclusive approach to the technology that merges some of the aforementioned options. For example, the Illinois Institute of Technology provides an iPad to every freshman and incorporates introductory courses, electronic textbooks, and student resources that are standard for all courses (Foresman, 2010).

Abilene Christian University (ACU) has the most inclusive program with their Mobile Learning Initiative (ACU 2009-10 mobile e-learning report, 2010; Carter, 2010). Funded by an AT&T grant starting in 2008, ACU laid the foundation of total use by providing iPhones or iPod Touches to 100% of their faculty, staff and student body. Among the normal connectivity uses like email and web browsing, the mobile learning technology is used for polling students in class and sharing opinions anonymously—thus increasing student participation. The devices also facilitate the incorporation of podcasts into course materials, encourages student blogs and social networking. In addition, ACU worked to create new applications for the iPhone/iPod touch to support their curriculum. The faculty publish their results and present at webcasts and conferences worldwide. The school also works directly with both Apple and publishers of e-books to make as much of their educational material compatible with the platforms as possible. ACU created the first iPad student newspaper application as well. By incorporating other Apple products early, the iPad is simply a logical progression to ACU's Mobile Learning Initiative and shows the breadth that total buy-in can achieve.

Usability

Several segments of this literature review discussed the various desired characteristics of electronic text and e-readers. The recurring overall benefits of e-readers are portability and cost-savings. Portability is a usability characteristic of the device, but cost-savings (compared to print materials) is a relative advantage created by

the substitution (Rogers, 2003). Usability refers to ease of use. In the context of e-readers, usability includes both the functionality of device and its user interface and the software and its interface. There is an ongoing debate of how to best design for usability on e-readers. Some think e-readers and e-books should replicate the form of p-books and should follow a print book metaphor (Catenazzi & Sommaruga, 1993; Landoni & Gibb, 2000). Others believe that e-books should be designed for the e-reader medium and maximize the benefits this medium affords (Nielsen, 1996; Shneiderman, 1998). The ongoing development of e-readers and e-books continues to refine the p-book features and is starting to integrate design features afforded by the new medium.

This section will summarize the usability features identified in each of the previous sections and present a consolidated list of overall desired usability features of an e-reader. To consolidate these usability features, from this point forward the terms may not be the initial terms presented in the original research or articles, but will be identified in standardized comparable terms that are applied to this study. For example, if an initial study identified the need for hyperlinks to a table of contents, this would be defined from this point forward as a usability desire for content integration.

The initial research regarding digital text compared the reading of print materials to reading digital materials on a computer screen. These features are explained thoroughly in the literature review section entitled the *Comparison of Print Text to Digital Text*. When looking at digital text on a computer, the following desirable usability features were identified: navigation, content integration, legibility, searchability, annotation tools, animation, sound, portability, ergonomic comfort, note-taking, and ease of use (Allison, 2003; Baker, 2010; Catenazzi & Sommaruga, 1993; Chu, 2003; Landoni & Gibb, 2000; Mercieca, 2004; Nielsen, 1996; O'Hara & Sellen, 1997; Vernon, 2006). Although the digital text was not read on an e-reader in these studies, these features closely match the desired usability features identified from the e-reader research.

The desired usability features of e-readers are addressed in several sections of the literature review. In the section entitled *Comparative Features of E-Readers*, portability, interface, screen size, battery life, accessibility for ADA compliance, annotation tools, navigation, content integration, and ergonomic comfort are all discussed in detail. The section about *E-Reader Research in the Academic Environment* summarizes e-reader research from the early e-reader models prior to the release of the Amazon Kindle. This early e-reader research identifies the following desirable features: portability, ample storage, annotation tools, animation, content integration, navigation, searchability, note-taking, legibility, ease of loading, battery life, and ergonomic comfort (Abram, 2004; Bell et al., 2002; Schcolnik, 2001; Simon, 2001a, 2001b). After the release of the Amazon Kindle, a few schools conducted pilot programs where digital course materials replaced printed course materials. Outlined in the *Amazon Kindle 3/Kindle 3 DX* section, the following desired usability features were listed: portability, legibility, sound, battery life, durability, ease of loading, annotation tools, navigation, color, ease of printing, and accessibility (Cliatt, 2010; Lee, 2009; Marmarelli & Ringle, 2010; Nielsen, 2009). Initial iPad and iAnnotate research identified the following desired usability characteristics: annotation, navigation, ease of loading, accessibility, screen size, ease of use, interface (keyboard), searchability, legibility, battery life, durability, access to additional functionality, ease of printing, and content integration (Aji, 2010; Budiu & Nielsen, 2010; Kolowich, 2010; Marmarelli & Ringle, 2011; Nielsen, 2010b). This list is consolidated from the *Apple iPad* section, the *iAnnotate Application on the iPad* section, and the *iPad Incorporated into Higher Education* section. A review of each section of the literature review shows several recurring desired usability features.

The desired usability features identified in research on electronic text and e-readers can be consolidated into one list. The list is not strictly ranked, but loosely

ordered based on the frequency the desired feature was mentioned in previous research. The consolidated list of desired usability features includes:

1. Portability
2. Navigation
3. Searchability
4. Legibility
5. Ease of Use
6. Annotation Tools
7. Ergonomic comfort (looking at screen, easily held (weight))
8. Content Integration
9. Durability
10. Note-taking
11. Battery Life
12. Ease of Loading
13. Color
14. Sound
15. Ample Storage
16. Ample Screen Size
17. Accessibility (for ADA compliance)
18. Access to additional functionality (web browsing, email, animation)
19. Ease of Printing
20. Keyboard

(Abram, 2004; Baker, 2010; Bell et al., 2002; Chu, 2003; Cliatt, 2010; Dominick, 2005; Lee, 2009; Marmarelli & Ringle, 2010, 2011; Nielsen, 2009, 2010b; Noorhidawati & Gibb, 2008; Rogers, 2003; D. Rowlett, personal communication, Septemer 14, 2010; Schcolnik, 2001; Simon, 2001a, 2001b; Vernon, 2006)

Standardizing the terms and consolidating the desired usability features into one list will ensure these features are referred to consistently in the remainder of this research.

Summary

The purpose of this study was to explore what can be learned from pilot program participant perceptions in regard to substituting traditional printed course materials with electronic course materials presented via iAnnotate on an Apple iPad. This literature review covered the history of literary technology and the development of the e-reader market, showing the gradual growth as the technology slowly diffused into the market. With the growing acceptance of e-readers came research about the usability of electronic text and e-readers themselves in the academic environment. To guide this

research, this chapter examined the Amazon Kindle and the anecdotal feedback provided from different pilot programs that used this e-reader. The Naval War College selected the Apple iPad tablet for their pilot program. This multi-modal device performs as an e-reader and brings additional functionality to the academic environment. While universities are adopting several strategies of incorporating the iPad device into the learning environment, the Naval War College pre-loaded all digital course materials onto the iPad within the iAnnotate application. The convergence of electronic text, e-reader, and multi-modal device provided an opportunity to learn about the usability of the iPad, the iAnnotate application, and the other functions of the iPad in an academic setting. This study asked students and faculty about their perceptions of this experience and documented them for future use.

Chapter 3: Methodology

Overview

The Naval War College initiated a pilot program to provide the Apple iPad to the faculty and students in three masters level courses. In lieu of printed course materials, the iPad was pre-loaded with all course materials in digital format and provided free of charge. The students read all the electronic text via the iAnnotate application, which offers a variety of annotation tools including highlighting and note-taking functions. While the students had the iPad, they were permitted to use the device for personal purposes and load their own applications. Also, for this pilot program none of the course facilitators intended to adapt their pedagogy to accommodate the additional features of the device. The purpose of this study was to explore what can be learned from pilot program participant perceptions in regard to substituting traditional printed course materials with electronic course materials presented via iAnnotate on an Apple iPad.

At the time of this research, there was little published research examining the use of e-books and the e-reader devices that display them in a learning environment. A better understanding of the e-reader phenomenon would aid in guiding future research and implementation within the educational context. In seeking to understand this phenomenon, the study addressed the following research questions: (a) How do students perceive reading course materials on an iPad using iAnnotate? (b) How do students perceive the use of the Apple iPad as an academic tool outside of assigned course readings? (c) Do students perceive that the multi-modal functions of the Apple iPad increase personal use, thereby increasing their academic use of the device? (d) Do faculty perceive any effects within the course from the replacement of traditional printed course materials with digital course materials? (e) Do both faculty and students recommend and/or prefer electronic course materials on a tablet device?

This chapter outlines the research methodology that was used in this case study with the following sections: (a) rationale for qualitative case study method, (b) research questions and propositions, (c) data collection methods, (d) methods for data analysis and synthesis, and (e) limitations of the study.

Rationale for Qualitative Case Study Method

This research explored what can be learned from a pilot program that substitutes traditional printed course materials with electronic course materials presented via iAnnotate on an Apple iPad. The following section outlines the qualitative case study method and describes the case, context, participants, and phenomenon in this study.

Qualitative research follows the principle constructivist philosophy that reality is constructed by individuals through contexts of their experience, their social surroundings, and their point in time (Creswell, 2003; Merriam, 1998, 2009; Stake, 2010). “Qualitative researchers are interested in understanding how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences” (Merriam, 1998, p. 5). This study was specifically interested in the pilot program’s participants’ perceptions. These perceptions are derived from their experiences using course materials on a particular device with a specific application within the social context of the pilot program. Therefore, qualitative research was an appropriate match for the intent of this study.

A case study is an in-depth analysis of a bounded system or a specific entity in a specific place and time (Merriam, 1998, 2009; Stake, 1995, 2010; Yin, 2009). The case was the Naval War College’s pilot program conducted with three courses during the 2010-2011 academic school year. The case study method is preferred when asking how or why questions while examining a contemporary event or phenomenon where the researcher does not have direct influence on or control of the behaviors of the

participants (Creswell, 2009; Isaac & Michael, 1995; Merriam, 1998; Morse & Richards, 2002; Stake, 1995, 2010; Yin, 2009). In this study, the researchers were not directly involved in nor had any influence on the pilot program.

In education, people and programs are the predominant cases of interest. Narrow in scope, a case is specific, complex and functioning. Stake (1995) defines the case as an integrated system with participants involved in a common process. In this study, the integrated system was the pilot program, the participants were the students and faculty, and the common process was the use of electronic course materials presented via iAnnotate on an Apple iPad. Faculty and student perceptions were used to explore the case. These perceptions were key and supported by the diffusion of innovation theory. This theory states that the perceptions of a technology are the defining factor in a technology's adoption (Rogers, 2003).

The context of the case included the pilot program faculty and pilot program students' perceptions of using course materials presented within iAnnotate on an Apple iPad. Holistically, the subject of this study was not the participants themselves, but the participants' perceptions of using digital course materials on a multi-modal tablet device. The perceptions of this substitution was the phenomenon (central focus) being studied and the participants were a part of the case's context (Merriam, 1998; Yin, 2009). Also within the context of this case, the course materials were strictly digital versions of the paper text. These static documents were organized within a file structure in the iAnnotate application on the iPad. iAnnotate provided the markup tools of highlighting, underlining, bookmarking, free form drawing, and note-taking. Although there was a search feature, within the text there were no hyperlinks to internal or external material, no animation, no sound, and no dictionary access. While the Apple iPad had an iBooks application, the course materials were organized in the document manager function of iAnnotate to provide a logical file structure. Supplemental course materials could have

been incorporated through iBooks, iTunes, iTunesU, other applications, web browsing or email—but were not.

The case in this research was revelatory in nature and fits a single case study design. Defined by Yin (2009), a case study is revelatory when it examines “a phenomenon previously inaccessible to social science inquiry”(loc. 1229/1249). The phenomenon in this study was due to the relative newness and uniqueness of the Apple iPad. According to Yin, a single-case study design is justifiable when the case serves a revelatory purpose. Within this single case study, there were two distinct groups of participants: students and faculty. The two groups of participants formed two embedded units of analysis in this single case study. Given the context of the phenomenon, the students had their unique set of perceptions and the faculty had their own unique set of perceptions. Thus, each was examined separately utilizing an embedded case study design (Yin, 2009).

Within the case of the pilot program, the student and faculty participant’s perceptions were gathered on the phenomenon of the electronic text on the Apple iPad. According to Yin, this qualitative case study method was revelatory based on the newness of a tablet device delivering course materials in an academic environment. Overall, this research studied the case of a pilot program that substituted printed course materials with electronic course materials presented within iAnnotate on an Apple iPad.

Research Questions and Propositions

The purpose of this study was to explore what can be learned from pilot program participant perceptions in regard to substituting traditional printed course materials with electronic course materials presented via iAnnotate on an Apple iPad. This case was pursued with research questions and study propositions. Study propositions point the researcher to what should be examined within the scope of the study (Yin, 2009). The

study propositions, also known as the theoretical framework of a qualitative study, were derived from the literature review (Merriam, 1998). The research questions with their ancillary propositional questions were as follows:

1. How do students perceive reading course materials on an iPad using iAnnotate?
    - 1.1 How do students perceive the replacement of print course materials with digital course materials with regard to their frequency of reading?
    - 1.2 How do students perceive the replacement of print course materials with digital course materials with regard to their duration of reading?
    - 1.3 How do students perceive the replacement of print course materials with digital course materials with regard to their speed of reading?
    - 1.4 How do students perceive the replacement of print course materials with digital course materials with regard to their reading comprehension?
    - 1.5 How do students perceive the replacement of print course materials with digital course materials with regard to their differentiation of course materials?
    - 1.6 How do students perceive the replacement of print course materials with digital course materials with regard to their class participation?
    - 1.7 How do students perceive the potential for distraction with a multi-modal device?
    - 1.8 How do students perceive their use of the iAnnotate software?
2. How do students perceive the use of the Apple iPad as an academic tool outside of assigned course readings?
    - 2.1 How do students perceive the use of additional functions with a multi-modal device related to academic use?

2.2 How do students perceive the replacement of print course materials with digital course materials with regard to their desire to print course materials? How much and why?

2.3 How do students perceive the replacement of print course materials with digital course materials with regard to writing a course paper?

3. Do students perceive that the multi-modal functions of the Apple iPad increase personal use, thereby increasing their academic use of the device?

3.1 How do students perceive how often they use the iPad for reading course materials?

3.2 How do students perceive how often they use the additional functions of the iPad other than reading course materials?

3.3 Do students perceive that they have the iPad with them more often than printed course materials?

3.4 How do students perceive their use of the iPad for personal use compared to academic use?

4. Do faculty perceive any effects within the course from the replacement of traditional printed course materials with digital course materials?

4.1 How do faculty perceive the replacement of print course materials with digital course materials with regard to student participation?

4.2 How do faculty perceive the replacement of print course materials with digital course materials with regard to student comprehension?

4.3 How will faculty change pedagogical approach in regard to the replacement of print course materials with digital course materials?

5. Do both faculty and students recommend and/or prefer digital course materials on a tablet device?

5.1 After experience with digital course materials, do students prefer printed course materials or digital course materials?

5.2 After experience with digital course materials, do faculty prefer printed course materials or digital course materials?

5.3 Will students recommend the replacement of printed course materials with digital course materials for future courses?

5.4 Will faculty recommend the replacement of printed course materials with digital course materials for future courses?

These research questions addressed the student and faculty experiences with iAnnotate and the Apple iPad.

Data Collection Methods

All methods of data collection may be used in case study research (Creswell, 2009; Merriam, 1998; Yin, 2009). In this study, multiple methods of data collection were utilized in researching the Apple iPad pilot program at the Naval War College. Data collection for this study occurred from 1 February 2011 to 3 March 2011. The survey and focus group methods were used for student participants and interviews were conducted with faculty. The following section will discuss the data-collection methods and how they were utilized.

The survey method was the best fit to collect data about student feedback at the Naval War College. The survey collection tool was selected based on the survey's strength of being unobtrusive (Fowler, 1993), while allowing the researcher to collect information directly from a large group of participants (Stake, 2010, p. 99). Typically considered a quantitative tool (Creswell, 2003), in this study surveys were used to build a more complete picture of the processes and perceptions of students' experiences with the digital course materials. The survey used both closed and open-ended questions.

These open-ended questions aided in illuminating the participants' perceptions. The quantitative data collected by the survey are presented and analyzed utilizing descriptive statistics to inform the qualitative study.

The student survey instrument was developed directly from the primary research questions and their supporting propositions (see Appendix B). Each survey question was tied directly to one or more proposition. The survey has been reviewed by two independent experts for bias, content validity, and construct validity. Content validity refers to whether an item measures what it was intended to measure. Construct validity assesses whether or not the data generated by a tool is useful in measuring or answering the theoretical proposition (Creswell, 2003). Suggested changes were integrated into the student survey tool. Based on Vernon's research, the finalized survey for data collection was implemented after week eight of the course because students would have developed their study habits with the device by this time. In addition, to collect useful information regarding the issues of differentiation and use of multiple sources, the surveys were given to each course after a major project or paper was completed. The student survey was given using Vovici online survey software. However, the researchers did provide paper copies of the survey if a student did not bring their iPad or preferred to take the survey on paper. Paper surveys were manually re-entered into the online survey tool and then destroyed. The survey was completed in 15-20 minutes.

A pilot test identified administrative changes in the survey instrument, tested construct validity and established reliability of the tool. One class was identified as the best potential candidates for conducting the pilot survey based on the full-time nature of the students, availability during the lunch hour, and small class size. An email invitation to participate was sent to the professor of the selected course and forwarded on to the students. The pilot test occurred during lunchtime and a meal was provided to

participants. Three full-time students and one part-time student piloted the survey. They recommended expanding the age block options in question 2 and clarifying the “mark all that apply” feature of iAnnotate’s mark-up tools in Question 14b. Both recommendations were adopted and administrative changes were applied to the survey. The changes did not alter the intent of the data collected.

With the cooperation of pilot program faculty members, students volunteered to complete the survey by accessing the appropriate Vovici survey website on their iPad. One course had recently finished; therefore the students were invited to participate via an email invitation forwarded from their professor. For the other two courses, the researchers were provided class time to conduct the survey. Those who decided not to volunteer for the survey used the time allotted in class for personal work on the iPad. The researchers introduced the survey during the class time and recited a standard announcement regarding the voluntary nature of the survey and how confidentiality and anonymity would be preserved (see Appendix C). Students were presented with an anonymous consent form via the survey software at the start of the survey (see Appendix D). This consent form included a box indicating their agreement with the confidentiality statement and that they are volunteering to take the survey. Class time for completion of the survey was sought to maximize participation and anonymity. If given outside of class, a tracking system of invitations, primary and secondary reminders would have been necessary, potentially compromising anonymity.

Student focus groups and faculty interviews were also utilized in this study. Interviews are one of the most important and traditional tools in case studies (Creswell, 2003, 2009; Merriam, 1998, 2009; Stake, 1995, 2010; Yin, 2003, 2009). “Qualitative interviewing begins with the assumption that the perspective of others is meaningful, knowable, and able to be made elicit” (Patton, 2002, p. 341). Unlike surveys, Yin (2009) describes interviews as “...guided conversations rather than structured queries” (loc.

2223/2255). Focused, semi-structured interviews were employed in this study to gain insights into the perceptions and experiences of the pilot program participants.

Student focus groups, or interview groups, were used to confirm and gain deeper insight into the perceptions of the student participants beyond what was collected in the survey, and provided a second source of student data. “Focus groups work particularly well to determine the perceptions, feelings and thinking of consumers about issues, products, services or opportunities” (Krueger, 1988, p. 8). Three separate focus groups were conducted with three volunteer students from each course involved in the pilot program. As part of the student consent form issued at the beginning of the online survey (see Appendix D), students were invited to contact the researchers if they wanted to be part of the focus group. Students were also invited to volunteer when the researchers introduced the survey (see Appendix C). It was understood that contacting the researchers would not compromise the anonymity of the survey input, but the student’s participation in a focus group would not be anonymous. However, it was also made clear that in the publication of the research, no information that would personally identify an individual would be released. The three focus groups were emailed with the time and location for their respective focus group interviews (see Appendix E) three days prior to the event. A reminder email about the focus group interview was sent the day before the interview (see Appendix F).

The focus group interviews were conducted in a focused interview style. Focused interviews follow a defined set of questions, but are open-ended and are conducted in a conversational manner (Yin, 2009). The focus group interview schedule (see Appendix G) provided students the opportunity to offer detailed feedback regarding differentiation of sources, how materials may have been printed, how the iPad was used in support of a major project, and distractions. The focus group interview schedule was reviewed by two independent experts for content and construct validity. Suggested changes were

integrated into the tool. In addition, based on feedback from an expert, at the start of the interview, students were given interview questions with room between each question. The space provided allowed focus group members to jot comments to share if someone else was talking. This document is further referred to as the focus group note sheet (see Appendix H). The focus group interviews took approximately one hour. The researchers served as the moderators for the focus groups. The student consent form (see Appendix D) initially agreed to at the beginning of the online survey also informed focus group members of the researchers' desire to audio-record the focus group session. A copy of the student consent form was attached to both emails to remind focus group members of the protections set in place to ensure the confidentiality of their input. All students were provided a meal and refreshments during the focus group interview and verbally thanked for their participation upon completion of the event.

