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A Comparison Study of the Use of Paper versus Digital Textbooks by Undergraduate Students

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A COMPARISON STUDY OF THE USE OF PAPER VERSUS DIGITAL TEXTBOOKS BY UNDERGRADUATE STUDENTS

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ABSTRACT

Today's undergraduate student faces many challenges. The challenges include paying for tuition and textbooks and finding a job upon graduation. These students are tech-savvy and seeking better ways to learn and retain material they learn in their classes. In addition, the textbook market is trying to evolve by serving this tech-generation through offering digital textbooks and other media-rich materials. New digital textbooks coupled with tablet e-readers are being used to help undergraduate students learn and retain information just as well as traditional paper textbooks. Undergraduate students have strong opinions about the use of paper and digital textbooks including the physical effects of digital e-readers, cost concerns for both formats of textbooks, and the features students want to see in e-readers. This study examined the effectiveness of using digital textbooks compared with traditional paper textbooks in undergraduate courses. Student performance comparisons were used to see if the digital versions have any significant influence on students' achievement scores versus paper books and if there are any differences between genders. Moreover, regardless of performance outcomes, features of software and devices were explored to determine if these influence use of digital texts.

Digital textbooks provide effective learning resources for undergraduate students at cost-effective prices. Features of digital e-readers can help students meet their learning goals and complete their coursework using new, interactive textbooks that pull together the content experts and multimedia.

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CHAPTER 1

INTRODUCTION

The digital generation of college students expects more from their education. They expect more access to information and more access to tools and technology to get their work done, and they want it at a competitive price. With the continued growth in distance education and the birth of the digital book or e-book reader and reader software, the opportunities exist to meet this desire and expectation. Instead of having to travel to a physical campus and its bookstore, students can take classes at a time that is convenient and gain access to the textbooks they need in digital format. Even though there are vast technology opportunities, major roadblocks to digital textbook adoption are presented in the limited format standards set by the publishing industry, hardware requirements for the books and devices that can read them, and the added cost for publishers to create digital copies that allow enhancements over the print textbook (Bedord, 2009).

Over the last few years the standards for digital books have been developed and more hardware devices and software are available to read these formats. Students can use software on their personal computers, a wide variety of e-book readers, and even cellular smart phones. But wider availability of digital books and readers does not mean that the mainstream student is ready to use a digital textbook. The K-12 textbook market has an abundance of new editions of textbooks from publishers as well as from open source free publishers such as the CK-12

Foundation. The non-profit CK-12 Foundation created flexbooks that use web-based delivery of enhanced teaching materials. This allows the instructor to use video, web pages, or other interactive materials on demand and when needed. The materials are updated without the instructors themselves having to worry about maintaining the materials (Hill, 2010).

Virginia State University (VSU) rewrote their business curriculum in 2009 to implement a fully integrated and technologically cutting-edge program for their students. The university is one of America's historically black colleges and serves socioeconomically challenged students. Dean Mirta Martin (2010) had a vision of offering a high-quality program at a competitive cost that included free textbooks and online learning materials. If a course required a textbook, many students reported they could not afford to buy it and would struggle to gain access to the text. In some cases, students would end up dropping out because of added costs to their college education. VSU's new program allows faculty to update their curricular materials immediately and has the flexibility for instructional materials to be used by students on various digital devices such as the Kindle, iPad, and smart phones. The university also worked with the campus bookstore to plan for access to computers and digital devices for the students. The content providers VSU chose to partner with were Flat World Knowledge and GoingOn.com. These companies offered free textbooks and customized portals created and developed by the faculty. The VSU initiative demonstrates that faculty can drive the curriculum and materials, not the publishing companies (Martin, 2010).

In contrast to the VSU program, a few studies have suggested that college courses that have been able to use digital textbooks did not encourage the students to read more or perform better on tests. In particular, a 2008 study conducted by Shepperd, Grace, and Koch, implemented in a psychology class, reported that several students who used the digital textbook

did not favor the electronic edition. Only a third of the digital text users said they would buy the same edition of the book if given the chance, in spite of the fact that the digital textbook was half the cost of the paper textbook. A comparison of the final grade between the paper and digital textbooks users did not show a significant difference in achievement. The researchers tentatively concluded that the digital textbook users may use less time in reading, yet get a grade at least similar to those who use paper textbooks. Shepperd et al. cautioned instructors not to adopt digital textbooks just because of cost savings as the technology behind e-books has changed dramatically.

Historically, since 1971 and the birth of Project Gutenberg, the e-book has grown from a simple text document to a full-featured book with built-in dictionary, highlighting function, bookmarking, search, and other features. The availability of these new features and capabilities led to the creation of the textbook rental market, typically in a digital format (Carreiro, 2010). Zou, found that college bookstores and companies, such as CourseSmart and Amazon, are offering digital copies of textbooks with many of the advanced features mentioned. According to Zou rentals are offered for a period of time, such as a semester or several months, to allow enough time for the student to complete a course. This delivery method allows for the publishing company to market its product at a competitive price without the need to print paper copies. The publisher retains the book copyright and access. Students do not need to buy the physical book, just access it through the company's web site, and the digital book access expires at the end of the rental period. Students can renew the book or remove it from their online accounts. The cost savings of a new paper textbook versus the digital textbook rental prices are appealing to college students (Zou, 2011).

College-bound students face numerous challenges. These challenges range from selecting a major as a pathway to a career, to financing their education, to landing a job in today's job market. As tuition at universities and colleges continues to rise and the world economy struggles to support and sustain itself, paying for that college degree has become even more of a challenge (Cancino, 2011). One part of the financial burden is paying for textbooks that are very costly to purchase with little return on investment when the course is completed. New editions of paper textbooks average 12% higher in cost than the previous editions, yet contain little new information (Christopher, 2008).

Purpose of the Study

This mixed-method study examined the effectiveness of using digital textbooks compared with traditional paper textbooks in undergraduate courses. Student performance comparisons were used to see if the digital versions had any significant influence on students' achievement scores versus paper texts. Moreover, regardless of performance outcomes, features of software and devices were explored to determine if these influence use of digital texts. This study provides information that could help university administrators and faculty make a determination about the use of digital textbooks for their classes. It provides useful information about the need for digital textbooks to the book publishing companies. Furthermore this study may help libraries decide on whether to increase their holdings of digital or paper textbooks.

Statement of the Problem

The costs for a college education continue to rise, causing students to explore alternative ways to access the information needed for their classes through textbooks and other resources (Cancino, 2011). In some cases, the proliferation of digital textbooks and e-reader software has helped to lower costs for students as well as provide study and reference tools. Some e-textbook

buying models being suggested include universities buying bulk editions of digital textbooks and course materials on behalf of students. These sales could decrease cost of digital textbooks per student by nearly half, according to Michael McPherson, the deputy chief information officer at the University of Virginia (Kolowich, 2012). Yu (2012) noted that sales for e-textbooks in higher education rose to $267.3 million in 2011, a 44.3% increase. University libraries are also benefitting from digital textbooks as more than one copy of a book can be made available digitally to students. Digital books help libraries offer similar levels of references and resources during a time of budget reductions and a tough economy. Librarians could be very useful in helping students learn how to use hardware and software to access digital textbooks and resources (Mardis & Everhart, 2011). Although cost benefits abound, a key question remains. If university faculty would adopt digital textbooks, would their students perform differently than when paper textbooks were used?

Significance of the Study

This study provides information concerning the effectiveness of using digital textbooks as compared with the effectiveness of paper textbooks. As the technology and formats of digital textbooks keep changing, the need for continued research in this area is warranted. The rising cost of textbooks and scholarly resources for students and university libraries will also help to determine the future use of paper or digital textbooks. This study also provides insight as to whether undergraduate students prefer to use digital textbooks. Finally this study discusses possible differences in preferences in regard to the use of digital textbooks as related to gender, textbook preference, and past experiences in using tablet computers.