For pilot program course faculty members, face-to-face focused interviews were conducted. These interviews captured faculty perceptions about the case. The faculty interview schedule (see Appendix I) was developed directly from the primary research questions and their supporting propositions and took no more than 30 minutes. The faculty interview schedule was reviewed by two independent experts for content and construct validity. Suggested changes were integrated into the tool. The interview schedule was pilot tested by the first volunteer faculty member for content validity and reliability prior to being used for data collection. The pilot test revealed that no changes were necessary to the faculty interview schedule and pilot interview data was included in the consolidated faculty responses. Email invitations were sent to the faculty members to volunteer for participation (see Appendix J). Appointments were arranged with the volunteer faculty members. Face-to-face, focused interviews were conducted individually and recorded with the interviewee's consent. At the beginning of the meeting, participants were asked to sign an interview consent form (see Appendix K) that

acknowledged their understanding that would be asked questions about their experience in the pilot program. The interview consent form also asked for their permission to be audio-recorded and informed faculty members that protections were set in place to protect the confidentiality of their input. The interview was focused and conducted in a conversational style. The day after the interview, thank you emails were sent to thank participants for their time and contribution (see Appendix L).

Methods for Data Analysis and Synthesis

From the outset, each survey question and interview question was designed to tie directly to a research question and proposition (also referred to as theoretical framework). Each question is reference coded and tied the data to the appropriate research question. All three data collection tools were reviewed by two independent experts for content and construct validity. Dr. Cal Stanley, an Ed.D. in Educational Technology and Dr. Theresa Stanley, also an Ed.D. in Educational Technology served as the two independent experts. Both reviewed these data collection tools independently of the researchers and independently of each other. Based on their feedback, survey questions nine and eleven were reworded (see Appendix B). In addition, focus group question five was reworded (see Appendix H). Dr. Theresa Stanley also suggested that focus group participants be given paper with the space to make notes, thus, the focus group question note sheet was developed (see Appendix I). No changes to the faculty interview schedule were deemed necessary. Dr. Cal Stanley suggested that estimated times of completion for each tool did not provide sufficient time to complete them; therefore the researchers adjusted the approximated completion times accordingly.

Merriam (2009) states that “qualitative data analysis is primarily inductive and comparative” (p. 175). It is the process of making meaning from the data and involves consolidating, reducing and interpreting (Creswell, 2003; Merriam, 2009). This study

utilized the method of open coding for categorization or themeing the data (Creswell, 2003; Merriam, 2009; Morse & Richards, 2002; Saldaña, 2009). “A theme is an abstract entity that brings meaning and identity to a recurrent [patterned] experience and its variant manifestations. As such, a theme captures and unifies the nature or basis of the experience into a meaningful whole” (DeSantis & Ugarriza, 2000, p. 362). A theme is an abstraction from the data that captures a recurring pattern. Once developed fully, these themes or categories informed the propositions by which a holistic understanding of the case will be formed (Merriam, 2009).

The student survey was collected electronically using Vovici online survey software (see Appendix B). Results from closed questions in the survey were analyzed using descriptive statistics. Open questions were open coded into categorizations for analysis, then themed. Using the individual proposition reference code, these data were then placed in the case study database for analysis.

Both the focus group interviews and faculty interviews were transcribed from the audio recordings for data analysis. During the transcription process, any participant names or other personally identifying information were removed and participant codes such as Student A or Faculty B were used. After the transcription was checked for errors, original interview recordings were destroyed. At this stage, the transcription data was open-coded and themed. Using the individual proposition reference codes, this data was placed in the case study database for later analysis. Yin (2009) points to using a case study database as a repository for all data collected during a case study. This database can not only be used for the current study, but also be stored for future examinations of the data without being limited to the case study reports. “In this manner, a case study database markedly increases the reliability of the entire case study” (Yin, 2009, loc. 2499/2519).

In light of the study's propositions, the researchers reviewed the themed data in the case study database to inform the research questions and thereby inform the holistic narrative of the case studies findings (Creswell, 2003; Merriam, 1998, 2009; Yin, 2009). The narrative highlighted the implications of the study. All coding and themeing were determined "in conjunction with data collection" (Merriam, 2009, p. 178). As the data grew, so did the analysis followed by intensive analysis when all data collection had been finalized (Merriam, 2009).

Design Considerations

Limitations exist within each part of the methodology. A common critique of qualitative research is the lack of uniformity and predefined road maps of inquiry. The quality of a case study is limited by the "sensitivity and integrity of the investigator" (Merriam, 1998, loc. 575/589). The researcher must report evidence fairly. Questionable processes, not being systematic in approach, lead to uncertainties of rigor (Yin, 2009). Therefore, rigor must be insured by using a well-documented process and tools as demonstrated earlier in this chapter.

The student survey tool and interview schedules used in this study were carefully crafted to avoid leading or biased questions. An independent panel of experts also reviewed these tools for question bias in addition to content and construct validity. Suggested changes were implemented into the tools for this study. The tools were also pilot/field tested prior to actual application.

There are also limitations with using a survey as a data collection tool. Surveys only collect data from voluntary, cooperative respondents (Isaac & Michael, 1995). They may inspire response sets: proneness to agree with positive sets of questions. "Surveys are vulnerable to over-rater or under-rater bias—the tendency for some respondents to

give consistently high or low ratings" (Isaac & Michael, 1995, p. 137). The focus group interview was used to corroborate and deepen results of the survey.

Limitations of using the interview method of data collection are as follows. Interviews are time intensive, from conducting the interview to transcribing the results. Additionally, the interviewer must be careful to avoid bias in questions or showing support for a particular answer (Isaac & Michael, 1995). To avoid interviewer bias, the interviewer showed sensitivity and neutrality, and followed the interview schedule tool when conducting interviews.

Coding and categorizing in qualitative research utilizes an analytic process that is inductive and comparative (Merriam, 2009). To avoid inconsistencies, the data were coded collaboratively; each researcher coded the data independently, then codes were discussed and harmonized by the researchers, thereby increasing rater reliability (Saldaña, 2009). Data reliability was increased by keeping all generated data in the case study database (Yin, 2009).

Other limitations in case study research are related to the findings. Researcher bias in case study analysis and narrative can lead to either overstating or understating the findings (Merriam, 1998). Patton (2002) addresses this potential by stating that "keeping findings in context is a cardinal principle of qualitative analysis" (p. 563). Generalization is also an issue with case studies. Case studies are not true experiments in establishing causal relationships, however they can be used to enlighten how or why an intervention worked (Yin, 2009). Case studies focus on a given context. While case studies are not generalizable to populations, they do "expand and generalize theories" (Yin, 2009, loc. 574/601).

This section explained the potential limitations of this study. There are potential pitfalls within the qualitative research design, case study method, data collection tools, coding and categorizing of data, and researcher bias. This research has thoroughly

identified the limitations at each level of the design in order to minimize their impact to the study.

Summary

This chapter has outlined the researchers plan to conduct a qualitative case study at the Naval War College. The purpose of this study was to explore what can be learned from pilot program participant perceptions in regard to substituting traditional printed course materials with electronic course materials presented via iAnnotate on an Apple iPad. To conduct this research, five research questions were pursued using a student survey, student focus groups, and faculty interviews. The limitations of this study have been thoroughly identified to minimize their impact on the results. This research was conducted after dissertation committee approval and successful completion of the Institutional Review Board process at Pepperdine University.

Chapter 4: Results

Overview

This study sought to gain a better understanding of the e-reader phenomenon in the academic environment. The purpose of this study was to explore what can be learned from pilot program participant perceptions in regard to substituting traditional printed course materials with electronic course materials presented via iAnnotate on an Apple iPad. To conduct this research, five research questions were pursued using a student survey, student focus groups, and faculty interviews. Chapter 4 presents the findings of this research. First, supplementary information about the Naval War College academic programs is provided to better explain the overall context of these findings. Following the explanation of the programs is an overview of the survey information and demographic information. Third, the comprehensive findings are presented organized by research question. For example, if a research question was addressed in both the student survey and the focus group, all data for that research question is reported at one time with the source clearly indicated. In summary, this study reports the following findings:

- Finding 1. The majority of students found that reading course materials on an iPad using iAnnotate did not affect the duration of reading, speed of reading, reading comprehension, or class participation. The file structure exacerbated differentiation issues. While most students were not distracted by the additional functions of the iPad, others presented mixed opinions about whether they were more or less distracted while using the device. A clear majority perceived their frequency of reading as about the same or more often due to portability. Finally, the iAnnotate software was found easy to use in both mark-up tools and

searchability. Overall, reading course materials on the iPad with iAnnotate was found to be as good as or better than print materials.

- Finding 2. The majority of students perceived the Apple iPad as a useful academic tool, frequently using it to enhance personal study and classroom learning. When writing reference papers, slightly less than half of students printed resources due to the need for tangibility, spatial flexibility, and manipulability of materials they would be referencing, while other students relied on the searchability of electronic sources.
- Finding 3. A clear majority of students found the iPad personally useful, carried it with them more often than print materials, and found themselves using it more academically due to its convenience and portability.
- Finding 4. The majority of faculty perceived no effects within the course in regard to participation, comprehension, or change in their pedagogical approach. A few expressed concerns about possible slightly poorer student comprehension and in-class distraction.
- Finding 5. Both faculty and students strongly recommended and preferred digital course materials on a tablet device for student use.

To reach these overall findings, the researchers list the research questions and the supporting propositions. The pertinent information collected from the data collection tools is examined through a supporting propositional question and a preliminary finding is presented. These preliminary findings for each proposition are then consolidated to create an overall finding for the entire research question.

Case Study Context

A better understanding of the findings in this research requires some additional information about the context of the Naval War College's academic programs. The Naval

War College offers two types of educational and military development: a full-time/in-residence program and a part-time/non-resident program. First, the full-time/in-resident program consists of three core courses and three electives. The three core courses are Strategy and Policy (S&P), National Security Decision Making (NSDM), and Joint Military Operations (JMO; 8 credit hours each). The completion of the three core courses provides a military certification designating an individual with Joint Professional Military Education (JPME). The JPME certification is a key milestone in a military officer's career development. With the addition of three elective courses (2 credit hours each), a full-time/in-resident student will also complete the requirements for an accredited Master's Degree. Each student takes one core course and one elective course during the three trimesters in this year-long program. Newport, Rhode Island is the main campus for the full-time/in-residence program.

One of the courses in the iPad pilot program is an elective course in the full-time/in-resident program. The course lasted three months, was pass/fail, and included 43 required readings. Eleven students were enrolled in the course, however one of the students completely opted out of using the iPad, leaving a total of 10 students available to participate in the study. This course was ending as the study started; therefore the students were contacted via their professor to maintain anonymity. In lieu of using class time to complete the survey, the participants were asked to participate in the survey pilot for the study or were provided the link via the researchers' invitation email forwarded from their professor. While the participating students used the iPad for the electives course, during the focus group (focus group D) they could speculate about their use for the increased academic requirements of one of the three core courses. There was one faculty member for this course.

Additionally, the Naval War College offers a variety of part-time/non-resident course options to the officers dispersed throughout the Navy. These programs offer the

three core courses in a variety of formats around the world so that officers have an alternative method of obtaining professional development and the JPME certification while still working at their full time jobs. The curriculum is rigorously standardized regardless of the delivery method. One of these programs is the Field Studies Program, which offers face-to-face evening courses at a variety of locations with a high concentration of Naval officers. Due to the volume of content in these core courses, students meet one night a week for 9 months to cover the vast amount of material. The same material is taught the same week at every location so that when personnel travel, they can attend the class at the other location and not miss valuable class time. The Newport, Rhode Island main campus also offers some evening courses to personnel working full-time in the area. However, these part-time/non-resident students do not receive a Master's Degree. Two evening courses were included in the iPad pilot program. The evening National Security Decision Making (NSDM) course (7 credits) included 16 students and 3 faculty members. Over the course of the 9 months, the students had 130 required readings from 130 separate sources and 41 supplemental readings from 41 separate sources. The evening Joint Military Operations (JMO) course included 18 students, 3 faculty members, 252 required readings from 223 separate sources, and 572 supplemental readings from 540 separate sources. Most readings are articles or segments of books/military publications.

The following information further informs the respondents' feedback provided in this study. Whether full-time or part-time students, all study materials are provided to the students at the beginning of the course and returned at the end of a course. With customary print course materials, this is commonly referred to as the "box of books". The number of materials provided per course was listed above to provide a visualization for how big the "box of books" is to students. With digital course materials, the iPad was pre-loaded in the file structure of iAnnotate. The materials were loaded by week in

accordance with the course syllabus. For example, all readings for a week were collected in order, consolidated into one PDF document, and loaded into iAnnotate with a weekly code file name. The student could then find the week and have all materials for that week immediately available. The students were issued the iPad at the beginning of the course with a one-hour introduction to the basic features of the device. They were authorized personal use of the device, which is counter to typical government policy that discourages/prohibits personal use of government issued items. There is no official policy on what is or is not authorized when using the iPad. Finally, whether issued print or digital course materials, the college operated with the assumption that all students would use personal computers to complete required coursework.

The Naval War College directly supported the learning environment. To provide information to all students, the college utilized the Blackboard learning management system. The college deferred to professors for what was or was not permitted in the classroom. In general, laptops have been highly discouraged in the classroom as a distraction to both students and professors. Unlike a university where laptops are commonly used in the classroom, for the most part the Naval War College professors had not adapted to the shared nature of student attention. As a result, several professors in this study transitioned from no devices in the classroom to competing for attention with the iPad. That being said, because of the newness of the device and its uncertain use in the learning environment, no protocols were set up for its use in the classroom. This additional information provides a broader context to interpret the findings of the research.

Introductory Data and Demographics

Participation in the study was offered to each student and faculty member in the iPad pilot program. This section will briefly cover participation in the student survey,

student focus groups, and the faculty interviews as well as the student demographic information reported on the survey.

Forty-two students in three courses (10 in elective, 18 in JMO, 16 in NSDM) participated in the iPad pilot program, however, two of the students were in both the NSDM and JMO courses so they were only counted once in the total number of students. Of the 42 students, 35 students participated in the student survey, which calculates to an 83% response rate. The researchers believe the response rate was so high based on the support of the college and use of classroom time for the survey during the two evening courses. However, not all of the students answered every question on the survey. The following findings are presented to show both the percentage of respondents who answered similarly, as well as the number of students compared to the total number who answered that particular question.

This research also included student focus groups and faculty interviews. The researchers conducted three separate focus groups timed around the three separate class schedules for convenience of student participation. Each focus group had three students from its respective class. In addition, all faculty members were invited to participate in an interview. There were seven total faculty members (one in elective, three in JMO, three in NSDM). All seven (100%) faculty members voluntarily agreed to participate in the research.

The student survey collected basic demographic information about gender, full-time/part-time residency status, age, government employment status, and previous e-reader experience. These data are descriptive of the students and does not contribute to any correlational determination of the findings themselves. The gender demographic showed 97% (34 of 35) of the respondents as male and 3% (1 of 35) as female. Of the total respondents, a clear majority (86% [30 of 35]) were part-time/non-resident students while only 14% (5 of 35) were full-time students.

The age demographic represents a diverse spread of ages among the student participants. Twenty-nine percent (10 of 35) were age 27-31, 11% (4 of 35) were 32-35, and 23% (36-40) were age 36-40, 17% (6 of 35) were age 41-45, 11% (4 of 35), and 9% (3 of 35) were age 51 or older. Combining the age blocks would consolidate the answers, but leaving the age blocks as submitted on the survey better reveals the distribution of respondents.

The government employment status further illuminates the student demographic. The JPME certification is valuable not only to naval officers, but officers from other military services, reserve officers in the Navy and other services, and civilian personnel from the Department of Defense and other governmental agencies. In this study, 69% (24 of 35) were active duty military, 23% (8 of 35) were government civilians, and 17% (6 of 35) were military reservists. Also unique to military and governmental employees is the potential to work in facilities that are classified and do not permit electronic devices like cell phones or tablet devices on their premises.

Student survey question 6 asked participants if they had previous experience with e-readers prior to start of their current course. A clear majority 85% (29 of 34) did not have prior experience with any e-reader. Three of the five (15%) respondents who had prior e-reader experience answered student survey question 6-2 that asked what devices they had used. Of the respondents, all three reported prior experience with the Amazon Kindle. One of the three had also used the Barnes & Noble Nook, Apple iPhone or iPod Touch as an e-reader, a Palm device and other.

This overall information about study participation and student demographics add further context to the results of the study. The basic foundation shown in the data above provides a base to understand the narrative of the findings of the research questions. The following section will examine the research questions and findings.

Research Findings

The following is a presentation of the findings. Each of the five research questions is supported by multiple propositional questions. These propositions act as a guide to inform the research questions from across the research tools. Each proposition will be given a preliminary finding, which will then be collected into an overall finding for the entire research question. In the coding of the student survey, student focus group interviews, and faculty interviews, this research applied the terms of Sellen and Harper's print affordances. The adopted terms include: print tangibility, print spatial flexibility, print manipulability, and print tailorability (2003). These terms are used throughout the findings. The results of the student survey are found in Appendix M.

Research question 1. How do students perceive reading course materials on an iPad using iAnnotate? The first research question is supported by eight research propositions. Each of the propositions will be presented with supporting findings from the research followed by an overall finding for the research question.

Proposition 1.1. How do students perceive the replacement of print course materials with digital course materials with regard to their frequency of reading? The student survey (7a) asked respondents if they read more or less often when using the iPad and why they believed that they were reading more or less often. Just under half of the respondents (16 of 34 [47%]) felt that they were reading about the same amount of time, while 38% (13 of 34) felt that they read more often. Of those that read more often portability (9 respondents) was the most common reason given. A few of the respondents (5 of 34 [15%]) felt that they read less often, with two giving the reason that they worked in a secure facility in which they were not allowed to take the iPad.

The student focus groups were also asked questions in support of proposition 1.1. Question 3 asked the groups if they found themselves reading course material more

because they were available on the iPad. All but one focus group participant stated that they increased the amount of course material read and their reading frequency. The one participant, who did not perceive he read the course material more, printed his course material for reading. Question 7 asked students how they prepared for class, specifically in regard to their reading of course materials. All focus group participants indicated that there was no change in their reading habits in preparation for class. This was in comparison to their experience reading of printed course materials in prior courses.

Finding 1.1. A clear majority of students (85% [29 of 34]) perceived their frequency of reading to be about the same or more often due to portability.

Proposition 1.2. How do students perceive the replacement of print course materials with digital course materials with regard to their duration of reading? The student survey (7b) asked respondents if they read for longer or shorter periods of time when using the iPad. A majority of respondents (56% [18 of 32]) read for about the same periods of time, while some (28% [9 of 32]) read for shorter periods of time and a few (16% [5 of 32]) read for longer periods of time. The student focus groups (7a) supported the survey finding that the majority of respondents felt that they did not experience a change in their preparation for class.

Finding 1.2. The majority (56% [18 of 32]) of students felt that their duration of reading of course materials was about the same when reading using the iPad.

Proposition 1.3 How do students perceive the replacement of print course materials with digital course materials with regard to their speed of reading? The student survey (7c) asked participants if they read more quickly or less quickly when using the iPad. Forty-seven percent (14 of 30) of the respondents read about the same speed while 30% (9 of 30) read more quickly and the remaining 23% (7 of 30) reported that they read less quickly.

Finding 1.3. While half the students found no change in their speed of reading, others were split on whether they were able to read faster or slower.

Proposition 1.4. How do students perceive the replacement of print course materials with digital course materials with regard to their reading comprehension? Student survey 7d asked if they find that they understand more or less of what they are reading when using the iPad. Of the respondents the clear majority (80% [24 of 30]) understood about the same amount, with an even split of a few remaining respondents, 10% (3 of 30) understood more and 10% (3 of 30) understood less.

Finding 1.4. The clear majority (80%) of students stated reading comprehension is about the same when comparing digital course materials to print.

Proposition 1.5. How do students perceive the replacement of print course materials with digital course materials with regard to their differentiation of course materials? To inform this proposition two survey questions and a focus group question were utilized. Student survey question 9 asked respondents after having read multiple course materials on the iPad if they found it more or less difficult to distinguish which material an idea was from. A little over half (53% [17 of 32]) of the respondents reported no difference in difficulty. Thirty-four percent (17 of 32) reported more difficulty and 13% (4 of 32) reported less difficulty. When asked why they believed it more or less difficult the majority of those who found it more difficult indicated it was due to the lack of print tangibility. As a reminder print tangibility refers to the physical experience of holding a book—seeing the size, cover, color, layout, navigation, how far along on is, or turning over a corner (Sellen & Harper, 2003). Alternatively, as one survey respondent answered, “No muscle memory or contextual clues from electronic media.” Four respondents indicated that their difficulty with differentiation was made more difficult due to the file structure in which the readings were stored.

Student focus group question 8 asked participants about differentiation. Focus group D consisted of participants in an electives course with light reading compared to the other two focus groups; this group had no issues with differentiation of digital materials. Both focus groups F and K were unanimous in thinking that digital course material needed a better file naming and structure system. Participants expressed how multiple readings are grouped within the same document that may be 150 pages long with a file name such as NWC-7045. As one participant stated:

> Perhaps some more compartmentalization of the readings would be recommended because again, we're scrolling through five readings all focused around a single concept or series of concepts that's all supposed to tie it together so that you leave the session with an understanding of a certain concept. (Student K-M)

Focus group F found it difficult in class to follow along when professors referred to information by author, out of the order in which the readings were arranged within the week's course material document. Focus Group F was also unanimous in stating that iAnnotate did make jumping to specific points within a document that was previously annotated easy.