Research Questions

The research questions for this study were

1. Are there any significant differences in reading comprehension test scores of undergraduate students when using paper texts versus digital texts?
2. Are there any differences in reading comprehension test scores of undergraduate students with regard to gender? Is there any relationship between text formats and gender on comprehension scores?
3. Is there any relationship between the hours of experience using tablet computers and reading comprehension test scores among study participants?

Definition of Terms

Digital text or e-text is defined as the digital representation of the printed material (print book); the medium can vary from a (laptop) computer to digital eBook reader, PDA, mobile phone, or even (through a desktop printer) traditional paper. Usually the content is available in PDF or HTML format but may also be in plain text or XML formats (van der Velde & Ernst, 2009).

Digital textbook or e-textbook is an educational or instructional book in digital form. As more students use their laptops and smart phones on a daily basis, e-textbooks are increasingly taking the place of printed books ("E-Textbook," n.d.).

Digital e-reader is defined as a hardware device designed to read digital text or e-text. Examples of such devices include the Apple iPad, Amazon Kindle, and Barnes and Noble Nook.

e-book is defined as a free or commercially book in digital format. Many e-books are digital copies of printed books. A digital e-reader uses software to access the content.

iPad is a tablet hardware device created and manufactured by Apple Computer. It runs its own operating system, iOS, and is the most popular tablet to date.

Limitations

The validity of this study depended on the number of volunteers completing the testing. This study was conducted at a mid-size, Midwestern university, specifically Indiana State University, and is generalizable to other universities and other schools with similar demographics.

1. The text sample used in this study in both paper and digital formats was excerpted from a digital textbook.
2. Students using the paper texts did not have the entire bound edition; therefore, students who would normally feel inhibited by writing in a bound edition did not have the same inhibition with the excerpted version they received.
3. This study also cannot account for the quality of participant's eyesight using either the paper text or tablet computer with the digital text.
4. The majority of participants in this study were women, due to using undergraduate students majoring in education.

Delimitations

Delimitations noted for this study include the following:

1. The study confined itself to the undergraduate student population at Indiana State University. The university currently has an enrollment of just over 10,000 students in the undergraduate programs.
2. The population that participated in the study was composed predominately of students majoring in education.

3. The study only used one chapter of a textbook, and data were collected in one single class period of several classes.

Assumptions

For this study, it was assumed that each participant would respond to the reading material and comprehension test as if it were part of a class for a grade. Participants were asked to perform in a similar manner as they would for typical class assignments.

CHAPTER 2

REVIEW OF THE LITERATURE

The use of textbooks at all levels of school has been a foundation for teaching content. For the past 40 years the popularity and usage of digital e-books and textbooks has been growing. Digital textbooks have experienced exponential growth in the past four to five years (Reynolds, 2011). College students and faculty have their opinions about the transition from paper to digital textbooks and what both groups prefer. Questions educators have include whether students can read and retain information pulled from digital devices and how well students can perform when tested for comprehension.

Reading Comprehension

Literacy skills are paramount to the level of success students will achieve during their academic and work careers. In the elementary school years, students are taught basic decoding, vocabulary, and literacy skills. These skills are developed through different practices and drills. The use of phonics, independent silent reading, and sustained silent reading has been shown to help increase student comprehension and higher performance (Cuevas, 2010).

Reading comprehension and skills in college students can be a challenge to address. Many instructors assume that their students come prepared to learn and have the skills needed to be successful in their classes. If students need help they typically must seek it on their own. Teaching reading methods and strategies to college students is just as beneficial as with K-12

students. According to Lei, Rhinehart, Howard, and Cho (2010), technology tools have been developed that can help college students with their reading comprehension as well. Lei et al. also asserted that students who have a large vocabulary perform better in their classes.

Use of Textbooks in Schools

Schools have been using textbooks for hundreds of years. The development of these textbooks is driven by book publishers who hire experts to write the content. Students need to know why the textbook is important and its value. In 2012, Guthrie and Klauda discussed the importance of basic reading skills as well as the need for higher order reading comprehension. Guthrie and Klauda suggested that textbooks are targeted to a small percentage of students in the middle of ability groups. This leaves a large majority of students needing help or being bored. Guthrie and Klauda suggested that students need to understand why a textbook is important and relevant. Students need to be introduced to the concept of collaboration and discuss what they are reading as well as what other students are reading. More importantly, there is a need for the knowledge of effective assessments of what the students are reading. This means using a variety of techniques such as "traditional" paper tests as well as project-based and other alternative assessments. Teachers must not avoid the textbook, but add value to it (Guthrie & Klauda, 2012).

A college textbook study by Durwin and Sherman (2008) discussed the readability between two textbooks with the same subject matter. Durwin and Sherman also asserted that the instructor must consider the students' backgrounds regarding who will take the course and what courses the students may have taken in the past. The decision about which textbook is to be used for a course must not be rushed but carefully planned out. Also, care must be taken when choosing supporting materials. The major result of this study was that there was no significant difference in reading comprehension between the two textbooks. Students were able to learn

from either textbook. The researchers concluded that the organization and subject matter approach of the textbooks can help students with their level of reading comprehension (Durwin & Sherman, 2008).

In her 2009 study, Robinson (2011) noted that college students are concerned about the cost of textbooks, but even when a textbook is offered free of cost, 33% of students still chose to pay for a paper copy of their textbook. Students from Robinson's 2009 study indicated, if given a choice, they would pay more for a paper copy of a textbook, even if the digital textbook was priced much lower, because they still preferred paper textbooks (Robinson, 2011).

History of Digital Textbooks

The idea of using digital textbooks in college courses is not a new one. Digitizing paper books and other texts has been ongoing since the creation of Project Gutenberg in 1971. Hart (1992) explained that the philosophy of Project Gutenberg was to provide free access to public domain texts and books. Hart further revealed that Project Gutenberg prioritized texts according to their importance in society and value to the general public. The very first document published was the Declaration of Independence. The work of transferring paper texts was divided into a library of three portions: light literature, heavy literature, and references. The light literature included classic fiction books that would entice readers to try digital books, such as *Alice in Wonderland* and *Peter Pan*. The heavy literature included the Bible and other religious documents as well as *Moby Dick* and the works of Shakespeare. The references section offered a set of encyclopedias, dictionaries, and a Roget's Thesaurus (Hart, 1992).

The power of Project Gutenberg is because the founder, Michael Hart, and other contributors, had the foresight to use a plain text or ASCII format for the books so they were accessible and not tied to one type of technology that might be obsolete in a few years. The work

of Project Gutenberg continues to the present day offering over 33,000 free e-books in various formats such as ePub, Kindle, HTML, and simple text formats accessible on multiple devices such as iPad, Kindle, Android, and others. These books are able to be offered without cost because they are out of copyright in the United States (Hart, 1992).

Chesser (2011) explained the genesis of digital textbook resources. In the 1990s, publishing companies developed several electronic books using the compact disc read-only memory (CD-ROM) as the delivery medium, but these failed to gain popularity. Textbook companies were slow to capitalize on the CD-ROM, and it took many years before they began offering expanded supporting materials such as textbook companions and web sites. Publishers would add these CD-ROMs to the paper textbook as an add-on instead of a stand-alone resource. The use of the CD-ROM declined when the Adobe Corporation created the portable document format (PDF) in 1993 for viewing electronic text. The PDF became the standard for sharing text through email, web sites, and other methods (Chesser, 2011).

Adobe Systems (2009) created the Acrobat Reader PDF file format initially for commercial use, but it was released to an open standard in 2008. The PDF is now one of the most widely used formats for digital texts. Many different hardware devices and software programs can create, read, and utilize the various features of PDF (Adobe Systems, 2009).