Finding 1.5. The majority (66% [21 of 32]) of respondents perceived no change in their ability differentiate material or less difficulty when having read it on the iPad compared to print. However, the current file structure of digital course materials exacerbated the differentiation issue.

Proposition 1.6. How do students perceive the replacement of print course materials with digital course materials with regard to their class participation? Student survey question 8 asked respondents if they found themselves participating more or less in class after having read course material on the iPad. A majority (70% [21 of 30] of the respondents found themselves participating about the same. Some (27% [8 of 30] participate more while one (3%) participated less.

Finding 1.6. The overwhelming majority (97%) of students participated the same amount or more after having read digital course materials on the iPad.

Proposition 1.7. How do students perceive the potential for distraction with a multi-modal device? Student survey question 11 asked participants if they found themselves more or less distracted with reading on the iPad compared to paper. Over half of the respondents (53% [17 of 32]) found that they were no more or less distracted when reading on the iPad. The remaining respondents were almost evenly split between being more distracted (25% [8 of 32]) and less distracted (22% [7 of 32]). When asked in 11-2 why they were more or less distracted, respondents listed the numerous iPad functions as distractions for those who were more distracted, and of those who were less distracted most stated that they focused better with the iPad.

The student focus group question 7f asked, "Do you get distracted when on the iPad because of all the other things you associate that can be done with it?" All but one participant stated that they were not distracted by the functionality of the iPad. One stated, "when I go to read, I read" (Student F-H). One participant stated that he focused better with iPad by saying:

> I'm probably less distracted. ...I mean, for some reason or another I feel like I can focus more and I can tune everything out with the iPad more than I can do with a computer where I'll go jumping back-and-forth between email and papers and, you know, getting up and watching TV; I tend to focus more with the iPad. (Student F-I)

The one participant who was distracted more on the iPad stated:

> A lot of the stuff quickly becomes information overload and it just becomes a bright, shiny object that distracts from the studies and the academics in there [iPad]. You can't search the weather on a hard-copy of Sun Tzu. (Student K-M)

Finding 1.7. The clear majority (75%) of students did not find themselves more distracted when reading on the iPad. Some found themselves more distracted primarily by numerous other functions they associated with the iPad.

Proposition 1.8. How do students perceive their use of the iAnnotate software? The student survey results in support for this proposition can be found in the student survey results (see Appendix M) questions 12 and 13. In summation, the clear majority (84% [27 of 32] of respondents thought that iAnnotate is easy to use, a majority (59% [19 of 32]) thought the search function made it easy to find passages, a majority (69% [22 of 32]) found it made annotation easy, a majority (63% [20 of 32]) used the markup tools frequently or more, and the top markup tool used is the highlighter.

Student focus groups confirmed the findings of the survey. When asked in question 7b, if they used any of the markup tools in iAnnotate, the highlighter was the most common answer. They also pointed out that the highlight tool was difficult to use in some documents due to the poor quality of the scanned document. Participants also used the mark-up features as a way to navigate back through the documents when referring back to them. Question 7c asked participants if they like iAnnotate. The participants were unanimous in answering that they liked iAnnotate, even student K-M who preferred print materials overall liked iAnnotate. Participants were asked if they took notes on the iPad. One participant from each focus group stated that they used the iPad for taking notes, while the majority did not.

Finding 1.8. The clear majority of students perceived that iAnnotate was easy to use, with a majority using the mark-up tools and search function. The highlight tool was the most frequently used mark-up tool, though occasional poor quality scans made it difficult to use.

Finding for research question 1. The majority of students found that reading course materials on an iPad using iAnnotate did not affect the duration of reading, speed of reading, reading comprehension, or class participation. The file structure exacerbated differentiation issues. While most students were not distracted by the additional functions of the iPad, others presented mixed opinions about whether they were more or less

distracted while using the device. A clear majority perceived their frequency of reading as about the same or more often due to portability. Finally, the iAnnotate software was found easy to use in both mark-up tools and searchability. Overall, reading course materials on the iPad with iAnnotate was found to be as good as or better than print materials.

Research question 2. How do students perceive the use of the Apple iPad as an academic tool outside of assigned course readings? The second research question is supported by three propositional questions. Each of the propositions will be presented with supporting findings from the research followed by an overall finding for the research question.

Proposition 2.1. How do students perceive the use of additional functions with a multi-modal device related to academic use? Three student survey questions and a focus group question were used to support this proposition. Student survey question 14 asked if they used the iPad to lookup supplementary academic materials outside of reading course materials in iAnnotate. A majority (66% [21 of 32]) answered that they lookup supplementary academic materials frequently or very frequently, 22% (7 of 32) answered occasionally and none answered rarely or not at all. Respondents were asked to list what sources they used most frequently. The most frequently reported source was Wikipedia, followed closely by Google and then various news sources. Student survey question 15 asked respondents if their instructor(s) had incorporated the iPad into the course beyond the preloaded course reading materials. Of the respondents, 61% (19 of 31) answered yes, while 35% (11 of 31) answered no, and 3% (1 of 31) were unsure. Of the uses, respondents most often stated additional web hyperlinks were given, some stated Blackboard material, and a few stated that it was used as a quick reference during course discussions.

Student focus group question 5 asked if they had found any academic uses for the iPad outside of the course readings. Focus group D stated that the iPad made it more convenient to lookup additional information on terms and concepts from either their readings or what was discussed in class. Focus group F stated that they used it to follow along in class, as one participant stated:

> it's incredible, especially for JMO where they actually have the PowerPoints listed for that class that day. I could follow along on there [on the iPad], while they're doing it on the screen. It just makes it a lot more easier and it's easier for me to be engaged with it instead of trying to strain and look at what's on the screen, especially when they're walking back-and-forth in front of it. I have it all right there in front of me so it makes it very easy to follow along the class because of that. (Student F-G)

Focus group K found that they check the course's Blackboard website more often with the iPad and one participant admitted that he used it to search for military acronyms and other unfamiliar terms without disrupting class.

Finding 2.1. A majority of students perceived that they frequently used additional functions of the iPad for academic purposes either to enhance their personal study or their classroom learning.

Proposition 2.2. How do students perceive the replacement of print course materials with digital course materials with regard to their desire to print course materials? How much and why? One student survey question and one student focus group question was used to support this proposition. Student survey question 16 asked respondents if they had printed or desired to print the course readings that were stored on the iPad. The potential answers served two categories: the desire statements and the action statement. Respondents were asked to mark all that apply. A total of 49 responses were given by the 31 respondents. The action statement "I have not printed course materials" received the most responses (55% [17 of 31]), while "I have printed course materials received 26% (8 of 31). Of the desire statements, 45% (14 of 31) selected "I have desired to print course materials" and 32% (10 of 31) selected "I have

not had the desire to print". Of those who printed or desired to print, the reason most often given was the printing of source documents to use while writing assigned papers (print manipulability).

It is important to reiterate that one segment of the survey respondents took an elective course, which, compared to the other core requirement courses, had comparably light reading and assigned primarily thought-based papers instead of research-based papers. When elective course respondents were removed, the data reflects a considerably different outcome. For the desire statements, 52% (14 of 27) of respondents selected "I have desired to print course materials" and 33% (9 of 27) of respondents selected "I have not had the desire to print". For the action statements, "I have not printed course materials" received the most responses (44% [12 of 27]), while "I have printed course materials" received 30% (8 of 27). The most significant change in the data when elective course respondents were removed was in the desire to print, changing from 45% to 52%.

Student focus group question 6 asked participants if they had printed anything or had desired to, and if so, what. Focus Group D (representing the elective course) was unanimous in having not printed anything or even desiring too. Focus groups F and K both printed sources for writing papers. This was done by after highlighting their material in iAnnotate, then printing the highlighted references. As one participant stated:

> I came in early yesterday and printed out, I'd say, about 20-pages ...for an upcoming paper I have due next week. I highlighted on the iPad so I know where it is and I can see what's important and what's not important and I print it off if I have a paper due. ...That's usually the only time I would print anything, would be if I have got multiple sources. I want to be able to have it right in front of me where I can just pick it up, look at it, put it back down and I guess the iPad makes it a little bit more difficult to do that. (Student F-I)

Student K-M stated that he prefers printed material and works in a secured workspace where the iPad is not allowed. Thus, he prints all of his course material.

Finding 2.2. A slight majority (52% [14 of 27]) of students taking core requirement courses have had the desire to print course materials motivated primarily to work with references when writing papers. Thirty percent (8 of 27) of students taking core requirements have printed some course materials.

Proposition 2.3. How do students perceive the replacement of print course materials with digital course materials with regard to writing a course paper? Both a student survey question and a focus group question support this proposition. Student survey question 17 asked respondents their preference for electronic course materials or traditional printed course materials with writing an assigned paper or course project. Forty-seven percent (15 of 32) of respondents preferred print, 28% (9 of 32) preferred electronic, and 25% (8 of 32) had no preference. As presented in the previous proposition, respondents from the elective course had comparably light reading and thought-based papers compared to the research-based papers of the core requirement courses. When elective course respondents were removed there was only a 1% shift in preference from print to electronic. Respondents were asked why they preferred one over the other. Of those that preferred print, the majority did so primarily due to print tangibility and a few cited print spatial flexibility and manipulability. For those that preferred electronic materials, searchability was the most common reason given.

Focus group question 9 asked participants their process when preparing to write, including how they gathered their materials and pulled what they needed from them. Focus group D participants responded unanimously that in their elective course their papers were thought papers not reference papers. They primarily take notes and quotes electronically and cut and paste them for their papers. Focus groups F and K were unanimous in printing specific sources for assigned papers with the exception of one student who as previously stated he prefers print and prints everything out. The most

common process in preparing to write is best described by students F-I and K-L as follows:

> Well, I'm working on one right now, so like I said earlier, I normally would print the sections off that I feel are relevant to the paper. I would highlight them, underline them on the iPad and print them off and they would show up just like that in the iPad and then I would take that and prioritize it, what I want, you know, figuring out my thesis, what I want to write about and then I would start writing. But I would gather all my sources first, so I would spend a day or two making sure I have all my sources, then I would print the sources out, put them in front of me, prioritize them. "Okay, most important, least important. The first thing I'm going to talk about, second thing, third thing and then conclusion" and then I would start typing the paper out after that. (Student F-I)

> Yeah, I do the same thing. And then I just find myself writing, once again, writing a paper. That I'm at the desktop writing a paper and referring to the hard copies and kind of discarding them as I go, "Okay, I've covered that one, I've used that one, I used that one, kind of thing." (Student K-L)

Finding 2.3. When writing course papers, slightly less than half of students preferred printed course materials, primarily for the reasons of tangibility, spatial flexibility and manipulability of printed materials. Some preferred electronic materials primarily for searchability, while a quarter of respondents had no preference.

Finding for research question 2. The majority of students perceived the Apple iPad as a useful academic tool, frequently using it to enhance personal study and classroom learning. When writing reference papers, slightly less than half of students printed resources due to the need for tangibility, spatial flexibility, and manipulability of materials they would be referencing, while other students relied on the searchability of electronic sources.

Research question 3. Do students perceive that the multi-modal functions of the Apple iPad increase personal use, thereby increasing their academic use of the device? The third research question is supported by four propositional questions. Each of the propositions will be presented with supporting findings from the research followed by an overall finding for the research question.

Proposition 3.1. How do students perceive how often they use the iPad for reading course materials? A student survey question and a focus group question were used to support this proposition. Student survey question 18 asked respondents how often they used the iPad for reading course materials. Slightly more than half (53% [17 of 32]) of the respondents reported that they read course materials multiple times a week, but not daily. Some (22% [7 of 32] read daily with 1 respondent reading multiple times a day. A few (16% [5 of 32]) read weekly while 2 respondents (6%) indicated that they read less than weekly.

Focus group question 3 asked participants if they found themselves reading course materials more because they were on the iPad. Focus group D reported no change in their reading habits due to the comparatively light amount of reading assigned, though they did picture themselves reading more often if they were using the iPad for a normal course. Focus group F found themselves reading more and more often because of the convenience, portability and comfort of use that the iPad provided. Likewise, focus group K found themselves more likely to read more by having the course materials on the iPad with the exception of one student who did not use the iPad for reading course material.

Finding 3.1. A majority (78% (25 of 32) of students reported that they used the iPad for reading course materials multiple times a week or more. Most found themselves reading more often due to the convenience, portability, and comfort of the iPad compared to printed course materials.

Proposition 3.2. How do students perceive how often they use the additional functions of the iPad other than reading course materials? Proposition 3.2 is supported by one multi-part question from the student survey and one focus group question. The student survey asked respondents in addition to course readings, how often they used the iPad for: note taking, reading email, writing email, news reading, web browsing,

media consumption, gaming, and other applications not listed. The results for this question are presented in the student survey results (see Appendix M) question 19 parts A through H. When answers from across activities are combined, a clear majority (81% [26 of 32]) of participants reported using the iPad in at least one activity multiple times a week. A majority (56% [18 of 32]) reported that they used the iPad for at least one activity daily and some (25% [8 of 32]) used it for at least one activity multiple times a day. Outside of reading course materials, web browsing was the most popular activity, followed by reading emails and news.

Student focus group question 2 asked participants how often and how they used the iPad outside of reading course material. Instructions on permissible usage of the iPad were not made clear to participants in the elective course, focus group D. Two participants did not use the iPad much outside of reading course materials. One participant in focus group D used the iPad quite a bit to lookup academically related terms and concepts in addition to personal web browsing. All members of both focus groups F and K reported daily use of the iPad for web browsing, news reading, and checking email.

Finding 3.2. A clear majority (81% [26 of 32]) of respondents reported using the iPad for at least one activity multiple times a week or more. Web browsing was the most popular activity.

Proposition 3.3. Do students perceive that they have the iPad with them more often than printed course materials? Student survey question 20 asked respondents if they carry the iPad with them more or less often than they would print course materials. Of the respondents, a majority (combined 72% [23 of 32]) carried the iPad either much more often (47% [15 of 32]) or more often (25% [8 of 32]) than printed materials. A minority (19% [6 of 32]) of respondents reported that they carried it about the same amount and a few (9% [3 of 32]) carried it less often.

Student survey question 20-2 asked students who carry the iPad more often whether they find themselves using it more or less often for academic purposes than they would use printed course materials. A clear majority (82% [18 of 22]) of respondents used the iPad more often for academic purposes than they would have used printed course materials. The remaining minority (18% [4 of 18]) who answered that they carried the iPad more often, reported using it academically about the same as they would have print course materials.

Finding 3.3. A clear majority (72% [23 of 32]) of students perceive that they have the iPad with them more often and they use it more often for academic purposes than they would print course material.

Proposition 3.4. How do students perceive their use of the iPad for personal use compared to academic use? Student survey question 21 asked respondents how much they use the iPad for personal use compared to academic use. Of the respondents, a majority (63% [20 of 32]) used the iPad more often for academic use. A few (9% [3 of 32]) used it equal amounts for academic and personal use and some (28% [9 of 32]) used the iPad more for personal use.

Finding 3.4. A majority (63% [20of 32]) of respondents perceived that they used the iPad more often for academic use than they did for personal use.

Finding for research question 3. A clear majority of students found the iPad personally useful, carried it with them more often than print materials, and found themselves using it more academically due to its convenience and portability.

Research question 4. Do faculty perceive any effects within the course from the replacement of traditional printed course materials with digital course materials? This research question is informed by four propositions. Each of the propositions will be presented with supporting findings from the research followed by an overall finding for the research question.

Proposition 4.1. How do faculty perceive the replacement of print course materials with digital course materials with regard to student participation? This proposition was examined through two faculty interview questions. Faculty interview question 2 asked faculty members how they perceived that the iPad had changed the classroom experience. Three of the professors did not think that the iPad had changed the classroom experience. Two of the professors were unsure of where the students' attention was directed in class and found it to be personally distracting, describing it as a "sea of iPads" (Professor X). Professor V also found the "sea of iPads" distracting at first, but now finds the iPads are useful in augmenting course discussions. The remaining professor described himself as undecided.

Faculty interview question 3a asked faculty members if there were any differences in student participation compared with traditional courses that they taught. Question 3b asked about differences in course discussions related to student use of the iPad. Four of the professors had mildly negative observations. Professor V found that the iPads provided a mild distraction, but did not feel that there was a change in course discussion. Three faculty members did not feel there was a change in participation, but suspected students may have had a slightly poorer grasp of the material. Professor X stated his hesitation:

> How do I say this? I perceive a lack of having grasped the material as well. And I don't know why I say that, because I don't have anything. It could just be this seminar. (Professor X)

Three professors found that there was no difference in either participation or course discussion, with one of them finding the iPad positively aiding in augmentation of course discussions by being a quick reference tool. Additionally, Professor P had this observation:

> I thought it [the iPad] was going to be a major one [change] and I thought it turns out it's not that major. I just got finished teaching my course and I really didn't think it changed it as much as I thought it was and I have a reason. I think I know

> the reason for that. We provided them to students and faculty of our pilot program. We didn't provide them to curriculum developers. If you want to change the classroom you have to give it into the hands of the people that are developing the lesson plans so they can incorporate the device into the presentation of the lesson, you don't do that, it's, I don't think it's going to have a major impact. (Professor P)

Finding 4.1. The majority of faculty did not find a change in student participation or course discussion. Some felt that the iPads might be mildly distracting in class while one felt that they had a positive effect on course discussions. Some felt that students may not be grasping content quite at the same level as previous courses but could not differentiate if it was due to digital course material or due to the current set of students in the seminar.

Proposition 4.2. How do faculty perceive the replacement of print course materials with digital course materials with regard to student comprehension? This proposition is informed by three faculty interview questions and the finding presented in support of proposition 4.1. Faculty interview question 3c asked faculty members if there were any differences in academic writing compared to traditional course that they taught. Of the 7 faculty members, 6 (86%) found no differences in the students' academic writing and one faculty member was undecided. Faculty interview question 3d asked if faculty members found students more or less prepared when they arrived in class. Four professors felt that there was no change; one professor observed that students were more likely to have their readings open in class, while two professors felt that students were less prepared when they arrived. One professor was undecided because he could not differentiate between seminar dynamics and digital course materials stating, "Perhaps marginally less but I'm not sure. Again, my data is little thin here. I can't make any definitive conclusions at this point"(Professor R).

Faculty interview question 4 asked faculty members if they felt that students in the pilot program are gaining more or less from the readings compared to other classes.

Six of the seven faculty members found no difference, while one faculty member felt that students were possibly gaining less from the readings and was concerned with students' depth of understanding.

Finding 4.2. The clear majority of faculty perceived no difference in regard to student comprehension, while some felt that student comprehension was a little lower.

Proposition 4.3. How will faculty change pedagogical approach in regard to the replacement of print course materials with digital course materials? Two faculty interview questions, a student survey question and a student focus group question were used to support this proposition. Faculty interview question 5 asked faculty members if using the iPad for course materials altered their approach to teaching. Faculty members were unanimous in stating that they did not change their approach to teaching. One professor did admit to roaming the room more to get a sense of what students were doing. Professor N observed that students do access the readings when they are mentioned in class, stating:

> sometimes when I refer to something in one of the readings, some of the students seemed more prone to go right to it on the iPad, where fewer with the paper correspondence would have actually picked up the paper and said, let's go back and review that part. So it seems like it's more, (pause) the students are more prone to use it as a short notice reference. (Professor N)

Professor X stated that he plans to change his pedagogy in the future, lamenting having his presentation slides available before class:

> I will change as a result. I won't put up anything, any of the slides up on the iPad [Blackboard], anymore, or have them have access. See, they gain access to my slides through Blackboard on the iPad. And in order to get their attention more focused on me and not down in the iPad, next year I won't put the slides on Blackboard until the day after class. So they can go back and review… (Professor X)

When asked by the interviewer whether students had access to the slides before class in the past, he responded:

> Yes, the iPad wouldn't have made any difference. What they do is burn them off and bring them to class. So that has gone away. Even with the iPad, I see

> students with copies of the slides printed in front of them with the iPad (laugh). Some students like to take notes on the slides. That is going away. (Professor X)

Faculty interview question 6 asked faculty if they have used the other iPad features outside of the course reading for course enhancement. Five of the professors had not used iPad features outside of course reading for course enhancement. Professor V reported using the iPad personally to aid in lecture presentation as well as to enhance the class through email and Blackboard access. Professor V observed that iPads enhance learning because of the immediacy with which students have access to materials on Blackboard.

Student survey question 15 asked participants if their instructor(s) incorporated the iPad into the course beyond the preloaded course reading materials. Sixty-one percent (19 of 31) responded that they had, while 35% (11 of 31) answered no, and 1 (3%) was unsure. Of those who answered yes, respondents noted that the faculty had given them additional web-links, provided additional access to materials on Blackboard, and had them use the iPad as a quick reference and web search.