Sony released the PRS-500 e-reader using E-Ink in October 2006 with little fanfare. Sony previously released the Libre reader in Japan, but the Sony e-reader line would not gain in popularity until companies such as Borders adopted the reader for their store (Zhang, 2006). Levy (2007) examined Amazon's launch of their new e-reader, the Kindle, which brought e-books back into the public spotlight. The online retailer also launched the Kindle Store, offering electronic books especially formatted for this new digital reader that featured long battery life

and a developing technology called E-Ink. Bonsor (2000) and Levy (2007) both described a new technology called E-Ink that was created in 1999 and was designed to have the same contrasting appearance as regular printed ink on paper. The words on these digital pages could be viewed at any angle and even in direct sunlight. The electronic paper could offer the daily newspaper, a person's favorite monthly magazine, or the latest novel on the bestseller list, all without needing to waste paper or worry about recycling or printing costs. Because these digital devices used very low power and held a battery charge for weeks or months at a time, this became a very efficient method of reading text and storing large quantities of materials all in a device the size of a six-inch paperback book. Albanesius (2011) noted that the Kindle quickly became the standard for e-book readers, and in 2010 sales of e-books would overtake sales of paper books. Amazon credited this success to the fact that since the launch of the Kindle, Amazon has expanded the number of digital devices that are capable of running the Kindle e-reader software application (Albanesius, 2011).

Kozlowski (2012) noted when other companies saw the success of Amazon's Kindle, the competition increased to create other e-book readers. Barnes & Noble released the Nook reader on November 30, 2009. Barnes & Noble used the same E-Ink technology and offered their own e-book store for customers to access their offerings (Kozlowski, 2012). The enhancement was that the Nook also featured a color panel at the bottom of the reader as part of a dual screen layout that customers would use to browse the Barnes & Noble store and other content, which would then be displayed on the upper E-Ink screen. This e-reader also used the Google Android operating system seen in many mobile devices and tablets today.

The computer world, as well as the publishing world, was challenged with the launch of Apple's iPad tablet in April 2010. According to the company, this new tablet was designed

similarly to the already popular iPod Touch (Apple Computer, 2012). It offered a 9.7-inch touch screen and ran the same iPod Touch applications (apps), but the device also ran new apps that were specifically designed to run on the iPad's larger screen and more advanced hardware. Both devices, as well as the iPhone, run the same operating system, iOS. The iPad is currently in its fourth generation, offering up to 128GB of storage in the latest device, with over 120 million iPads purchased since 2010 (Apple Computer, 2013b). Apple released a new, smaller device, the iPad Mini. It has a 7.9-inch touch screen and other features similar to the iPad. The iPad mini was priced at $329 to offer a competitive price to other 7-inch tablets on the market, but it would still run iOS apps (Apple Computer, 2012).

Keizer (2013) stated that iOS devices ushered in a new competitive technology race for the best tablet on the market. Since the iPad's launch, several major technology companies have been trying to develop a competing tablet. After three years of competition, the research group International Data Corporation projected that the Android operating system will overtake Apple's iOS in 2013 for the first time (Keizer, 2013). This is mainly due to the lower cost of Android-powered devices and smaller screen sizes being in demand. Apple has not lowered any of their device prices to a competitive level for devices such as Amazon's Kindle or Google's Nexus tablet (Keizer, 2013).

One of the appealing qualities of the iPad is the App Store. In a 2013 press release, Apple Computer stated that as of January 2013, the App Store provides an organized catalog of over 800,000 apps that add functionality and productivity to the iPad. Total unique downloads have topped over 40 billion with 20 billion in December 2012 alone. The App Store has over 500 million active user accounts (Apple Computer, 2013a).

Kaufman (2012) explained that Apple continued to add value to their iOS devices with the May 2007 launch of a new service, iTunes U, with the intent of giving schools and universities a way to create and share educational resources. iTunes U gives schools, libraries, museums, and other educational content providers a free publishing method to share courses, lectures, and lessons that connect educators with students around the world. The service has over 250,000 enrolled students and 2,500 courses offered. As of February 2013, iTunes U has over 1 billion downloads (Apple Computer, 2013c). In 2010, Apple released the iBook app, which allows readers to import PDFs and other digital books and to buy books from the iBookstore. What makes the iPad a contender for promoting the growth of digital textbooks and e-books is that it can also run other e-book stores such as Kindle, Nook, Borders, and other free bookstore apps. There is continued development for digital textbooks through companies like CourseSmart and Inkling, which may jumpstart more sales or rentals of textbooks (Zou, 2011).

Current Trends in Digital Textbooks

Bosman and de la Merced (2011) revealed the fierceness of the race to be the dominant retailer in the e-book market, and that major sellers such as Amazon and Barnes & Noble have emerged as the leaders. The battle for the digital textbook market is still heating up. Competition is tight as Borders Books declared bankruptcy in order to reorganize the company (Bosman & de la Merced, 2011). Kary (2011) conveyed that Borders Books initially closed 250 stores, but later closed the entire business and sold in auction to Barnes & Noble. The selloff closed 399 stores and over 10,000 employees were released from contract (Kary, 2011). Also, the loss of Borders meant that some publishers, who had divisions set up to service the retailer, had to lay off workers and regroup to recover lost sales.

Reynolds (2011), Director of Product Design and Research for the research company Xplana, reported that in 2010, the cost of digital textbooks was 50% of the cost of print textbooks, and leading digital textbooks companies experienced an 80% to 100% increase in sales over the prior year. In the same research conducted by Xplana, the company predicted that by 2017 digital textbooks will account for 44% of the total textbook market (Reynolds, 2011). If these data are any indication of how the education market may expand, schools should expect major changes in how books are delivered to students.

Despite the positive projections cited by Reynolds (2011), there are major challenges that must be met to encourage broader adoption of digital textbooks. One of the hurdles is that the number of available digital textbooks must increase to hold a wider percentage of the total market. A further challenge to the adoption of digital textbooks is that paper textbooks can be given away (transferred), sold to another person, or traded to another bookstore for money. Heider, Laverick, and Bennett (2009) described another hurdle in using digital textbooks; when renting books online that require passwords for access, the passwords expire after a certain period of time and students lose the ability to use the materials. Heider et al. (2009) explained that some publishers restrict access to the digital textbook on multiple computers or devices, which may pose a problem for students wanting choices as to where and when they want to read their textbooks. Another very important issue when downloading digital textbooks is the software that supports the book. Each publisher or bookstore uses a different software package to deliver their content, and these publishers or bookstores will not allow the combining of content or textbooks from other software to make a master e-book reader software package (Heider et al., 2009).

In a 2009 pilot study at Northwest Missouri State University, Butler engaged 200 students in using digital textbooks on Sony PRS-505 e-book readers. Butler discovered that students tried to use the digital textbooks in the same way they had used paper textbooks. Butler found that students wanted to read short sections, find particular passages in the book they needed to review and simply flip through pages of the book. The Sony PRS-505 did not allow for such behavior, so students got frustrated with the e-reader. When the pilot group was upgraded to the newer Sony PRS-700, which did allow for search and easy access to what students wanted, student satisfaction with the device increased. A major conclusion of Butler's study was that until the e-reader devices themselves are upgraded to the correct set of features and are large enough in screen size to show content in meaningful ways, students would not be likely to use digital textbooks.

The trend of renting textbooks has become a new way for book publishers and bookstores to offer textbooks at cheaper prices and still retain ownership of the book or copyright of the digital textbook. CourseSmart is one of the major companies that offer textbook rentals online. Students who use this service do so mostly because of the lower cost of the textbooks (Smith, 2010). Several feedback and opinion web sites revealed that students have a mixed reaction regarding how they like to use the CourseSmart service. The company limits printing and the copy and paste features—some publishers block content for copyright reasons—but the search feature and accessibility on multiple platforms helps to balance the experience (Delle, 2008; Heydasch, 2009).