Student focus group question 4 asked participants if faculty members had them use the iPad outside of reading course materials. Focus group D stated that faculty did not have them use the iPad outside of reading course materials. Focus group F answered that a professor occasionally sends out a link via email, and the professor occasionally has people look things up in class. Student F-I stated:

> if something pops up in class and the instructor doesn't know the answer or if someone asks a question, "Hey, pull out your iPads and look this up for me", and 30-seconds later someone has the answer to the question everyone was curious about and without the iPad we would never have been able to that.

Focus group K answered that the professor did not have them use the iPad outside of the reading, but that it did give them greater access to Blackboard.

Finding 4.3. Faculty members were unanimous in their perception that they did not change their pedagogical approach. A majority of faculty did not use features outside

of course readings on the iPad for course enhancement, though they did observe the immediacy with which students had access to materials. A few students observed the iPad's use in class as a quick reference to augment course discussion.

Finding for research question 4. The majority of faculty perceived no effects within the course in regard to participation, comprehension, or change in their pedagogical approach. A few expressed concerns about possible slightly poorer student comprehension and in-class distraction.

Research question 5. Do both faculty and students recommend and/or prefer digital course materials on a tablet device? This research questions is informed by four propositions. Each of the propositions will be presented with supporting findings from the research followed by an overall finding for the research question.

Proposition 5.1. After experience with digital course materials, do students prefer printed course materials or digital course materials? One student survey question and one student focus group questions were used to inform this proposition. Student survey question 23 asked respondents which format they preferred for course material: digital or print. Of the respondents, a clear majority (78% [25 of 32]) preferred digital course materials, a few (13% [4 of 32]) were indifferent and 3 (9%) preferred print course materials.

Student focus group question 1 asked participants which format of course materials they preferred; digital course material in iAnnotate or printed course materials. Focus group D was unanimous in not having a preference, but all wanted more time with digital course materials on the iPad. They were also unanimous in pointing out the issues in attempting to highlight PDF files that were poor quality scans. Focus group F was unanimous in preference for digital course material on the iPad. Two of the three participants in focus group K preferred digital course material on the iPad and one student preferred printed course material. Portability and convenience were primary

factors for participants that preferred digital course materials. One student best stated this sentiment:

> I have never liked reading off the screen, I always wanted to have it in front of me, where I can flip pages, where I can highlight myself. Having it on the screen, I didn't know if I'd prefer that very much. But the iPad is similar to a book, I mean the screen looks the same, you're tapping it, its changing pages, I mean I've become very, very used to it over the last six months. I never used any type of e-reader before now. Because I like the iPad so much, I've since bought my wife a Kindle and she fell in love with that. So, we've become e-reader family over the last six months. So I feel like, yes, I would prefer the digital material and as he said, being able to locate the section number, click on it, and it brings up all the readings. Click on it again and it is right there. I think last year I would get lost certain weeks; does this reading go with this, does this book go with this night. I would have to pull up the syllabus, find the page then go through my box of thirty books, figure out which book goes with which night and that took twenty or thirty minutes to do. And the iPad is just convenient too. I wouldn't obviously take the books on trips and I have traveled. I went down to Florida recently... and I was able to keep up with the readings on the plane. I was able to keep up with the readings while visiting with family and obviously I would have never been able to do that, taking around a big box of books on the plane. So, the convenience is good too. (Student F-G)

The student who exhibited a preference for print course material best described his preference in the following statement:

> I'm a printed material kind of guy so I prefer reading, in fact, I've printed tonight's readings on paper and I brought it with me. I prefer that functionality because, especially with around paper writing time, rather than just being shuffling through different readings or looking through concepts, having all the materials in front of me, I usually tag out with post-it notes of important concepts or reference points, and spread them out all on the bed or the desk, wherever I'm working and see the forest as a function of the individual trees. And it's harder with the iAnnotate to reference back. I understand that there's a little highlight function, things like that, but I'm still a more of a neo-luddite and I prefer to have my hard copy in front of me. (Student K-M)

Finding 5.1. A clear majority (78% [25 of 32]) of students prefer digital course materials, primarily for portability and convenience.

Proposition 5.2. After experience with digital course materials, do faculty prefer printed course materials or digital course materials? Three faculty interview questions were used to support this proposition. Faculty interview question 1 asked faculty members for pros and cons of using digital materials. Six of the 7 members

acknowledged the iPad's portability, which consolidates all student materials in one place. Professor X stated:

> they have all the materials in one spot. It is much more readily transportable than if they had individual books or readings. ...we used to give them a very large box of books. This drastically decreases that. Not all of it, but the vast majority of it. That is one of the biggest advantages. One stop shopping with everything in front of you.

Another pro given was the search function, both within the reading material and Internet search. Two professors pointed out the ability for real-time search in class that aided in augmenting class discussions. There was a greater variation in responses given for the cons of using digital course materials. Professors N and L perceived no cons. Professors X and V felt personally distracted and reported feeling unsure of student attention in class. Professor V stated:

> I haven't seen to many negative occurrences with it. It is kind of, I wouldn't say daunting, but your first couple of classes when …a number of folks are looking down instead of looking up. It can get a little, what can I say, it's a funny feeling. It's something that I haven't run into before. But as far as using these types of devices, I have no problem with it.

Professor P had concerns with the possibility of outside distractions through functionality such as email, stating:

> Obviously, the negative is you're in competition; you're in constant competition with outside requirements, personal life, media devices now, for their attention. We teach in a night course, all our students are not full-time students, they are part-time students, so they have day-to-day life activities that are going on. They come to us with that on their mind and this [the iPad] provides an opportunity for them to escape back into that world after we've pulled them out by doing maybe an e-mail, etcetera.

Professor T thought that digital course material lacked the easily recognizable visual cues for recall of flagged documents compared to paper with sticky flags inserted. Additionally, Professor R shared a concern stating, "I'm not so sure the students are internalizing the concepts of the same depth" and went on to explain that he felt that way due to the potential to search for key terms and not take time to think and reflect.

Faculty interview question 1b asked faculty members if they preferred digital course materials over print course materials or preferred print over digital. Three of the professors preferred printed course material for themselves while preferring digital course materials for students. Two professors had no preference regarding which to provide to students, while Professor N preferred digital materials for students and both types for himself, using paper for notation and both digital and print for consumption. Overall, 5 of the 7 professors (71%) interviewed preferred digital course materials for students while the 2 (29%) remaining had no preference.

Finding 5.2. After obtaining experience with digital course materials, the majority of faculty preferred digital course materials for students, however several noted individual apprehensions. A clear majority of faculty preferred print materials for their own use.

Proposition 5.3. Will students recommend the replacement of printed course materials with digital course materials for future courses? Three student survey questions and two student focus group questions were asked in support of this proposition. Student survey 22 asked respondents if they would recommend or oppose the delivery of course materials on a tablet device for future courses. Of the respondents, a resounding majority (88% [28 of 32]) recommended digital course materials, while a few (9% [3 of 32]) were indifferent and one (3%) opposed. Of those that recommended digital course materials, 64% (18 of 28) answered that they strongly recommend them.

Student survey question 25 asked respondents if they would recommend the continued use of a tablet device or another device for future courses. Of the respondents, a clear majority (77% [24 of 31]) preferred the Apple iPad. A few (16% [5 of 31]) were indifferent, preferring any tablet device, while 2 (6%) reported that they would

prefer another device, but did not give a recommendation. No respondents (0% [0 of 31]) answered that they prefer no devices or would not recommend the use of any device.

Student survey 24 asked respondents for their opinion regarding what could be done to improve the use of electronic materials. The most common answer dealt with the file structure that housed the course materials, desiring clearer organization of smaller files referenced by author and title. Two answers tied for the second most popular way to improve electronic course material. The first answer addressed improving the quality of PDF documents provided, citing that poor quality PDF limited the ability to highlight in some documents. The second answer reflected students' desire to be able to print select readings directly from the iPad.

Focus group question 10a asked participants if they would recommend the use of digital course materials for future courses. Focus groups D and F were unanimous in their recommendation of digital course materials. Student F-G offered this example:

> for JMO and NSDM it is 10-times better having it on the iPad. …From people who have visited our class, you can see the jealousy in their eyes from us being able to use the iPad. …They were coming and lugging in these books all tapped out. …With two clicks of a button, I can pull up the exact section, …that we're talking about and be able to reference it. If it is a part of the discussion during class, which then, they are trying to lookup and flip through [to find] it with one book and then they have to reach over and grab the other one. So, yeah, the iPad is definitely …I mean, the way to go.

In focus group K, two participants strongly recommended digital course materials, while the third gave his recommendation this way:

> Yes with a caveat. If it's offered, I will take another iPad again. If given the option, I would prefer to take hard copies. ...I think you would probably find some people who are maybe in a minority that would prefer hard copies. And every student is a different learner, learning style, and will be able to write more efficiently and write more effectively if they get the materials at their level. So I would recommend the iPad. It's great. And again, I don't carry around three linear feet of books everywhere now, which is great. But I still prefer to have …some hard copy in my hands that I can use, even if that necessitates lugging around 50 pounds of books twice a semester. (Student K-M)

Student focus group question 10b asked participants how digital course materials in iAnnotate on the iPad could be improved. Focus groups F and K talked at length about improving the file naming convention, citing the need to label files with descriptive names that would be more relatable and suggesting that readings be broken into smaller separate files. Student K-L pointed out:

> the difficulty in differentiating between the articles or the pieces because they all kind of run together because of the ways you're looking at them. It's like this conveyor belt of information. It's tough to differentiate between.

Student K-N further described the readings:

> The way they're broken up now is by date. So you go into the date for that class and there's all your readings. There's 150 pages and while they are, when you look at them, you know they're separate articles that you're reading and there are different topics. They were all clumped together.

Other recommendations included having some way for the students to have the option to keep the iPad at the end of their course, and the option to make a 3G iPad available (3G referring to wireless data access from cellular service).

Finding 5.3. The resounding majority (88% [28 of 32]) of students recommended the use of digital course materials for future courses, but strongly emphasized the need for readings to be broken into smaller file segments with an improved, more relatable file naming convention. In the end, all survey respondents recommended the use of a tablet device.

Proposition 5.4. Will faculty recommend the replacement of printed course materials with digital course materials for future courses? Two faculty interview questions were used in support of this proposition. Faculty interview question 8 asked faculty members if they would recommend or oppose the delivery of digital course materials on a tablet device for future courses. The clear majority (86% [6 of 7]) of faculty recommended the use of digital course materials and 1 (14%) was undecided. Faculty interview question 7 asked faculty members what could be done to improve the

use of digital materials. Professor X pointed out that he intended to establish clearly defined protocols for in-class conduct. Professor V recommended that the school needed a dedicated group to oversee the iPad program and course materials. Professor T requested a better way of being able to instantly recall what has been annotated. Professor R expressed potential concerns with document copyrights and the possibility of recording course discussions. Professor P recommended the addition of a presentation app such as Keynote. Professor N recommended the investigation of in-class use for real-time interaction and collaboration opportunities. Professor L thought that digital course materials could be improved through further investigation to ensure that the adoption of new technology enhanced students' learning experience.

Finding 5.4. The clear majority of faculty (86% [6 of 7]) recommended digital course materials for future courses and noted that their use could be improved through further investigation.

Finding for research question 5. Both faculty and students strongly recommended and preferred digital course materials on a tablet device for student use.

Summary

This chapter presented the overall findings of this research. First, supplementary information about the Naval War College academic programs and an overview of the survey and demographic information was provided. Then, the information collected from the student survey, student focus groups, and faculty interviews was applied to the supporting propositions of the research questions. Once examined, a preliminary finding was presented for each supporting proposition. These preliminary findings were combined to create an overall finding for each research question. The following chapter includes an analysis of the findings as well as conclusions and recommendations.

Chapter 5: Analysis, Conclusions and Recommendations

Overview

This study sought to gain a better understanding of the e-reader phenomenon in the academic environment. The purpose of this study was to explore what could be learned from pilot program participant perceptions in regard to substituting traditional printed course materials with electronic course materials presented via iAnnotate on an Apple iPad. Chapter 4 presented the following findings of this research:

- Finding 1. The majority of students found that reading course materials on an iPad using iAnnotate did not affect the duration of reading, speed of reading, reading comprehension, or class participation. The file structure exacerbated differentiation issues. While most students were not distracted by the additional functions of the iPad, others presented mixed opinions about whether they were more or less distracted while using the device. A clear majority perceived their frequency of reading as about the same or more often due to portability. Finally, the iAnnotate software was found easy to use in both mark-up tools and searchability. Overall, reading course materials on the iPad with iAnnotate was found to be as good as or better than print materials.
- Finding 2. The majority of students perceived the Apple iPad as a useful academic tool, frequently using it to enhance personal study and classroom learning. When writing reference papers, slightly less than half of students printed resources due to the need for tangibility, spatial flexibility, and manipulability of materials they would be referencing, while other students relied on the searchability of electronic sources.

- Finding 3. A clear majority of students found the iPad personally useful, carried it with them more often than print materials, and found themselves using it more academically due to its convenience and portability.
- Finding 4. The majority of faculty perceived no effects within the course in regard to participation, comprehension, or change in their pedagogical approach. A few noted concerns about possible slightly poorer student comprehension and in class distraction.
- Finding 5. Both faculty and students strongly recommended and preferred digital course materials on a tablet device for student use.

Chapter 5 will analyze these findings in the following segments: (a) usability, (b) disparity between faculty and student perceptions, (c) personal and academic use of a multi-modal device, (d) impact on learning, (e) substitution of printed course materials with digital course materials, and (f) diffusion of innovation. Following this analysis of the findings is a list of conclusions and recommendations.

Analysis

At the beginning of this research, a review of the literature showed an enduring preference for p-books due to the lingering problems with electronic text. However, the introduction of the iPad as a tablet device merged electronic text and e-reader functionality with a multi-modal device. The following question was posed: would the combination of these factors finally address the problems that held back the diffusion of e-reading—particularly in an academic environment? This following analysis of the findings informs the future adoption of the device in the academic environment.

Usability. The majority of previous research conducted about electronic text and e-readers addressed numerous concerns about usability. This study inquired about the range of usability features and whether these concerns were resolved with the use of the

Apple iPad and/or the iAnnotate application on an Apple iPad. Findings 1, 2 and 3 all address the various functions of the usability of the device. These results are compared to a consolidated list of desired features established in previous literature followed by an in depth analysis of the remaining usability issues uncovered during the course of this research.

Early research indicated several desired features of e-readers. Of these, several features were met with the capabilities found in the Apple iPad and/or iAnnotate software. The results of this study are compared with the following list of desirable features of e-reading on an e-reader:

1. Portability
2. Navigation
3. Searchability
4. Legibility
5. Ease of Use
6. Annotation Tools
7. Ergonomic comfort (looking at screen, easily held (weight))
8. Content Integration
9. Durability
10. Note-taking
11. Battery Life
12. Ease of Loading
13. Color
14. Sound
15. Ample Storage
16. Ample Screen Size
17. Accessibility (for ADA compliance)
18. Access to additional functionality (web browsing, email, animation)
19. Ease of Printing
20. Keyboard

(Abram, 2004; Baker, 2010; Bell et al., 2002; Chu, 2003; Cliatt, 2010; Dominick, 2005; Lee, 2009; Marmarelli & Ringle, 2010, 2011; Nielsen, 2009, 2010b; Noorhidawati & Gibb, 2008; Rogers, 2003; D. Rowlett, personal communication, Septemer 14, 2010; Schcolnik, 2001; Simon, 2001a, 2001b; Vernon, 2006)

Overall, the participants in this study expressed satisfaction with several of these usability aspects of the device. Students made positive comments about the iPad itself, such as portability, ease of use, ergonomic comfort, legibility, access to professor materials, and screen size. Of those that read more often, portability was the most

common reason given. In the focus group, student D-B stated, “it’s a pound and a half little thing, it fits in my bag, I can take it wherever I want and go read from it and that’s the goal.” Student F-G stated “It’s a lot more comfortable for me to sit in my chair, reading off the iPad vice having to lug a book around reading it.” Also, students commented on the immediacy of accessing professor-created materials while using the internet feature of the iPad to access the Blackboard learning management system. The design and features of the iPad itself contributed to students’ satisfaction with these features.

Other positive comments were related to the iAnnotate application. From the survey, 84% (27 of 32) found iAnnotate easy to use, 59% (19 of 32) found searchability easy, 69% (22 of 32) found the annotation tools easy to use, and 63% used the annotation tools frequently or more. A survey respondent declared the iPad was “easier to annotate—no need to carry pens, pencils, and highlighters.” Student F-I stated:

> I use the highlight and the underline probably 75% of the time, so those are the two that I most commonly use. But I also use the text box…it’s the box where you can type and then it stays and you can minimize it or bring it back up. I use that too… if there is a certain piece from that reading that I may use for a paper or I know that maybe we’re going to talk about that night in class and I need to quickly refer back to it, I type a little note in there and put in bold.

The comment by student F-I ties together student use of the annotation tools with class participation and preparing to write a paper. Finally, some features like the durability, battery life, storage, color, ease of loading, and accessibility were transparent to the participants and not mentioned directly as issues or concerns. Combined, several usability functions of the iPad and iAnnotate software enhanced the learning environment.

Counter to the many positive aspects of the iPad’s usability, this study revealed potential issues with the use of the Apple iPad and iAnnotate application in the academic environment. Areas of improvement include the file structure, file naming, PDF quality,

content integration, and keyboard. As a reminder, the iPad was preloaded in the file structure of iAnnotate. The materials were organized by week in accordance with the course syllabus. For example, all readings for a week were collected in order, consolidated into one PDF document, and loaded into iAnnotate with a weekly NWC-00XX code file name. The student could then locate the week's file and have all materials for that week immediately available. However, several issues derived from the presentation of course materials in this manner.

First, students had a variety of comments about the weekly file structure and consolidation of materials into one large document. The file structure contributed to navigation problems in scrolling versus paging and differentiation issues. Schcolnik (2001) examined the navigation mode for presenting text material by paging or scrolling. In her research, she found 90% of polled users preferred paging in the portrait layout. Consolidating the weekly material into a vertically scrolled PDF also compounded the differentiation issue of segmenting articles from each other. As student K-N stated, "To me, I don't lose the content, but the articles kind of morph into each other more readily if you will." Student K-M made a similar comment regarding the file structure:

> They're all in the same file. So if you compartmentalize those readings in a way that a book would be compartmentalized from a separate book, then I think the human mind works like a file cabinet. It really does. So they've done it to some degree in here, and maybe looking at how to break those readings down into small chunks so that they're not just one long streaming 150, 160-page document would maybe help with the memory protection and the compartmentalization of the concepts and readings.

Participants agreed that while the weekly file system made assigned weekly readings easier to locate and access, it also made the materials more difficult to differentiate when focusing on analysis and synthesis of concepts.

The coded file naming further complicated the weekly file structure. Students mentioned issues with connecting concepts, titles, and authors in the high volume of material. Student F-H stated:

> You know, I really don't care for the way they list things. NWC-8345; that doesn't mean anything to me, you know. If they put a name to it, it would be so much nicer because in class sometimes they even will mention who the author was. I don't know, you know, you guys teach this everyday; I'm just one of the students going by. You may be giving me more of a descriptor than a number or maybe the guy's last name, the author.

Student F-G in the following statement echoed the lack of connection with title and author:

> For me, usually they're pretty good on stating like, which block we're in. So they'll go like, 7.1. And then the way they have it in the iPad is separated by 7.1. And usually when they do the discussion, they'll go in order. But when they don't do that, and then like they said, you have to try to figure out which one it was; as long as they give me the title or something, and then I can sometimes [find my place]… but then even still, because like he said, it is under that NWC, I have to pull that up and then flip through and then see what the title was. And sometimes they'll have multiple readings by the same author so sometime even giving the author name doesn't help because we might have had two or three readings by that same author during that block so.

The file structure and file naming is not an issue with the iPad or iAnnotate software. This is a commentary of the organization and volume of materials provided. The file structure and file naming added an element of differentiation confusion not anticipated in this research. Due to the organization and naming conventions, students had issues with class participation, cross-referencing materials from week to week, and differentiating between materials within the class session.

Another drawback identified in the course of this research was the use of PDF materials on the tablet device. There are several pros and cons to using PDF files. The pros include maintaining *fixity on the page*, original pagination for reference, and the ease with which they can loaded and read on any device. Fixity on the page refers to the ability to visually reference headings, pictures, and text in the same location on a page—a characteristic of print text that can be reproduced in digital text by converting the print to a digital image. By having this fixity, the document also maintains its original pagination—meaning everyone will be looking at the same text in the same presentation and can refer to the same page numbers. Also, in conjunction with PDFs being easily

opened on any device, this format of presenting digital materials is also easy to organize and load. When a digital document is converted directly to a PDF, it retains the textual bases and images in the original layout no matter what device is used to view them. However, when a printed document is scanned and converted to PDF, it becomes an image of the document and is no longer digital text. The scanned document then must go through a process of optical character recognition (OCR) to make text in the document usable in a textual format for selecting, highlighting, or other manipulation. To make a scanned document user friendly in the academic environment, it is essential to use OCR in order for the annotation software to recognize the text within the image.

The use of PDFs also has potential pitfalls in the academic environment. First, the use of annotation tools is highly dependent on the quality of a scanned PDF. The quality of the scan (dependent on the scanner and document being scanned) from which a PDF is made will determine success of OCR. Without accurate text recognition through OCR, the annotation tools will not pick out the text within the document and students will not be able to highlight or underline as they desire. The Reed College study had this commentary on PDF handling:

> The faculty member who participated in the study took great care to provide his students with PDFs of the assigned texts optimized for the iPad: optical character recognition had been performed as needed, articles that had been scanned with two pages of a book or journal side by side were converted to single pages to make the text larger and more readable, and so forth. When students used the iPad to read PDFs for other classes that had not been prepared in this way, two main difficulties arose: (a) Students found that highlighting became very difficult when they worked with certain scanned PDFs. (b) They noted that when they read documents with two pages scanned side by side, the size of the iPad required them to scroll horizontally in order to read all of the text. They suggested that both of these issues could be addressed by adopting college-wide standards for the preparation of PDF versions of assigned readings. (Marmarelli & Ringle, 2011, pp. 4-5)

The quality of scanned PDFs remains a key issue for academic materials and the usability of mark-ups tools. This commentary shows the extra steps necessary to provide quality scanned PDFs to students and the consequences of not providing this quality in

an academic setting. Also, when a document is not of sufficient quality to be annotated, the student is then distracted from learning because of the interruption in utilizing their annotation tools. Student F-I commented:

> Not everything you can annotate...some documents don't allow you to highlight and annotate. Probably 1-out-of-10, or 2-out-of-10 you can't…you want to highlight a certain paragraph and it won't allow you by the way they scanned it in.

This student's feedback captures another concern with the presentation of materials in the course. While scanned PDFs may offer benefits, their quality is an essential component of their usefulness in the academic environment. Creating PDF files from electronic documents negates the need for OCR text recognition. Direct electronic conversion to PDF preserves document layout and text that is inherently recognizable. By preparing PDF files directly from electronic documents, the annotation tools can be used as intended all of the time without the potential hazards created by scanning paper documents.

When using an electronic text, another option would be to use digital file formats such as e-Pub instead of PDF conversions. While some fixity and pagination is lost, other features of electronic text are gained. With formats such as e-Pub, the document can be adjusted in font size to the reader's preference. As the font size adjusts, the flow of the document alters and reference points are determined by location instead of pagination. When adjusting the size of text for user preference on a PDF, the reader must zoom-in on the document, which then requires the reader to pan or scroll the document on the screen. This zoom feature does permit the increase in size of text, but it also requires the reader to pan, adjusting the screen right to left because of its fixity to the page and inability to flow.

As a final thought on the presentation of materials, the static documents converted to PDF did not utilize the electronic advantage of content integration. This

usability feature incorporates any number of options external or internal to documents. External options include a syllabus hyperlinked to readings or outside supplemental resources. Internal options could include a hyperlinked table of contents or a hyperlinked glossary (Abram, 2004; Noorhidawati & Gibb, 2008; Schcolnik, 2001). Without content integration, this study is more representative of a truer substitute of print text with static digital text. However, this study was unable to examine this usability feature of digital text or examine the degree of distraction or potential for enhanced learning that could have resulted from the hyperlinks.

Finally, the students found the touch on-screen keyboard feature insufficient for producing academic products. Similar to findings from George Fox University, University of Maryland at College Park, and Reed College, the touch keyboard relegated the iPad to more of a content consumption device (Kolowich, 2010; Marmarelli & Ringle, 2011). The study at Reed College revealed:

> Our study participants found that the iPad's greatest shortcoming as a tool for academic work was its keyboard. While they appreciated that the absence of a physical keyboard made it possible to have a larger screen, they found the soft keyboard to be awkward to use, particularly in portrait orientation, and reported difficulty typing efficiently with it. Most students used the keyboard only to annotate texts outside of class, not to take notes in class or to write papers; many avoided composing anything longer than a brief email on the iPad (Marmarelli & Ringle, 2011, p. 5)

The students in the Naval War College pilot program also expressed disappointment with the touch on-screen keyboard and desire to have an external keyboard. As one student stated on the survey, "only thing difficult to do is write with the electronic keyboard. I still take notes on paper." Student D-B in the focus group commented: "if I were to do things exclusively with the iPad, I would definitely want an external keyboard." These combined results imply that the iPad alone will not meet all academic requirements.

This section examined the usability features of the iPad based on a consolidated

list of desirable features from previous literature. As the previous findings stated, the majority of features on the Apple iPad and iAnnotate software more than met the needs of the students with regard to the replacement of print text with digital text. However, some features like the file structure, file naming, PDF quality, content integration, and the keyboard left potential areas of improvement. Overall, the Apple iPad and iAnnotate software were perceived to be as good as or better than printed course materials in meeting students' usability requirements.

Disparity between faculty and student perceptions. This research found a disparity between faculty and student perceptions. The intent of asking both faculty and students about the iPad use was to get a holistic understanding of the phenomenon. However, a review of the data juxtaposing student perceptions with faculty perceptions revealed contradictory perspectives. Finding 1 addressed student perceptions of reading comprehension, class preparation, and class participation and Finding 2 ascertained student perceptions on supplemental materials for academic use and printing of course materials. These student perceptions contrast with the faculty perceptions presented in Finding 4. While these observations came from a minority of the faculty, their contrary nature to student perceptions could lead to future decisions about iPad use without a complete understanding of student use. This disparity includes perceptions of classroom impact, perceptions of pedagogical approach, and perceptions in printing of material. The following section will discuss these disparities.

Perceptions of classroom impact. Classroom impact describes the different aspects of in-class use of the iPad. Contrary observations include teacher and student distraction, presentation materials, reaching comprehension, class preparation, and class participation. Two professors commented that they were personally distracted by not knowing where the students' attention was directed. One stated:

I have 20 people sitting there with those little black things opened up. I'm not

> sure what they're looking at--if they are following along with the slides that I issue ahead of time? I won't [post the slides] next year, but I did this year. Or, are they talking to their significant other on the other end via email? So, I don't know and it is kind of distracting and disconcerting for me to sit out there and look at it and not know what they are doing. (Professor X)

Prior to having iPads in the classroom, these faculty members had not grown accustomed to students using electronic devices during class. A faculty member at Reed College, more accustomed to students with laptops in the classroom, thought the iPad improved the dynamic. He stated:

> [it's] the end of the "great wall of china.". That is what we jokingly call the wall of laptop covers that create a physical and psychological barrier between you and your students when they read materials online. An increasing proportion of my class readings are PDFs--I myself virtually never open a paper journal anymore. ...the ability to annotate is important. But just as important, with the iPads flat on the table, everyone can make sure everyone is on the same page, and that the page is not Facebook! (Gronke, 2010)

In addition to this commentary, the Reed College study pointed out that some faculty members were more accepting of the iPads even though they had rejected laptops in the classroom previously (Marmarelli & Ringle, 2011). Another Naval War College faculty member found himself distracted at first, but then adjusted to the classroom impact. He expressed himself this way:

> From my standpoint, I've gotten used to it [students with iPads in the classroom] and it doesn't bother me anymore. You know, seeing the student doing stuff on the iPad while class is going on. Since this is a seminar type thing and something will come up that I know some of them have Googled...a certain person or event or what not…I think that it's helpful. I know from at least this class here, they are not trying a one-up-man-ship on whoever is teaching the class. I think that it adds to their knowledge. (Professor V)

When asked by the interviewer if he saw it as a distraction at this point, Professor V replied, "I don't, I think that it is augmenting." Another student used the iPad to take notes, stating, "what I do is I take notes in class with it and then I'll email it to myself" (Student F-H). It is plausible that both students and faculty required an adjustment period to fully understand how the device would impact the classroom. The novelty of the device will be covered under an analysis of personal use in the following section.

Another distraction to the faculty was the faculty presentation materials. The in-class presentation materials (slides, PowerPoints) are available to students via the Blackboard learning management system prior to class regardless of students' use of the iPad. Two other faculty members discussed not making their presentation slides available prior to class in the future because he felt the students were distracted by looking at them on paper or on the iPad and not looking at the faculty member or the screen behind them. While questions about in-class use of the iPad were not asked directly in this study, students in the focus groups did allude to their classroom use. Even though students did admit to occasionally getting distracted during class and using the iPad as a quick diversion, one student focus group participant specifically spoke about following along in class with the presentation slides on his iPad:

> it's incredible, especially for JMO where they actually have the PowerPoints listed for that class that day. I could follow along on there [on the iPad], while they're doing it on the screen. It just makes it a lot more easier and it's easier for me to be engaged with it instead of trying to strain and look at what's on the screen, especially when they're walking back-and-forth in front of it. I have it all right there in front of me so it makes it very easy to follow along the class because of that. (Student F-G)

Collectively, the faculty trepidation regarding student use of the iPad in-class was distracting to a few of the faculty members. However, students discussed the benefits of using the iPad in class for note-taking and following along with the presentation.

This research also uncovered disparities regarding reading comprehension, class preparation, and student participation. When faculty members were asked about student participation and course discussions, they felt that there was no change overall, though three faculty members suspected students had a slightly poorer grasp of the material. Additionally, the clear majority of faculty perceived no difference in regard to student comprehension, however two of the faculty members felt that students were less prepared when they arrived in class. One of the two faculty members stated:

> I think they are less prepared, but that's just a gut feeling because I think that the

> reading is so accessible. Once the discussion comes on to the reading, they flick it up there and they are scanning a bit and they may miss discussion points as a result of that. So, they rely on the fact that they've got the information on hand more, so maybe they skim the readings quicker they don't quite so. I don't know. And yet they use to come in with the printed readings which were flagged up on what have you and because I think they have to go through it more maybe they, um, they absorbed it more. I don't know, that's just a happenstance of, it's a bit difficult to prove that, but that's my feeling. (Professor T)

In Schcolnik's (2001) study, "ninety-six percent disagree with the statement that the e-reader makes them lose the context of what they read, and more than 70% feel they can both deep read and skim with their e-reader" (pp. 58-59). The clear majority (80%) of Naval War College students stated that they understood about the same amount of what they read on the iPad compared to print materials, while 10% understood more and 10% understood less. This finding also concurred with Baker's (2010) assertion that "for basic reading comprehension, the medium does not matter" (p. 31). Baker also found that a person's preconceived preference for a medium affected his/her objectivity of perceived comprehension, while his/her actual comprehension did not change. In this instance, the faculty members could have been projecting their preconceived notions about digital reading comprehension onto the students. However, previous research and student perceptions in this study conclude that the medium does not impact reading comprehension.

This research also found a disparity between faculty and student perceptions about class participation. Students also felt that they participated about the same amount or more (97%) in class after having read course material on the iPad. Professor N noted that more students accessed the readings on the iPad during class when they were mentioned in the lecture compared to prior courses using only print course materials. This increased access to the readings may have lead a few faculty members to perceive that students were less prepared for class, as stated earlier. However, while the reading materials are readily accessible on the iPad, the current file structure and

naming system made it difficult for students to refer to current or previous reading materials. As revealed out in the student focus group, the weekly readings were consolidated in a single document up to 150 pages long or more and were difficult to navigate. Also, if a faculty member referred to a reading by author from a previous week, the access to that specific reading was made more difficult by each of the weekly documents only having a class and date code for a file name. Thus, the student had no direct means of referencing that author or article and was forced to spend time searching for it. When found, they were then able to view the notes and/or annotations they made to aid them in the class discussion. It is possible this delay in access could have caused a few faculty members to perceive that students had not read especially deeply or comprehended as much from the reading.

A final disparity revealed student use of the iPad to supplement learning in the course. Outside of course readings, students reported using the iPad to lookup supplemental information like terms, events, or acronyms. One focus group participant commented:

> the professor might say something in class and at least myself, who does not have a military background, I'm like, "What was that?" I may look at up while the class is going on so while he's not directing me do it, I know I'm able to lookup something in real time on the iPad, and go, "Oh, that's what that is," without interrupting the class and look like an idiot asking, "What does the acronym stand for". I can quickly look it up. (Student K-L)

As mentioned earlier, Professor V pointed out that students used the iPad in class to lookup information such as people or events mentioned in discussion and used what they found to add to the discussion. The Reed College study also reported the ease of locating augmenting information quickly through the web browser "without interrupting the flow of the conversation" (Marmarelli & Ringle, 2011, p. 3). While this may be seen as distracting to faculty, the in-class use of the iPad can further augment student learning in a variety of ways. Overall, previous literature and student perceptions

countered the faculty concerns brought out in this study.

Perceptions regarding pedagogical approach. A disconnect between faculty and students appeared in their perceptions of professors' pedagogical approach. While 100% of faculty did not believe that they had changed their pedagogical approach to their pilot program course, 61% of the students perceived that they had. Students perceived that faculty members had given them additional web-links, additional access to materials on Blackboard, and had them use the iPad for quick reference. Professor V did observe that while he did not give students additional material, the immediacy with which students had access to materials on Blackboard did enhance classroom learning. Focus group K also came to the same conclusion that the iPad gave them greater access to Blackboard. Though the faculty reported that they did not provide more information than they would have for a print-based course, the immediacy of the augmenting materials left the students with the perception that faculty had altered their pedagogy in concert with the device.

Perceptions in printing of material. A comparison of printing showed an additional perceptual mismatch between faculty and students. In reference to printing of course material, one faculty member perceived that about half of his class was printing their course materials, stating:

> I would say looking at my lot…half of them print their readings out from this and probably a little over half don't, but I don't know quite how they go back to things, they can highlight and everything, so they can, but they have to scroll through it each time. I think. (Professor T)

From the students' vantage point, particularly those in the core classes, 52% had desired to print at some point during the pilot, while only 30% had actually printed course material. The student focus group revealed that for those who had printed, the desire to do so arose when they were preparing to write assigned research papers. When preparing to write, they narrowed the relevant sources they would use on the iPad and

printed them to use when writing their papers. When writing, the print-based affordances of spatial flexibility and manipulability were difficult to overcome using the iPad alone (Sellen & Harper, 2003). However, what was printed represented only a small portion of their overall course materials. This discrepancy is noted now as a disparity between faculty and student perceptions, however, an in-depth analysis of the desire to print is provided in a following section discussing the substitution of printed course materials with digital course materials.

This research revealed disparities between faculty and student perceptions regarding iPad use. Again, the dissenting observations presented in this section came from a minority of the faculty and it is plausible that they projected their own personal preconceived notions about the device onto their students, causing this discrepancy. The disparities noted could have an impact on future decisions regarding the overall usefulness of the device. However, the faculty also noted their complete support for the program and interest in meeting the students' needs with regard to a potential preference for digital course material. This section reviewed the disparities in perceptions of classroom impact, perceptions of pedagogical approach, and perceptions regarding printing of course material. Overall, previous literature and student perceptions countered the faculty concerns brought out in this study.

Personal and academic use of a multi-modal device. This study investigated not only whether digital text was a suitable replacement for print text, but also whether the multi-modal device enhanced the overall learning environment. Findings 2 and 3 stated that students found the device enhanced their learning experience and that they read more and read more often due to the device's convenience and portability. The personal use of the Apple iPad had an overall positive effect, but the qualitative nature of the research also revealed concerns that could have improved personal use. This study

identified overall time with the device, additional up-front training, and a clearer policy on personal use as aspects that affected personal use.

One distinguishing factor in personal use was the amount of time students had to use the device. This discrepancy was noted between the 3-month elective course and the 9-month JMO and NSDM courses. The focus group from the elective course discussed utilizing the basic features of the device, but did not go beyond the basic uses. With only 3 months to use the iPad, students may have been less invested in using the device personally and figuring out the additional features available. Vernon's (2006) research observed that students had established their habits with electronic text at 5 weeks and stopped collecting data after 8 weeks because the students had routinized their habits. It is plausible that 3 months was not enough time for students to fully immerse themselves with the device. Students in the 9-month course discussed both how long the novelty of the device lasted and the additional features they could utilize. Student F-H explained his initial experience with the device thusly:

> I would say that at the beginning, I ate all the candy I could and I was a bit, probably, distracted. Because you are just… curious about, "Well, what does this do?" or "That reminded me of this" or "I want to do that now; can I do that?" or "How do I get over to here if I want to do that?" So… I would say that like, maybe the first 2-months I was more easily distracted and now that, okay, I know what it does, it's all "ho-hum" now. When I go in to read, I read.

Student F-I also commented:

> I have cracked the nut on music and photos and I do load the stuff on there [the iPad] and so when I do travel it's just sort of nice you know, plug in, put ear phones on…might be reading and listening to music. It's also great to put the photos on there and connect it to your TV, and then instead of everybody trying to huddle around you, you can have it on the TV and it just does the slideshow. So, I've tried a lot of those different things and I haven't found one that I really didn't like it.

These comments show that the students in the longer courses had time to adjust to the novelty and use the device for more personal as well as academic functions.

An additional factor contributing to the personal use or non-use of the iPad derived from the training and lack of clear guidelines for use. This lack of clarity could have discouraged students in the elective course from bothering to explore the device further. As elective student D-B stated, “I don’t know how to connect it [a laptop] with the iPad, I didn’t want to plug into my laptop and end up wiping all my readings or something like that.” This was also confusing for those in the 9-month courses. For example, student F-G stated:

> I think that a little bit more tutorial upfront just showing all the different toys and how to use it. …I think everybody probably went off on their own and like, for the first couple of weekends were just nuking it on our own trying to figure out what was good and they would come to class and say, “Oh, I did this.” “Oh, I did that, I did this.” There are a lot of neat things. Maybe the first class ought to be just taught to do iPad or maybe add a class to do that or, you know, something. Because he [the iPad coordinator] did… he gave an orientation and you had to go there, but that was probably not even an hour, you know. Got you in really quick, “This is how you turn it on, this is how you turn it off, this is how you get here, this how you get there, you can do these kinds of things, see you later. Goodbye.” You know, while there is a lot more. You know, he gave you the book but, my experience is if you’re sent course materials… for read aheads, they’re not getting read and it’s the same thing with the manual. There is like, the Help button on your thing; whoever hits the Help button? It’s never a help! (laugh)

While personal use did have a positive effect on academic reading using the device, additional time and training and clearer instruction could have further enhanced the personal use of the device.

Impact on learning. This study researched the impact that replacing printed course materials with electronic materials on a multi-modal device had on learning. This analysis drew upon all of the findings of this study and incorporated previous research. This section will describe the impacts of this transition on the act of reading, distraction, reading comprehension and writing assigned papers.

Act of reading. This study examined student usage of a multi-modal device for reading course materials as well as personal and academic uses outside of reading course materials. Findings 1 and 3 found that a clear majority of students in this study

used the iPad for some purpose multiple times a week or more utilizing the multi-modal features of the device. Concurrently, a majority of students also reported that they used the iPad for reading course materials multiple times a week or more and felt that they read more often than they would with printed course materials. Previous research studied only single-modal devices. For example, Simon's 2001 study with the Rocket eBook found that students increased the number of locations in which they read, but the overall amount of time spent reading did not increase nor did the device affect how students read (Simon, 2001a, 2001b). Unlike a single-modal e-reader, the functionality of the iPad motivated students to keep it with them more often as compared to printed course materials. As a result, 47% of respondents reported carrying the iPad with them much more often and 25% carried the iPad more often than print course materials. Of those that carried it with them more often, 50% used it more often for academic purposes and 32% much more often. Focus group participants also discussed keeping the iPad with them more, reading it more often and reading more of the material in general. Student F-G commented:

> Yeah, I definitely… I actually definitely do more of the course reading now with the iPad than if I didn't... and had to do it from the book, it's just makes it a lot more convenient, like I could travel with it, I can sit at my house. It's lot more comfortable for me to sit in my chair, reading it off the iPad vice having to lug a book around reading it. And it's a lot smoother, with a little flip of the thumb the next page comes up and if the print is a little too small, like this go in there widen it up a little bit. It's just makes it a lot more easier to read more comfortable with. And it's just more accessible.

The accessibility and usability of the device positively contributed to increased reading of course materials.

In contrast to an overall increase in reading frequency, when preparing for class the majority did not change their preparation habits. When asked about reading in preparation for class, focus group participants kept their previously-formed reading habits and felt that they read for the same length of time as they would have with printed

course materials. This research found that students read more often based on the multi-modal functionality of the device, which contributed to their personal use and frequent possession of the device. This fact, combined with their normal reading habits, resulted in the overall increase in reading course materials.

This study also inquired into the students' perception of their reading speed when using the iPad. Almost half (47% [14 of 30]) of the students reported that they found themselves reading at about the same speed on the iPad as they did print. This corresponds with Nielsen's (2010a) finding that there was no statistically significant difference in reading speed between the iPad and printed material. The remaining survey respondents (53%) were split in their responses, some reading more quickly and others reading less quickly. Thirty percent (9 of 30) perceived that they read more quickly on the iPad. Reasons for this perceived increase may be related to the ability to zoom and pan documents that were found to be difficult to read or familiarity with content gained from accessing it frequently. Twenty-three percent (7 of 30) found that they read less quickly. Reasons for this perceived decrease may be related to differentiation issues related to file structure as discussed earlier, difficulty with annotation tools, or lack of confidence with the electronic medium as found in Baker's (2010) research:

> the more uncomfortable a person is with technology and expertise in the requested task (in this case, reading), the more they cling to the belief that they will do better on traditional (paper) media-regardless of how well they actually do. (p. 31)

Overall, the duration and speed of reading were not impacted by substituting print course materials with digital course materials. However, the substitution positively impacted the frequency of reading. The combination of normal academic reading habits with increased frequency based on the portability and convenience of the device resulted in an overall increase in reading course materials.