A study completed by Taylor (2009) at San Diego University determined that students could learn equally well from paper or digital textbooks. The study used laptops to deliver the digital textbook. Students using the digital textbook were able to score comparably with students

reading the paper textbook. The ability to annotate the text did not reveal any significant difference on the scores, nor did the complexity of the text. Taylor stated that there is no pedagogical reason to avoid using digital texts and that cost savings and convenience are factors to consider when selecting textbooks.

Several K-12 and postsecondary schools are currently moving to digital textbooks or trying to determine whether they should offer them to their students. In the state of Indiana, some K-12 school corporations are using textbook funds to buy netbooks or digital tablets for their students to use in their classes and purchasing digital content for teachers to integrate into their lesson plans (Aronowitz, 2010; Schwarz, 2011). Indiana University began a research study in 2009 to determine how students chose digital textbooks, to determine their perceptions about using digital textbooks, and to determine the impact of digital textbooks on learning (Dennis, 2011). The students who were interviewed favored switching to digital textbooks and using devices such as laptops and tablets. The reasons for the switch to digital textbooks included cost savings, fewer books to carry, and better interaction with their course materials and instructors (Dennis, 2011).

Student Opinions of Digital Textbooks

Today's college students are facing what many call the toughest job market in decades. When graduating from college in 2010, the average student loan debt was $25,250, according to the annual report from the Project on Student Debt (2012). This was an increase of 5% over 2009. Couple this debt with an 8.7% unemployment rate for college graduates ages 20 to 24 in 2009 and 9.1% in 2012 and the concern about the health of the United States economy, and the severity of this problem becomes clear. If students are saddled with large student loan debts, this affects their prosperity and financial well-being (Project on Student Debt, 2012).

If students are seeing little return on their college education because the costs of tuition, room and board, and textbooks keep rising, these factors may influence the future of higher education. The issue of college costs has generated discussion at colleges, by politicians, and by others concerned with the issues of how to get students through four years of college on time and within a reasonable budget (Hopkins, 2011). In the past, only one-third of Indiana's four-year college students were graduating from college on time and a little over half graduated in six years of study. The Indiana Commission for Higher Education adopted a new strategic plan for college completion in March 2012. By 2018, the graduation rate is to be increased by at least 50% at four-year colleges, and by 2025 college are to double the number of college degrees and certificates. The third part of the plan is to increase higher education graduation by Indiana residents to 45% by 2018 and 60% of the state's population by 2025 (Indiana Commission for Higher Education, 2012).

The cost of textbooks is an important area where colleges and universities can help students manage their school debt. Faculty and course instructors choose the textbooks they require in their classes and some institutions require expensive bundles of books from a specific vendor that cannot be bought elsewhere (Redden, 2011). Courses with multiple sections may use different books or change the textbooks used each year, rendering the books impossible to sell back to booksellers for use by other students. These examples demonstrate hindrances to students' ability to select textbooks that may allow significant savings. An average annual cost of textbooks can range from $700 to $900 per student (Foderaro, 2010).

Textbook retailers are selling new and used books and more are now offering rentals. Many of these same retailers are adding digital textbooks as well. This wide array of choices can be very overwhelming for students who just want to get a good deal and not incur a large bill for

their books. Another frustrating aspect of buying textbooks is the poor resale values after using the textbooks for only a semester (Foderaro, 2010; Redden, 2011). When students choose to rent their textbooks either online or in paper form, they pay less than the price of a new book but either must return it to the campus bookstore or the book access will expire 90-180 days after purchase (Allen, 2009). There has been movement among campus bookstores to offer paper textbook rentals, around 1,500 in the fall of 2010, but students are finding some of the policies too strict when they return the book, and students get charged for not meeting the standards of good condition for the book (Foderaro, 2010).

In a study of textbook preferences conducted by Walton (2007) at Southwest Baptist University, students preferred to use paper textbooks at a rate of 68% to 19% over using digital textbooks. College faculty preferred paper textbooks 92% to zero, which means that no faculty in this population wanted to use digital textbooks (Walton, 2007). In addition, a study was conducted of graduate students' perceptions regarding digital textbooks during the spring 2011 semester at Indiana State University (Johnson, 2011). The results indicated that when graduate students considered the use of digital textbooks and print textbooks, they felt that digital textbooks might be less expensive (Johnson, 2011). Graduate students also appreciated the ability to search the text for words in the digital text. A summary of reasons to use digital textbooks over print textbooks is shown in Table 1.