Distraction. This section examines the impact of external distractions on reading using the iPad. Finding 1 showed the clear majority (75% [24 of 32]) of students did not find themselves more distracted when reading on the iPad. As stated earlier, students in this study primarily kept their previously-formed reading habits and felt that they read for the same amount of time in preparation for class as they would with print materials. Of the 8 (25%) of the 32 survey respondents that stated they were more distracted, 2 were much more distracted and function distraction was the most common reason given. Function distraction refers the various possible uses of the iPad outside of reading course material and the urge to switch tasks due to the availability of the functions. Aamodt (2009) found that external distractions or task switching interferes with concentration needed for deep thinking about what is being read. Of the 7 (22%) of the 32 survey respondents that stated they were less distracted, 2 were much less distracted, and the ability to focus better with the iPad was the most common reason given. From a device design point of view, Nielsen (2010b) pointed out that the iPad has no visual distractions like buttons or a physical keyboard. This lack of visual distractions may be what minimized the potential distractions for the majority of users. The bulk of prior research focused on internal distraction when reading electronic text (González & Mark, 2004; Mark, 2009; Wolf & Barzillai, 2009). Internal distraction is the use of hyperlinked content or content integration among the reading materials. This study did not examine internal distraction because all of the digital materials were static documents with no content integration. Overall, the clear majority of students did not find themselves more distracted when reading course material on the iPad.

Reading comprehension. Reading comprehension has a dramatic impact on overall learning in a course. Findings 1 and 4 of this research revealed that student and faculty perceived no change in reading comprehension and that the use of annotation tools did not detract from reading comprehension. The overwhelming majority (90% [27

of 30]) of students stated that their reading comprehension of course material was about the same or better when reading course material on the iPad. A clear majority of faculty perceived no difference in regard to student comprehension. Nielsen's (2010a) study also found no difference in comprehension between reading on the iPad or printed material. Of note, the O'Hara and Sellen (1997) study found that annotation and note-taking deepened comprehension of text, but also found that those who read electronic text on a computer did not annotate as much as if they were reading a print version. In this study, a clear majority (84% [27 of 32]) of survey respondents found iAnnotate easy to use and 69% (22 of 32) found annotation easy. When reading course material, a majority (63% [20 of 32]) used the markup tools frequently or more, 19% (6 of 32) used them occasionally, and 19% (6 of 32) used them rarely or not at all. The annotation tools in iAnnotate do not pose a barrier to reading comprehension. However, as presented earlier, the quality of scanned PDF materials affects the user's ability to use the annotation tools. Also addressed previously, additional training and experience with the annotation tools could increase the use of the tools and further aid comprehension. Overall, the clear majority of students' comprehension of course material was about the same or better when having read it on the iPad as perceived by both students and faculty.

Writing assigned papers. Writing assigned papers shows a student's ability to synthesize reading materials, concepts discussed in class, and supplementary academic information. Finding 2 addressed the students' perceptions of writing a paper and printing, and Finding 4 noted the faculty members' observations of academic writing. The clear majority of faculty (86% [6 of 7]) found no differences in the students' academic writing and one faculty member was undecided. Slightly less than half of students preferred printed course materials when writing course papers, primarily for the reasons of tangibility and few for manipulability and spatial flexibility (Sellen & Harper, 2003).

Some preferred electronic materials primarily for searchability, while a quarter of respondents had no preference. The students in the focus groups explained their individual processes for using digital course material for writing a paper. Of those that did print, most annotated first and only printed the sources they planned on using. Others cut and paste into emails or word documents for later use in citing readings. Nevertheless, regardless of students' preference in working with the materials, substituting print with digital course materials had no impact on students' quality of academic writing.

Integrating all the findings in this research, this section addressed the impact that replacing print course materials with digital course materials in the academic environment had on learning. In summary, the clear majority of students did not find themselves more distracted when reading course material on the iPad and students' comprehension of course material was about the same or better when having read it on the iPad. Also, regardless of the preference of working with the materials, substituting print with digital course materials had no impact on students' quality of academic writing. However, the combination of normal academic reading habits with increased reading frequency based on the portability and convenience of the device resulted in an overall increase in reading course materials. Overall, the substitution of printed course materials with digital course materials on the Apple iPad was neutral or had a positive impact on learning.

Substitution of printed course materials with digital course materials. The purpose of this study was to explore what could be learned from pilot program participant perceptions in regard to substituting traditional printed course materials with electronic course materials presented via iAnnotate on an Apple iPad. This analysis examines the digital replications of the affordances of print material within the iAnnotate application. As Simon (2001a) stated, once e-readers "can successfully reproduce

familiar features they [students] have come to expect from the printed medium, they can begin to look toward enhanced utility" (p. 5). These affordances include tangibility, spatial flexibility, manipulability, and tailorability (Sellen & Harper, 2003). This section will identify the different print affordances, relate how each affordance is addressed in digital format, and discuss the feedback from students about the suitability of substituting digital for print materials.

Tangibility refers to the physical experience of holding a book—seeing the size, cover, color, layout, navigation, how far along one is, or turning over a corner (Sellen & Harper, 2003). In this study, the digital PDF documents maintained the fixity of the pages, which represent the print presentation of cover, layout, and size in a digital format. Student survey respondents compared their ability to differentiate course materials after having read them on the iPad to their experience with having read them on print. Of the respondents, the majority (66% [21 of 32]) reported no change in their ability to differentiate material or less difficulty when having read it on the iPad compared to print. Thirty-four percent (11 of 32) of respondents responded that they experienced more difficulty and 7 of the 11 indicated print tangibility as the most prominent issue. One student observed there was "no muscle memory or contextual clues from electronic media." Another survey respondent stated: "with books I have something tangible to associate the reading with." These comments explain why some (22% [7 of 32]) of the students viewed lack of print tangibility as a reason for having more difficulty with differentiation of material. However, the differentiation issue is connected to the aforementioned issues derived from file size, file structure, and file naming, which 4 respondents (13%) directly cited as an issue in their differentiation. Thus, this study cannot definitively pinpoint the lack of print tangibility as a leading cause of differentiation issues among those who reported them. Familiarity, comfort and confidence with print text could also motivate some respondents' perceived preference for print tangibility

(Baker, 2010). Out of the 31 survey respondents, only 1 respondent indicated that he or she had the desire to print or actually printed out course materials due to a need for print tangibility. Overall, the majority of students in this survey did not have an issue with differentiation of material or lack of print tangibility. However, file structure issues within the course material should be addressed to minimize differentiation issues.

Sellen and Harper's (2003) second basic affordance of print text is spatial flexibility. Spatial flexibility describes the ability to surround oneself with several print-based texts simultaneously and arrange multiple texts in close proximity around oneself. The closest simulation to spatial flexibility within iAnnotate is the ability to open six documents at once within the program. These documents are represented with visual tabs across the top of the open document. The tabs indicate the file names of the open documents. Given the weekly presentation of materials incorporated in one file, this aspect of spatial flexibility was not fully explored. However, students did mention difficulty referring to previous weeks' materials based on the file structure and naming conventions. If the texts were separated from each other, students would most likely have experienced the digital representation of spatial flexibility more fully. Also, with the volume of materials, six tabs across the top may have shown to be a limiting factor to seeing all of the weekly course materials at once and cross-referencing between them.

Manipulability addresses the ease of shifting from reading print-based documents while simultaneously writing a separate text (Sellen & Harper, 2003). Applied in the digital format, this would describe the ability to shift between digital course materials easily while writing a paper. In electronic form, this would be better simulated on a personal computer where a student could simultaneously open multiple windows to see the digital readings and an open word processing document to write the paper. The students in this study did not use the iPad device itself to write the paper, therefore they would not have tested the ease in shifting between digital documents. In this sense, the

simulation of manipulability now resembles the representation of spatial flexibility in iAnnotate. This would be the ease of navigating within the long weekly document and possibly tabbing across the top of iAnnotate to shift between weekly documents for the purpose of referring to information to use in a paper. The majority of students in the core courses did not print materials, therefore they would have had some experience shifting within and between the documents for writing a paper. Of that majority, the students provided no comments related to manipulability in digital context. However, from the respondents taking the core requirement courses, a minority (30%) of students printed some course materials. The majority of those that did print chose to print sources for assigned papers and were motivated to do so by print manipulability. Overall, manipulability was not a major factor in this study.

Tailorability is the ease of jotting down notes, highlights, and annotations (Sellen & Harper, 2003). This is the duplication of what a student would do with a highlighter, pen, sticky flags, or other various markup strategies on paper documents. The iAnnotate application closely simulates this through the following annotation tools: highlight, underline, free-from drawing, text notes, typewriter, stamps, and bookmarks. As noted earlier, 69% (22 of 32) of survey respondents found that iAnnotate made annotation easy. When reading course material, a majority (63% [20 of 32]) used the markup tools frequently or more, and19% (6 of 32) used them occasionally. One survey respondent declared that iAnnotate on the iPad compared to paper was “easier to annotate—no need to carry pens, pencils, and highlighters.” These findings stand in contrast to the findings of prior studies. For example, Mercieca (2004) and O’Hara and Sellen (1997) both found that print was preferred for annotation. Also, Simon’s (2001a, 2001b) Rocket eBook study and multiple Kindle studies identified the need for improved annotation tools (Cliatt, 2010; Marmarelli & Ringle, 2010; D. Rowlett, personal communication,

Septemer 14, 2010). Overall, the digital simulation of tailorability has been successfully addressed in the iAnnotate application.

After examining the degree to which the affordances of print can be replicated in digital format, another factor in the successful transition from print materials with digital materials becomes evident. Transitioning to digital course materials requires both faculty and students to adapt to the new medium. How well the affordances of print can be addressed by the software associated with digital readings will ease this transition, but it does not ensure the adoption of digital reading. The reader must still be willing to learn how to function in the new environment of reading digital materials. This requires motivation to break with the familiarity of learning with print text and confidence in acquiring new skills for learning to read with digital text. Any reticence in the transition could result from an unwillingness to change or a lack of confidence in the ability to learn how to learn in a new way. The question remains, will a student's personal interest in using a multi-modal device help overcome his or her unwillingness or lack of confidence? The diffusion of innovation will be examined in the following section.

Diffusion of innovation. The diffusion of innovation theory directly relates to the findings of this study. Finding 5 found that both faculty and students strongly recommended and preferred digital course materials on a tablet device for student use. The diffusion of innovation theory describes whether a technology is adopted and the rate of adoption (Rogers, 2003). To evaluate the diffusion of innovation, Rogers outlines the following five key characteristics of innovations: relative advantage, compatibility, complexity, trialability, and observability. In this section, each of the characteristics will be examined in the context of this study.

Relative advantage refers to the degree of perceived advantage an innovation has over its predecessors (Rogers, 2003). This study found digital course materials held a relative advantage in portability, convenience, searchability, immediacy of

supplementary materials, class participation and print savings. The clear majority of students in this study preferred digital course materials on the iPad primarily due to portability of course material. As a reminder, this study defined portability as the quality of having all materials on one device and easily transporting those materials from one location to another. Portability also contributed to course readings being read more and more often. Searchability is also a distinct characteristic unique to digital materials alone. In addition, students found the immediacy of materials helped in many instances. Some referred to the immediacy of looking up supplemental information on the Internet and accessing materials on Blackboard. Students felt this immediate access to lookup terms, events, names, or acronyms and refer directly to readings helped them augment their learning without interrupting the class and participate more in class discussions. Finally, digital materials drastically reduced the funding required for printing course materials. Of the few respondents who preferred print materials, print affordances like tangibility, special flexibility and manipulability were cited—particularly to help differentiate sources or help in writing papers. Finally, one student mentioned the inability to take the iPad to his classified workspace as a justification for his preference for print. However, the relative advantage can ultimately be determined by the clear majority (78%) of students preferring digital course materials.

Compatibility is the degree to which an innovation is perceived to fit within an individual's or group's respective life or structure (Rogers, 2003). The authorization to use the iPad for personal use greatly impacted how the students accepted the device into their overall life structure. In Finding 1, students found little to no impact on reading with respect to the usability of the device. This compatibility based on ease of use contributed to overall acceptance. Also, Finding 3 found the overall portability, convenience, comfort, and ease of use contributed to the integration of the device into students' lives. Contrary to student acceptance, faculty revealed compatibility concerns

in Finding 4. A few faculty members found student use of the device distracting in the classroom and this disrupted the device's fit within their class structure. Overall, students accepted the device both personally and academically while a few faculty members were still adapting to the device in the classroom.

Complexity is the innovation's perceived degree of usability or ease of understandability (Rogers, 2003). Students and faculty found the Apple iPad and iAnnotate software easy to use. Students used the Apple iPad device multiple times a week both personally and academically. Also, a clear majority also found iAnnotate easy to use and a majority frequently used the annotation tools. With regard to tailorability in comparison to print, students found the annotation features within iAnnotate an acceptable alternative to print. The overall degree of complexity with the iPad and iAnnotate was minimal in comparison to print.

Trialability is the degree to which an innovation can be experimented with (Rogers, 2003). As Rogers states, if a great investment is required to experiment with an innovation, then it less likely to be adopted. The relatively low cost of the iPad with digital course materials, compared to the production, reproduction, and storage of the large quantity of physical print materials motivated the college to conduct the iPad pilot program. After their experience in the pilot program, the resounding majority of students (88% [28 of 32]) and clear majority (86% [6 of 7]) of faculty strongly recommended digital course materials for future courses, as stated in Finding 5. Part of this study also experimented with how much personal use of the iPad would impact academic use. Finding 3 found that a majority (63% [20of 32]) of respondents perceived that they used the iPad more often for academic use than they did for personal use. The trialability of the iPad can be seen as a reasonable expense compared to the cost of printing course materials.

Observability defines the degree to which an innovation can be observed or communicated to others. Simply put, the greater the visibility, the greater the adoption (Rogers, 2003). Both students and faculty commented on other students and faculty members not in the pilot program observing the benefits and wanting to be included. This was particularly mentioned by students who still carried the “box of books” compared to the Apple iPad device. When visiting students from outside of the Newport-based seminar attended class, they immediately saw the advantage that those in the pilot program had. Also, the portability of the device meant the students typically had the device with them, even for other classes. The device itself made them immediately recognizable as one of the pilot program participants. All in all, the visibility of the device was easily observed by others.

An application of Rogers’ (2003) five key characteristics shows that the iPad pilot program participants can express the relative advantage, compatibility, complexity, trialability, and observability of the iPad. Finding 5 stated that both faculty and students strongly recommended and preferred digital course materials on a tablet device for student use. Based on the preferences and recommendations in Finding 5, of those who participated in the pilot study, the clear majority were ready to adopt the innovation of electronic materials on a multi-modal tablet device.

Conclusions

The purpose of this study was to explore what could be learned from pilot program participant perceptions in regard to substituting traditional printed course materials with electronic course materials presented via iAnnotate on an Apple iPad. The conclusions of this study follow the research questions, findings, and analysis, and address the following four areas: (a) usability of the iPad and the iAnnotate application,

(b) the iPad enhanced learning, (c) faculty perceptions of student use of the iPad, and (d) digital course materials—preferences and recommendations for future use.

Usability of the iPad and the iAnnotate application. The first major finding of this research is that the majority of students found that reading course materials on an iPad using iAnnotate did not affect their duration of reading, speed of reading, reading comprehension, or class participation. The majority of students in this study did not have an issue with differentiation of material or lack of print tangibility. In addition, the clear majority of students did not find themselves more distracted when reading course material on the iPad. Also, a clear majority perceived their frequency of reading as about the same or more often due to portability, but their normal reading habits did not change. The combination of normal academic reading habits with increased frequency of reading resulted in an overall increase in reading course materials. Finally, the iAnnotate software was easy to use in both mark-up tools and searchability and the digital simulation of tailorability has been successfully addressed in the iAnnotate application. Overall, this study concludes that the majority of students in this study perceived electronic course materials on an iPad in iAnnotate to be as good as or better than printed course materials.

The iPad enhanced learning. The second and third major findings of this study expressed how the multi-functionality of the iPad enhanced learning and how personal use increased academic use. The majority of students perceived the Apple iPad as a useful academic tool, frequently using it to enhance personal study and classroom learning. When writing reference papers, slightly less than half printed out resources due to the need for tangibility, spatial flexibility and manipulability of materials they would be referencing, while some relied on the searchability of electronic sources. Regardless of students' preference regarding working with the materials, students used a personal computer to complete written assignments and the iPad did not impact the quality of

academic writing. Overall, the substitution of printed course materials with digital course materials on the Apple iPad had a neutral or positive impact on learning. As a conclusion, students in this study frequently used the multi-modal functionality of the Apple iPad to augment personal study and classroom learning. However, for academic purposes, the Apple iPad was primarily used as a content consumption device in conjunction with a personal computer. The third finding stated that a clear majority of students found the iPad personally useful, carried it with them more often, and found themselves using it more academically due to its convenience and portability. Therefore, this study also concludes for students in this study, the portability of the Apple iPad combined with personal use positively contributed to academic use of the device.

Faculty perceptions of student use of the iPad. The fourth major finding stated that the majority of faculty perceived no effects within the course in regard to participation, comprehension, or change in their pedagogical approach. A few noted concerns about possible slightly poorer student comprehension and in-class distraction. This study concludes that for faculty observing students, the iPad had negligible effect on student participation, comprehension, or written materials.

Digital course materials—preferences and recommendations. The fifth finding stated that both faculty and students strongly recommended and preferred digital course materials on a tablet device for student use. The preference for digital course materials and recommendation for future use will be addressed separately. The preference for digital course materials considers both the usability of the device and its software and the students' willingness to use it. First, the majority of students perceived the Apple iPad as a useful academic tool and the iAnnotate software was easy to use in both mark-up tools and searchability. In addition to usability, a second consideration in transition to digital materials is student willingness. Students must be motivated to break with the familiarity of learning using print text and acquire the confidence in learning new

skills to read digital text. In comparison to the affordances of printed course materials, the iAnnotate application successfully addressed tailorability (Sellen & Harper, 2003). In addition, the majority of students in this survey did not have an issue with differentiation of material based on a lack of print tangibility. Also, of the minority of students who printed course materials, they only did so for assigned papers and were motivated by print manipulability and spatial flexibility—but these were not major factors in this study. In conclusion, based on the usability of the device and willingness of students to adopt a new way of learning, both students and faculty preferred digital course materials on a tablet device for students instead of print course materials.

Rogers defined five characteristics of innovation adoption: relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2003). This study found that digital course materials held a relative advantage over print materials in portability, convenience, searchability, immediacy of supplementary materials, class participation, and print savings. For compatibility, the authorization to use the iPad for personal use greatly impacted how the students accepted the device into their overall life structure both personally and academically. The overall degree of complexity with the iPad and iAnnotate was minimal in comparison to print. The trialability of the iPad can be seen as a reasonable expense compared to the cost of printing course materials. Finally, others routinely observed and desired the device. In conclusion, based on the digital course materials meeting the five key characteristics of innovation adoption, both students and faculty recommended digital course materials on a tablet device for future student use.

Recommendations

The researchers offer recommendations based on the findings, analysis, and conclusions of this study. The recommendations that follow are for iPad program

administrators, content developers and faculty followed by recommendations for future research.

Recommendations for iPad program administrators. Administrators of iPad or tablet programs should consider the following recommendations:

1. Establish clear guidelines for personal use of the device.
2. Develop and implement a student orientation session for device familiarity, use, content delivery and annotation software such as iAnnotate.
3. Investigate option for student purchase of iPad to improve personal use of device.

Recommendations for faculty and course developers. Faculty and course developers in iPad or tablet programs should consider the following recommendations:

1. Implement faculty development on how tablets change classroom dynamics and potential uses of tablet devices for course enrichment.
2. Involve course developers to maximize delivery of course materials.
3. Establish protocols for appropriate use in the classroom. Appropriate uses could include referring to readings, following along with lecture presentations, or looking up supplementary academic material.

Recommendations for course content developers. Course content developers in iPad or tablet programs should consider the following recommendations:

1. Course materials should utilize content integration such as individual readings linked directly from course syllabi and the utilization of a table of contents with hyperlinks within long documents.
2. Organize course materials in an orderly file structure with a naming convention that takes into account the bibliographic information for the material contained within each file. Individual files should be used for individual readings. These two suggestions combined will aid in reinforcing

content identity as students navigate in and among course materials and aid in relocating content when students need to reference it.

3. Course content presented in a PDF format should be converted directly from digital files. If scanned content cannot be avoided, ensure high quality scans are made from a clean original documents and OCR is used to ensure the proper functioning of digital annotation tools and content search.

Future research. The researchers recommend the following areas for future research to gain a more comprehensive understanding of the phenomenon of a tablet device in the academic environment:

1. A further similar study with a larger survey sample of both students and faculty to assess the extent to which the same or similar findings would be uncovered.
2. A further similar study after corrections are made to file structure, file naming and content integration.
3. A quantitative study comparing the impact on learning between students using printed course materials and digital course materials.
4. A study investigating the use of e-Pubs instead of PDFs and their impact on usability and learning.

Researcher Reflections

Throughout the history of human civilization, major shifts in literary technology have circled around usability, durability and ease of reproduction. Each major advancement has broadened the population of readers and made the written word more efficiently organized and replicated. However, the act of reading has stayed mostly the same. Each development required adjustment, like learning to read the codex of two pages side-by-side or learning to read typeset words instead of handwritten words.

Eventually, the innovation became the new standard. However, with each shift there are those who resist change and rely on the prior technology. Those who rely on print are no different. It is in the realm of possibility that in the not-too-distant future e-readers will replace p-books. The better it is understood how to design e-readers for a naturally intuitive experience, the better the technology will be. This research hopes to inform the digital revolution.

Research Summary

The purpose of this study was to explore what could be learned from pilot program participant perceptions in regard to substituting traditional printed course materials with electronic course materials presented via iAnnotate on an Apple iPad. At the beginning of this research, a review of the literature showed an enduring preference for p-books due to lingering problems with electronic text. However, the introduction of the iPad as a tablet device merged electronic text and e-reader functionality with a multi-modal device. Through this research, it was concluded that the majority of students in this study perceived electronic course materials on an iPad in iAnnotate to be as good as or better than printed course materials, the multi-modal functionality of the Apple iPad augmented personal study and classroom learning, and the students' personal use positively contributed to academic use of the device. Additionally, faculty observing students in this study found the iPad had negligible effect on student participation, comprehension, or academic writing. Finally, based on the digital course materials meeting the five key characteristics of innovation adoption, both students and faculty preferred and recommended digital course materials for students on a tablet device.

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APPENDIX A: Photograph of the iPad and Various Screenshots of iAnnotate Functions

Figure A1. Photograph of iPad

Figure A2. iAnnotate application showing file structure

Figure A3. iAnnotate Application Showing Documents within File Structure

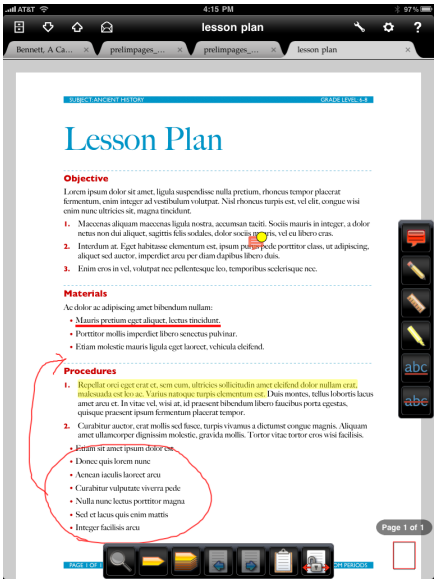

Figure A4. iAnnotate application showing example of mark-up tools

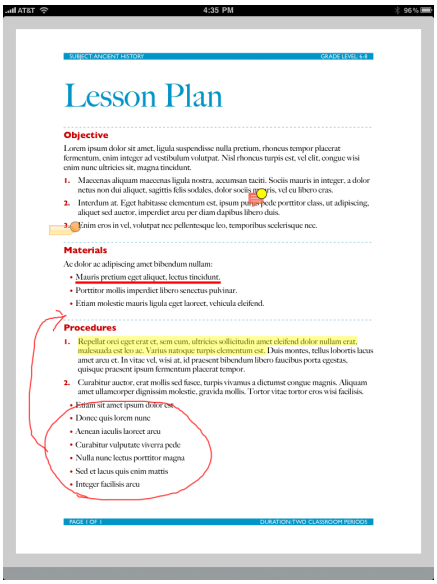

Figure A5. iAnnotate application showing full screen reading

APPENDIX B: Student Survey

The following survey will be used to improve future development and application of technology in the academic environment. Survey responses are anonymous. No names will be associated with responses. While giving thoughtful answers, this survey should take approximately 15 minutes to complete. Thank you in advance for time and thoughtful answers.

Demographics

1. Gender: ○ Female ○ Male
2. Age:
   - ○ less than 26
   - ○ 27 – 31
   - ○ 32 – 35
   - ○ 36-40
   - ○ 41-45
   - ○ greater than 45
3. Employment status: □ Active Duty Military □ Reservist □ Civilian
4. Student status: ○ Resident (full time) ○ Non-Resident (part time)
5. NWC/CDE courses currently taking:
   - □ JMO
   - □ NSDM
   - □ S&W
   - □ Elective
6. Prior to beginning your current course, had you used any type of e-reader?

   ○ Yes ○ No

6-2. If so, which of the following: (Mark all that apply)

- ☐ Amazon Kindle
- ☐ Apple iPad
- ☐ Barnes & Noble Nook
- ☐ Sony eReader
- ☐ As an e-reader Apple iPhone or iPod Touch
- ☐ Other _____

Reading of course materials on iPad compared to Print

7. When comparing your current experience reading course materials using iAnnotate on an iPad with your prior experience with traditional printed course materials:

   a. (1.1) Do you read more often or less often when using the iPad?

      ○ more often

      ○ about the same

      ○ less often

      ○ I do not read course materials on the iPad (*if selected skip to question 14*)

      Why do you believe that you are reading more or less often?

      _____

      _____

   b. (1.2) Do you read for longer or shorter periods of time when using the iPad?

      ○ longer with iPad

      ○ about the same

      ○ shorter with iPad

c. (1.3) Do you find that you read more quickly or less quickly when using the iPad?

- ○ more quickly with iPad
- ○ about the same
- ○ less quickly with iPad

d. (1.4) Do you find that you understand more or less of what you are reading when using the iPad?

- ○ understand more with iPad
- ○ about the same
- ○ understand less with iPad

8. (1.6) After having read course material on the iPad, do you find yourself participating more or less in class?

- ○ participate more
- ○ participate about the same
- ○ participate less

9. (1.5) After having read multiple course materials on the iPad, do you find it more or less difficult to distinguish which material an idea is from? (i.e. document A from document B)

- ○ more difficult when having read material on the iPad
- ○ no difference in difficulty when having read material on the iPad
- ○ less difficult when having read material on the iPad

9-2. Why do you it believe it to be more or less difficult?

_____

_____

10. (1.7) When reading course materials in any format (paper, iPad or other) do you find yourself easily distracted?

    O Yes

    O Unsure

    O No

11. (1.7) Do you find yourself more or less distracted when reading on the iPad compared to paper?

    O much more distracted

    O more distracted

    O no difference

    O less distracted

    O much less distracted

    Why do you feel that you are more or less distracted?

    _____

    _____

12. To what extent do you agree with the following statements about iAnnotate:

    a. (1.8) iAnnotate is easy to use.

       O strongly agree

       O agree

       O undecided

       O disagree

       O strongly disagree

    b. (1.8) iAnnotate's search function makes it easy for me to search for important passages in the course readings.

       O strongly agree

       O agree

       O undecided

O disagree
O strongly disagree
O I have not used the search function

c. (1.8) iAnnotate makes it easy for me to annotate (i.e. markup, add notes, highlight important passages, etc.) the course readings.
O strongly agree
O agree
O undecided
O disagree
O strongly disagree
O I have not used the annotation tools

13. (1.8) When reading course materials, I use the markup tools in iAnnotate
O very frequently
O frequently
O occasionally
O rarely
O not at all

(if "not at all" is selected skip 13b)

13-2. (1.8) Arrange the markup tools in the order you most often use them:
- ⌑ Bookmark
- ⌑ Highlighter
- ⌑ Note
- ⌑ Pencil
- ⌑ Underline
- ⌑ Other (specify) _____

Using the iPad as an academic tool

14. (2.1) Outside of reading course materials in iAnnotate, have you found yourself using the iPad to lookup supplementary academic materials (i.e. dictionary, Wikipedia, other reference type sources)?
O very frequently
O frequently
O occasionally

O rarely
O not at all

14-2. If so, what sources do you use most frequently?

_____

15. (2.1)(4.3) Has your instructor(s) incorporated the iPad into the course beyond the preloaded course reading materials? (suggested resources on the web, supplemental video, in class to lookup references, etc.)
O Yes
O Unsure
O No

If yes, in what ways?

_____

16. (2.2) Have you printed or desired to print the course readings on the iPad? (Mark all that apply)
 I have desired to print course materials
 I have printed course materials
 I have not printed course materials
 I have not had the desire to print

16-2. If you have desired to print or have printed, how often and please give examples for what purpose?

_____

_____

_____

17. (2.3) When writing an assigned paper or course project, which do you prefer: electronic course materials or traditional printed course materials?
O Strongly prefer electronic course materials
O Prefer electronic course materials
O No preference (makes no difference)
O Prefer printed course materials
O Strongly prefer printed course materials

17-2. Why do you prefer one to the other?

_____

_____

General iPad use

18. (3.1) How often do you use the iPad for the reading of course materials?
    - ○ Multiple times a day
    - ○ Daily
    - ○ Multiple times a week but not daily
    - ○ Weekly
    - ○ Less than weekly
    - ○ Not at all

19. (3.2) In addition to course readings, how often do you use the iPad for the following functions?

    a. Note taking
        - ○ Multiple times a day
        - ○ Daily
        - ○ Multiple times a week but not daily
        - ○ Weekly
        - ○ Less than weekly
        - ○ Not at all

    b. Reading email
        - ○ Multiple times a day
        - ○ Daily
        - ○ Multiple times a week but not daily
        - ○ Weekly
        - ○ Less than weekly
        - ○ Not at all

    c. Writing email
        - ○ Multiple times a day
        - ○ Daily
        - ○ Multiple times a week but not daily
        - ○ Weekly

- ○ Less than weekly
- ○ Not at all

d. News reading

- ○ Multiple times a day
- ○ Daily
- ○ Multiple times a week but not daily
- ○ Weekly
- ○ Less than weekly
- ○ Not at all

e. Web browsing

- ○ Multiple times a day
- ○ Daily
- ○ Multiple times a week but not daily
- ○ Weekly
- ○ Less than weekly
- ○ Not at all

f. Media consumption (music, video, etc.)

- ○ Multiple times a day
- ○ Daily
- ○ Multiple times a week but not daily
- ○ Weekly
- ○ Less than weekly
- ○ Not at all

g. Gaming

- ○ Multiple times a day
- ○ Daily
- ○ Multiple times a week but not daily
- ○ Weekly
- ○ Less than weekly
- ○ Not at all

h. Other personal applications not listed above

- ○ Multiple times a day
- ○ Daily
- ○ Multiple times a week but not daily

- ○ Weekly
- ○ Less than weekly
- ○ Not at all

20. (3.3) Do you carry the iPad with you more or less often than you would print course materials?
    - ○ much more often
    - ○ more often
    - ○ about the same amount
    - ○ less often
    - ○ much less often

21b. (3.3) If you carry the iPad more often, then do you find yourself using it more or less often for academic purposes than you would use printed course materials?
    - ○ much more often for academic purposes
    - ○ more often for academic purposes
    - ○ about the same amount
    - ○ less often for academic
    - ○ much less often for academic

21. (3.4) How much do you use the iPad for personal use compared to academic use?
    (slide for the proper ratio of use)
    100% personal use ----------50/50, equal amount----------100% academic use

Preference / Recommendation for course materials

22. (5.3) Would you recommend or oppose the delivery of course materials on a tablet device for future courses?
    - ○ Strongly recommend
    - ○ Recommend
    - ○ Indifferent
    - ○ Oppose
    - ○ Strongly oppose

23. (5.1) With your experience with digital course materials in mind, which format for course material do you prefer, digital or print?
    - ○ Strongly prefer digital course materials

- ○ Prefer digital course materials
- ○ Indifferent
- ○ Prefer print course materials
- ○ Strongly prefer print course materials

24. (5.3) In your opinion, what could be done to improve the use of electronic materials?

_____

_____

25. (5.3) Would you recommend the continued use of a tablet device for future courses or another device?
    - ○ Prefer the Apple iPad
    - ○ Would prefer other. Give recommendation _____
    - ○ Indifferent (any tablet device)
    - ○ None, would not recommend the use of any device

Thank you for your time and thoughtful answers in completing this survey.

This concludes the survey.

Survey Notes

Research question / proposition codes, along with question numbers will not be visible to survey respondents when taking the survey. A progress bar will be visible at the bottom of each screen to indicate the respondent's progression through the survey and how much is left in the survey.

Key:
- ○ - radio buttons (only one answer can be selected)
- □ - check box (mark multiple answers that apply)
- ⌑ - place in order
- (#.#) – Research question / proposition code

APPENDIX C: Verbal Statement to Students

Our names are Michael H. Bush and Andrea H. Cameron, and we are doctoral students in Educational Technology at Pepperdine University. We are currently investigating student and faculty experiences with the Apple iPad. We have been provided 15 minutes of class time for you to participate in the study. Please understand that your participation in our study is voluntary. At the beginning of the online survey is a consent form with full details of what your study participation entails. Please read this information before deciding to participate. The survey is completely anonymous.

We are also looking for volunteers for a focus group to discuss the use of the iPad in more detail. The focus group will meet once for about an hour. Participation in the focus group will be kept confidential.

Thank you for your time and we hope you decide to complete the survey and consider volunteering for the focus group.

APPENDIX D: Student Consent Form

Dear Student:

Our names are Michael H. Bush and Andrea H. Cameron, and we are doctoral students in Educational Technology at Pepperdine University, Graduate School of Education and Psychology, who are currently in the process of recruiting individuals for our study entitled, “A case study of student and faculty perceptions regarding the use of electronic course materials on an Apple iPad.” The professor supervising our work is Dr. Ray Gen. The study is designed to investigate student and faculty experiences with the Apple iPad, so we are inviting individuals who are involved in the pilot program to participate in my study. Please understand that your participation in our study is strictly voluntary. The following is a description of what your study participation entails, the terms for participating in the study, and a discussion of your rights as a study participant. Please read this information carefully before deciding whether or not you wish to participate.

If you should decide to participate in the study, you will be asked to participate in an online survey and consider volunteering for focus group. It should take approximately 15 minutes to complete the survey. Please complete the survey alone in a single setting. All survey data is collected anonymously through the Vovici software. If you are interested in participating in the focus group, please contact the researchers. Out of all the volunteers for the focus group, six total students will be randomly selected to participate. By signing the checkbox for this form, you would be consenting to participate in the focus group as well if you volunteer and are selected. The focus group would be audio-recorded and transcribed for an accurate record of the event. In the transcription, you would only be identified as Student A, B, C, etc. None of this input will be shared with the faculty of the Naval War College until after the course is complete.

Participation in this study carries the same amount of risk that individuals will encounter during a usual classroom activity. If you have any questions please contact the researchers or IRB Manager Jean Kang at xxx-xxx-xxxx.

The participant will not directly benefit from their study participation.

If you should decide to participate and find you are not interested in completing the survey in its entirely, you have the right to discontinue at any point without being questioned about your decision. You also do not have to answer any of the questions on the survey that you prefer not to answer--just leave such items blank.

If the findings of the study are presented to professional audiences or published, no information that identifies you personally will be released.

If you have any questions regarding the information that we have provided above, please do not hesitate to contact us at the address and phone number provided below. If you have further questions or do not feel we have adequately addressed your concerns, please contact Dr. Ray Gen at xxxxxxx@xxxxx.xxx. If you have questions about your rights as a research participant, contact Jean Kang, IRB Manager, Pepperdine University, at xxxxxxxxxx@pepperdine.edu.

By completing the survey, you are acknowledging that you have read and understand what your study participation entails, and are consenting to participate in the study.

Thank you for taking the time to read this information, and we hope you decide to complete the survey.

Sincerely,

Michael H. Bush, Doctoral Candidate
Andrea H. Cameron, Doctoral Candidate

APPENDIX E: Initial Letter for Student Focus Group Members

Dear [Student Volunteer],

Thank you for volunteering to be part of a student focus group to discuss your experiences with the iPad. Again, the overall purpose of this research is to explore what can be learned from pilot program participant perceptions in regard to course materials presented via iAnnotate on an Apple iPad. Participation is strictly voluntary. As a reminder, attached to this email is the consent form that details what your participation in this study entails, the terms for participating in the study, and a discussion of your rights as a study participant. Your earlier consent to participate in the online survey also covers your voluntary participation in the focus group.

Your focus group interview will be at [*time*] on [*date*] at [*location*] and will take approximately one hour. You will be provided a meal and refreshments. Thank you for your time.

Sincerely,

Michael H. Bush and Andrea H. Cameron
Doctoral Candidates, Pepperdine University

APPENDIX F: Reminder Letter for Student Focus Group Members

Dear [Student Volunteer],

We greatly appreciate your willingness to contribute to this research during a student focus group. As a reminder, the focus group will be meeting at [*time*] on [*date*] at [*location*]. We look forward to seeing you there.

Sincerely,

Michael H. Bush and Andrea H. Cameron
Doctoral Candidates, Pepperdine University

APPENDIX G: Student Focus Group Schedule

Purpose: The purpose of this focus group interview is to gain a better understanding of your experience with using the iPad and iAnnotate for course materials.

Guidelines: This interview is meant to be a conversation about your experiences. With that, there are a few guidelines that we need to follow for this session.

- First and foremost, if you have something to say please do so. There is not a particular order to who may speak.
- Please refrain from speaking while someone else is speaking.
- It is important that each of you participate and share your experiences.
- You will receive a focus group note sheet. Use it to jot down comments that come to you if someone else is talking. Then share when appropriate.
- We have roughly an hour for the group session. At some point we may need to stop and redirect our discussion.
- Any questions about how we are going to proceed?

Interview Questions:

1. (5.1) At this point, which do you prefer, digital course material in iAnnotate or printed course materials?
    - Why so?
2. (3.2) Lets think about the usefulness of the iPad… outside of reading course material, how do you use it? (email, web surfing, news reading, Netflix?)
    - (3) How often do you use it?

3. (3.1)(1.1) Do you find yourself reading course material more because you have them on the iPad?
    - Explain?
4. (4.1) Have faculty members had you use the iPad outside of reading the course materials?
    - How so?
5. (2.1) Have you found any academic uses for the iPad outside of the course readings?
6. (2.2) Have you printed anything? Desired to print anything? What have you printed?
    - Why?
7. (1) Picture yourself getting ready for a class… How do you prepare the class?
    a. (1.1, 1.2) Do read the course materials all at once?
    b. (1.8) Do you use any of the markup tools in iAnnotate?
    c. (1.8) Do you like iAnnotate?
    d. (1.8) Do you take notes?
    e. How do you take notes?
    f. (1.7) Do you get distracted when on the iPad because of all the other things you associate that can be done with it?
8. (1.5) During an in class discussion do you have any issues placing in what material particular piece of information was in?
    - Do you believe that it is any better or worse with printed course material?
9. (2.3) Now you have a course paper or project due… and you are writing it up. What is your process when preparing to write?
    - How do you go about gathering all the necessary materials?

- How do you pull from them what you need?

10. (5.3) After your experience with course materials on the iPad…
    a. Do you recommend their use for future courses?
        - Why or why not?
    b. How could it be improved?

Conclusion: This concludes our session. Thank you very much for your willingness to be here and share your experiences.

Focus group interview notes

Bulleted items are prompts to aid discussion.

APPENDIX H: Focus Group Note Sheet

To protect your anonymity, **do not place your name on these note sheets!**

Purpose: Use these note sheets to jot down comments that come to you if someone else is talking. Then share when appropriate.

Interview Questions:

11. At this point, which do you prefer, digital course material in iAnnotate or printed course materials?

12. Outside of reading course material, how and how often do you use the iPad?

13. Do you find yourself reading course material more because you have them on the iPad?

14. Have faculty members had you use the iPad outside of reading the course materials?

15. Have you found any academic uses for the iPad outside of the course readings?

16. Have you printed anything? Desired to print anything? What have you printed?

17. How do you prepare the class?

    a. Do read the course materials all at once?

    b. Do you use any of the markup tools in iAnnotate?

    c. Do you take notes?

    d. Do you get distracted when on the iPad because of all the other things you associate that can be done with it?

18. During an in class discussion do you have any issues placing in what material particular piece of information was in?

19. What is your process when preparing to write a course paper or for a course project?

20. After your experience with course materials on the iPad…
    c. Do you recommend their use for future courses?

    d. How could it be improved?

Thank you very much for your willingness to be here and share your experiences.

APPENDIX I: Faculty Interview Schedule

Purpose: The purpose of this interview is to gain a better understanding of your experience with the use of the iPad and iAnnotate for course materials.

Guidelines: This interview is meant to be a conversation about your experiences. Your experience with teaching the pilot program course is important. Any questions before we proceed?

Interview Questions:

1. (5.2) In your view, what are some pros and cons of using digital course materials?

    1b. (5.2) Do you prefer one over the other?

2. (4) How do you perceive that the iPad has changed the classroom experience?

3. (4.1, 4.2) Compared to traditional courses that you taught, are there any differences in:

    a. (4.1) student participation?

    b. (4.2) course discussions?

    c. (4.2) academic writing?

    d. (4.2) Do you feel that students are more or less prepared when they arrive in class?

4. (4.2) Do you feel that students in the pilot program are gaining more or less from the readings compared to other classes?

- What brings you to that conclusion?

5. (4.3) Has using the iPad for course materials altered your approach to teaching?
    - How so?

6. (4.3) Have you used other iPad features outside of the course readings for course enhancement?

7. (5.4) In your opinion, what could be done to improve the use of digital materials?

8. (5.2) Would you recommend or oppose the delivery of digital course materials on a tablet device for future courses?

Conclusion: This concludes our session. Thank you very much for your willingness to meet with us and share your experiences.

APPENDIX J: Invitation Letter for Faculty

Dear [Faculty Member],

We, Michael H. Bush and Andrea H. Cameron, are currently doctoral students at Pepperdine University conducting research in fulfillment of a degree in Educational Technology. The overall purpose of this research is to explore what can be learned from pilot program participant perceptions in regard to substituting traditional printed course materials with electronic course materials presented via iAnnotate on an Apple iPad. As a faculty member in the pilot program, we would like the opportunity to interview you individually to gain knowledge from your observations of the use of the iPad in your course. Participation is voluntary. Attached to this email is a consent form that details what your participation in this study entails, the terms for participating in the study, and a discussion of your rights as a study participant.

We hope you will consent to be interviewed as part of this study. The interview will take approximately 30 minutes. If you agree to participate, please reply to this email to set up a time and place at your convenience. Thank you for your consideration.

Sincerely,

Michael H. Bush and Andrea H. Cameron
Doctoral Candidates, Pepperdine University

APPENDIX K: Faculty Consent Form

INFORMED CONSENT FOR PARTICIPATION IN RESEARCH ACTIVITIES

Participant: _____

Principal Investigators: Michael H. Bush and Andrea H. Cameron

Title of Project: A Case Study of Student and Faculty Perceptions Regarding The Use of Electronic Course Materials on the Apple iPad

1. *I _____ , agree to participate in the research study being conducted by Michael H. Bush and Andrea H. Cameron under the direction of Dr. Ray Gen.*

2. *The overall purpose of this research is to explore what can be learned from pilot program participant perceptions in regard to substituting traditional printed course materials with electronic course materials presented via iAnnotate on an Apple iPad.*

3. My participation will involve the following: answering questions in a face-to-face interview.

4. My participation in the study will take approximately one hour. The study shall be conducted at the Naval War College.

5. I understand that the possible benefits to myself or society from this research include informing academic institutions, faculty and technology designers on improved incorporation of a multi-modal device into a course.

6. I understand that there are certain risks and discomforts that might be associated with this research. These risks include:
Potential risk of this study is minimal. There are no known risks at this time. Discomfort associated with this study is no more than that experienced during the normal course of a day.

7. I understand that my estimated expected recovery time after the experiment will be:
This study is not an experiment. There is no recovery necessary.

8. I understand that I may choose not to participate in this research.

9. I understand that my participation is voluntary and that I may refuse to participate and/or withdraw my consent and discontinue participation in the project or activity at any time without penalty or loss of benefits to which I am otherwise entitled.

10. I understand that the interview will be recorded and transcribed. In the transcription, I will be referred to as Faculty Member A, B, C, etc.

11. I understand that the investigators will take all reasonable measures to protect the confidentiality of my records and my identity will not be revealed in any publication that may result from this project. The confidentiality of my records will be maintained in accordance with applicable state and federal laws.

12. I understand that the investigators are willing to answer any inquiries I may have concerning the research herein described. I understand that I may contact Dr. Ray Gen if I have other questions or concerns about this research. If I have questions about my rights as a research participant, I understand that I can contact Jean Kang, IRB Manager, Pepperdine University, xxxx@pepperdine.edu.

13. I will be informed of any significant new findings developed during the course of my participation in this research which may have a bearing on my willingness to continue in the study.

14. I understand to my satisfaction the information regarding participation in the research project. All my questions have been answered to my satisfaction. I have received a copy of this informed consent form which I have read and understand. I hereby consent to participate in the research described above.

_____
Participant's Signature

_____
Date

_____
Witness

_____
Date

I have explained and defined in detail the research procedure in which the subject has consented to participate. Having explained this and answered any questions, I am cosigning this form and accepting this person's consent.

_____ _____
Principal Investigator Date

_____ _____
Principal Investigator Date

APPENDIX L: Thank You Letter for Faculty Interview

Dear [Faculty Volunteer],

Thank you very much for participating in a faculty interview for our research. Your input is valuable and greatly contributes to the larger body of knowledge. We greatly appreciate your time and involvement. Thank you.

Sincerely,

Michael H. Bush and Andrea H. Cameron
Doctoral Candidates, Pepperdine University

APPENDIX M: Student Survey with Results

The following survey will be used to improve future development and application of technology in the academic environment. Survey responses are anonymous. No names will be associated with responses. While giving thoughtful answers, this survey should take approximately 15 minutes to complete. Thank you in advance for time and thoughtful answers.

Demographics

1. Gender: ○ Female ○ Male

Male	34	97%
Female	1	3%
Total Respondents	35	

2. Age:
   - ○ less than 26
   - ○ 27 – 31
   - ○ 32 – 35
   - ○ 36-40
   - ○ 41-45
   - ○ greater than 45

Age 27-31	10	29%
Age 32-35	4	11%
Age 36-40	8	23%
Age 41-45	6	17%
Age 46-50	4	11%
Age 51 or greater	3	9%
Total Respondents	35	

3. Employment status: Active Duty Military Reservist Civilian

Active Duty	24
Reservist	6
Civilian	8

4. Student status: ○ Resident (full time) ○ Non-Resident (part time)

Resident (full time)	5	14%
Non-Resident (part time)	30	86%
Total Respondents	35	

5. NWC/CDE courses currently taking:

- JMO
- NSDM
- Elective

Elective	5
JMO	16
NSDM	17

6. Prior to beginning your current course, had you used any type of e-reader?

○ Yes ○ No

Yes	5
No	29
Total Respondents	34
Percentage of Prior usage	15%

6-2. If so, which of the following: (Mark all that apply)

- Amazon Kindle
- Apple iPad
- Barnes & Noble Nook
- Sony eReader
- As an e-reader Apple iPhone or iPod Touch
- Other _____

Amazon Kindle	3
Barnes & Noble Nook	1
Sony eReader	1
As an e-reader, Apple iPhone or iPod Touch	2
Palm	1

Reading of course materials on iPad compared to Print

7. When comparing your current experience reading course materials using iAnnotate on an iPad with your prior experience with traditional printed course materials:

   a. (1.1) Do you read more often or less often when using the iPad?

   ○ more often
   ○ about the same
   ○ less often
   ○ I do not read course materials on the iPad (*if selected skip to question 15*)

more often	13	38%
about the same	16	47%
less often	5	15%
Total Respondents	34	

Why do you believe that you are reading more or less often?

_____

Read More often	
Portability	9
Searchability	2
Mark-up ability	1
Night Readability	1
Navigation on iPad	1
Prefers Digital material	1
Read Less often	
Secured work area, print	2
Print Tangibility	1
Less often - Non-iPad reason	
Familiarity with Content	1

   b. (1.2) Do you read for longer or shorter periods of time when using the iPad?

   ○ longer with iPad
   ○ about the same
   ○ shorter with iPad

longer with iPad	5	16%
about the same	18	56%
shorter with iPad	9	28%
Total Respondents	32	

c. (1.3) Do you find that you read more quickly or less quickly when using the iPad?

- ○ more quickly with iPad
- ○ about the same
- ○ less quickly with iPad

more quickly with iPad	9	30%
about the same	14	47%
less quickly with iPad	7	23%
Total Respondents	30	

d. (1.4) Do you find that you understand more or less of what you are reading when using the iPad?

- ○ understand more with iPad
- ○ about the same
- ○ understand less with iPad

understand more with iPad	3	10%
about the same	24	80%
understand less with iPad	3	10%
Total Respondents	30	

8. (1.6) After having read course material on the iPad, do you find yourself participating more or less in class?

- ○ participate more
- ○ participate about the same
- ○ participate less

participate more	8	27%
participate about the same	21	70%
participate less	1	3%
Total Respondents	30	

9. (1.5) After having read multiple course materials on the iPad, do you find it more or less difficult to distinguish which material an idea is from? (i.e. document A from document B)

○ more difficult when having read material on the iPad

○ no difference in difficulty when having read material on the iPad

○ less difficult when having read material on the iPad

more difficult when having read material on the iPad	11	34%
no difference in difficulty when having read material on the iPad	17	53%
less difficult when having read material on the iPad	4	13%
Total Respondents	32	

9-2. (1.5) Why do you it believe it to be more or less difficult?

_____

less difficult when having read material on the iPad	
Ability to change font size	1
Clearer on iPad	1
more difficult when having read material on the iPad	
Print Tangibility	7
Print spatial flexability	2
Print Differentiation - Digital more difficult due to file structure	3
Print Tailorability	1
no difference in difficulty when having read material on the iPad	
Differentiation - Digital more difficult due to file structure	1

10. (1.7) When reading course materials in any format (paper, iPad or other) do you find yourself easily distracted?

○ Yes

○ Unsure

○ No

Yes	10	32%
Unsure	5	16%
No	16	52%
Total Respondents	31	

11. (1.7) Do you find yourself more or less distracted when reading on the iPad compared to paper?

○ much more distracted

○ more distracted

○ no difference

○ less distracted

○ much less distracted

much more distracted	2	6%
more distracted	6	19%
no difference	17	53%
less distracted	5	16%
much less distracted	2	6%
Total Respondents	32	

11-2. (1.7) Why do you feel that you are more or less distracted?

---

more distracted (total)	**8**	**25%**
iPad function distraction	6	
distracted by annotation tools	1	
distracted by portability of reading material	1	
less distracted (total)	**7**	**22%**
focus better with iPad	5	
pages are clearer / adjustable in size	1	
portability of reading, can escape to focus	1	
no difference	**17**	**53%**

12. To what extent do you agree with the following statements about iAnnotate:

a. (1.8) iAnnotate is easy to use.

O strongly agree
O agree
O undecided
O disagree
O strongly disagree

strongly agree	10	31%
agree	17	53%
undecided	2	6%
disagree	2	6%
strongly disagree	1	3%
Total Respondents	32	

agree	27	84%
undecided	2	6%
disagree	3	9%
Total Respondents	32	

b. (1.8) iAnnotate's search function makes it easy for me to search for important passages in the course readings.

O strongly agree
O agree
O undecided
O disagree
O strongly disagree
O I have not used the search function

strongly agree	11	34%
agree	8	25%
undecided	5	16%
disagree	4	13%
strongly disagree	2	6%
I have not used the search function	2	6%
Total Respondents	32	

agree	19	59%
undecided	5	16%
disagree	6	19%
I have not used the search function	2	6%
Total Respondents	32	

c. (1.8) iAnnotate makes it easy for me to annotate (i.e. markup, add notes, highlight important passages, etc.) the course readings.

O strongly agree
O agree
O undecided
O disagree
O strongly disagree
O I have not used the annotation tools

strongly agree	6	19%
agree	16	50%
undecided	2	6%
disagree	7	22%
strongly disagree	1	3%
Total Respondents	32	

agree	22	69%
undecided	2	6%
disagree	8	25%
Total Respondents	32	

13. (1.8) When reading course materials, I use the markup tools in iAnnotate

O very frequently

O frequently

O occasionally

O rarely

O not at all (if selected skip 13-2)

very frequently	12	38%
frequently	8	25%
occasionally	6	19%
rarely	6	19%
not at all	0	0%
Total Respondents	32	

frequently or more	20	63%
occasionally	6	19%
rarely or not at all	6	19%
Total Respondents	32	

13-2. (1.8) Arrange the markup tools in the order you most often use them:

- ⌑ Bookmark
- ⌑ Highlighter
- ⌑ Note
- ⌑ Pencil
- ⌑ Underline
- ⌑ Other (specify) _____

	Average Rank Order
Highlighter	1
Note	2
Bookmark	3
Underline	4
Pencil	5

Using the iPad as an academic tool

14. (2.1) Outside of reading course materials in iAnnotate, have you found yourself using the iPad to lookup supplementary academic materials (i.e. dictionary, Wikipedia, other reference type sources)?

O very frequently

O frequently

O occasionally

O rarely

O not at all

very frequently	11	34%
frequently	10	31%
occasionally	7	22%
rarely	4	13%
not at all	0	0%
Total Respondents	32	
frequently or more	21	66%
occasionally	7	22%
rarely or not at all	4	13%
Total Respondents	32	

14-2. If so, what sources do you use most frequently? _____

Sources listed in order of popularity	
Wikipedia.com	14
Google.com	12
news sources	7
dictionary	4
joint doctrine pub	3
articles	2
DoD sites	2
academic journals	1
agency pages	1
cia.com	1
class website	1
email	1
Google scholar	1
internet	1
journals	1
maps	1
periodicals	1
think tank material	1

15. (2.1)(4.3) Has your instructor(s) incorporated the iPad into the course beyond the preloaded course reading materials? (suggested resources on the web, supplemental video, in class to lookup references, etc.)

○ Yes

○ Unsure

○ No

Yes	19	61%
Unsure	1	3%
No	11	35%
Total Respondents	31	

If yes, in what ways?_____

Web Links	6
Blackboard	5
Quick reference search	3
additional material	3
video links	2
news	1

16. (2.2) Have you printed or desired to print the course readings on the iPad? (Mark all that apply)

- I have desired to print course materials
- I have printed course materials
- I have not printed course materials
- I have not had the desire to print

I have desired to print course materials	14	45%
I have printed course materials	8	26%
I have not printed course materials	17	55%
I have not had the desire to print	10	32%
Total Responses (mark all that apply)	49	
Total Respondents	31	

16. With respondents from electives course removed		
I have desired to print course materials	14	52%
I have printed course materials	8	30%
I have not printed course materials	12	44%
I have not had the desire to print	9	33%
Total Responses	43	
Total Respondents	27	

16-2. If you have desired to print or have printed, how often and please give examples for what purpose?

_____

Printed Sources for Papers (Manipulabiliity)	5
Printed to use as reference material	2
Printed for faster access and marking (Tailorability)	2
Easier to flip back and forth with Paper (Tangibility)	1
Printed graphs for study	1
Printed notes and highlighted sections	1
Printed for use in workspace	1
Printed syllabus	1

17. (2.3) When writing an assigned paper or course project, which do you prefer: electronic course materials or traditional printed course materials?

- ○ Strongly prefer electronic course materials
- ○ Prefer electronic course materials
- ○ No preference (makes no difference)
- ○ Prefer printed course materials
- ○ Strongly prefer printed course materials

Strongly prefer electronic course materials	2	6%
Prefer electronic course materials	7	22%
No preference (makes no difference)	8	25%
Prefer printed course materials	11	34%
Strongly prefer printed course materials	4	13%
Total Respondents	32	
prefer electronic	9	28%
no preference	8	25%
prefer print	15	47%
Total Respondents	32	

17. With respondents from electives course removed		
Strongly prefer electronic course materials	2	7%
Prefer electronic course materials	6	21%
No preference (makes no difference)	7	25%
Prefer printed course materials	10	36%
Strongly prefer printed course materials	3	11%
Total Respondents	28	
prefer electronic	8	29%
no preference	7	25%
prefer print	13	46%
Total Respondents	28	

17-2. Why do you prefer one to the other?

_____

_____

Prefer electronic course materials	
Cut & Paste	3
Searchability	5
Portability	2

Prefer printed course materials	
Print tangibility	9
Print spatial flexibility / manipulability	3
Print tailorability	2
experienced with print	1

General iPad use

18. (3.1) How often do you use the iPad for the reading of course materials?

- ○ Multiple times a day
- ○ Daily
- ○ Multiple times a week but not daily
- ○ Weekly
- ○ Less than weekly
- ○ Not at all

Multiple times a day	1	3%
Daily	7	22%
Multiple times a week but not daily	17	53%
Weekly	5	16%
Less than weekly	2	6%
Not at all	0	0%
Total Respondents	32	

18. Data with elective respondents removed.		
Multiple times a day	1	4%
Daily	5	18%
Multiple times a week but not daily	17	61%
Weekly	3	11%
Less than weekly	2	7%
Not at all	0	0%
Total Respondents	28	

19. (3.2) In addition to course readings, how often do you use the iPad for the following functions?

a. Note taking

Multiple times a day	0	0%
Daily	2	6%
Multiple times a week but not daily	9	28%
Weekly	7	22%
Less than weekly	3	9%
Not at all	11	34%
Total Respondents	32	

b. Reading email

Multiple times a day	2	6%
Daily	9	28%
Multiple times a week but not daily	9	28%
Weekly	3	9%
Less than weekly	2	6%
Not at all	7	22%
Total Respondents	32	

c. Writing email

Multiple times a day	2	6%
Daily	2	6%
Multiple times a week but not daily	9	28%
Weekly	3	9%
Less than weekly	8	25%
Not at all	8	25%
Total Respondents	32	

d. News reading

Multiple times a day	3	10%
Daily	10	34%
Multiple times a week but not daily	6	21%
Weekly	7	24%
Less than weekly	2	7%
Not at all	1	3%
Total Respondents	29	

e. Web browsing

Multiple times a day	5	17%
Daily	10	33%
Multiple times a week but not daily	8	27%
Weekly	5	17%
Less than weekly	2	7%
Not at all	0	0%
Total Respondents	30	

f. Media consumption (music, video, etc.)

Multiple times a day	3	10%
Daily	1	3%
Multiple times a week but not daily	4	13%
Weekly	7	23%
Less than weekly	9	29%
Not at all	7	23%
Total Respondents	31	

g. Gaming

Multiple times a day	0	0%
Daily	2	6%
Multiple times a week but not daily	3	9%
Weekly	3	9%
Less than weekly	5	16%
Not at all	19	59%
Total Respondents	32	

h. Other personal applications not listed above

Multiple times a day	4	13%
Daily	2	6%
Multiple times a week but not daily	3	9%
Weekly	1	3%
Less than weekly	5	16%
Not at all	17	53%
Total Respondents	32	

20. (3.3) Do you carry the iPad with you more or less often than you would print course materials?

much more often	15	47%
more often	8	25%
about the same amount	6	19%
less often	2	6%
much less often	1	3%
Total Respondents	32	

more often	23	72%
about the same	6	19%
less often	3	9%
Total Respondents	32	

20b. (3.3) If you carry the iPad more often, then do you find yourself using it more or less often for academic purposes than you would use printed course materials?

○ much more often for academic purposes
○ more often for academic purposes
○ about the same amount
○ less often for academic
○ much less often for academic

much more often for academic purposes	7	32%
more often for academic purposes	11	50%
about the same amount	4	18%
less often for academic purposes	0	0%
much less often for academic purposes	0	0%
Total Respondents	22	

more often for academic purposes	18	82%
about the same amount	4	18%
less often for academic purposes	0	0%
Total Respondents	22	

21. (3.4) How much do you use the iPad for personal use compared to academic use?

100% academic	2	6%
90% academic	5	16%
80% academic	5	16%
70% academic	7	22%
60% academic	1	3%
equal amounts, 50/50	3	9%
60% personal	4	13%
70% personal	4	13%
80% personal	1	3%
90% personal	0	0%
100% personal	0	0%
Total Respondents	32	

60% or more for academic use	20	63%
equal amounts	3	9%
60% or more for personal use	9	28%
Total Respondents	32	

Preference / Recommendation for course materials

22. (5.3) Would you recommend or oppose the delivery of course materials on a tablet device for future courses?

- ○ Strongly recommend
- ○ Recommend
- ○ Indifferent
- ○ Oppose
- ○ Strongly oppose

Strongly Recommend	18	56%
Recommend	10	31%
Indifferent	3	9%
Oppose	1	3%
Strongly Oppose	0	0%
Total Respondents	32	

Recommend	28	88%
Indifferent	3	9%
Oppose	1	3%
Total Respondents	32	

23. (5.1) With your experience with digital course materials in mind, which format for course material do you prefer, digital or print?

- ○ Strongly prefer digital course materials
- ○ Prefer digital course materials
- ○ Indifferent
- ○ Prefer print course materials
- ○ Strongly prefer print course materials

Strongly prefer digital course materials	9	28%
Prefer digital course materials	16	50%
Indifferent	4	13%
Prefer print course materials	2	6%
Strongly prefer print course materials	1	3%
Total Respondents	32	

Prefer digital course materials	25	78%
Indifferent	4	13%
Prefer print course materials	3	9%
Total Respondents	32	

24. (5.3) In your opinion, what could be done to improve the use of electronic materials?

_____

_____

file structure / naming system, smaller files referenced by author and title	9
ability to print select readings	4
quality of PDFs affecting ability to annotate	4
need the addition of document creation tool like MS Word	2
not able to take iPad into secured work areas	2
supplemental media linked to need to be supported for iPad consumption (in light of the lack of flash support)	2
would like materials provided on CD in addition to iPad	2
give students option for printed material	1
longer introduction to iPad/iAnnotate	1
option to buy iPad at end of year	1
optional keyboard	1
stronger faculty acceptance (stop giving paper handouts)	1

25. (5.3) Would you recommend the continued use of a tablet device for future courses or another device?

○ Prefer the Apple iPad

○ Would prefer other. Give recommendation _____

○ Indifferent (any tablet device)

○ None, would not recommend the use of any device

Prefer the Apple iPad	24	77%
Would prefer other. Give recommendation	2	6%
Indifferent (any tablet device)	5	16%
None, would not recommend the use of any device	0	0%
Total Respondents	31	

Thank you for your time and thoughtful answers in completing this survey.

This concludes the survey.