Table 1

Summary for Reasons to Use Digital Textbooks over Print Textbooks

What reason(s) would you use a digital textbook over a print textbook?	Responses
Cost of digital textbook might be cheaper	153
Ability to search for words in the text	138
Ability to bookmark pages, annotate and define words from a dictionary	90
Ability of reading the textbook to you (audio)	74
Instructional support available from campus IT group, library, or bookstore	24

In the same Johnson (2011) study, an interesting result was found when asking graduate students about their preferences for the devices they would use to access digital textbooks. The overwhelming choice was laptop, netbook, or desktop computer. A summary of device choices is shown in Table 2.

Table 2

Summary of Devices Students Would Use To Access Digital Textbooks

What device(s) would or do you use to access digital textbooks?	Responses
Laptop, netbook or desktop computer	174
E-book reader (Kindle, Nook, etc.)	73
iPad, iPhone or iPod Touch	61
Cell Phone/Smart Phone	41
Other	2

When these same graduate students were asked about options they would want on a digital textbook reader, the highest response revealed students wanted text reader software that

could be accessed on multiple platforms. Thus, preferences indicated that textbooks should be accessible on traditional computers, mobile devices, and other computers. A second choice included devices having the lowest price.

As several new e-readers are entering the market more color screens and the transition from E-Ink (monochrome screen) to color screens is occurring. Half of the respondents in the Johnson (2011) study wanted color screens. These graduate students also wanted devices that could read email, browse the Internet, watch videos, and listen to music. Only 56 respondents out of 204 wanted an E-Ink monochrome screen. The summary of options is shown in Table 3.

Table 3

Summary of Options on a Digital Textbook Reader

What option(s) would you want on a digital textbook reader?	Responses
Text reader software that can be used on multiple platforms	142
Lowest price	124
Color screen	106
Ability to read email and browse the Internet	92
Ability to watch videos and listen to music	64
E-Ink print (monochrome)	56

Johnson (2011) reported in his study that many of the graduate students wanted to buy or use paper textbooks because that is what they experienced in their previous schooling and paper is comfortable and familiar. Barnes & Noble operates 636 campus bookstores in the United States; to encourage the adoption and usage of digital textbooks, they launched a new software program called NOOKstudy (Foderaro, 2010). NOOKstudy is a way to organize and collect all

of one's digital textbooks in a "locker" to make finding and accessing all the books purchased easier. The software also allows the uploading of PDF and ePub files that can be added to any course created inside NOOKstudy alongside any textbooks purchased (Cavender, 2010). Publishing companies and textbook retailers are starting to realize that there is a need for an organized and directed effort in helping students who use their products. If they can offer the best tools and other supporting materials, students and hopefully faculty as well as university administrators may adopt their products (Foderaro, 2010).

A study conducted by National Association of College Stores and Student Public Interest Research Groups in the fall of 2010 found that the majority of college students still preferred and bought paper textbooks (Foderaro, 2010). Notably, only 8% of students bought digital textbooks. Several experts in the field of publishing offer explanations as to why this happens. Publisher McGraw-Hill's Vice President of Strategy and Business Development, Vinett Madan, stated, "As long as the online experience doesn't offer significant value over the print experience, I believe the preference in consumption will still be toward print" (as cited in Waters, 2011). Digital publishing companies such as Inkling have been hard at work developing digital textbooks for the iPad complete with supplemental materials. The textbooks are being developed from the ground up to use the iPad's multimedia and web-connected features to their fullest. In a show of support, publishers such as Cengage Learning, Wiley, Wolters Kluwer, and McGraw-Hill have started publishing content on the Inkling platform (Waters, 2011).

Faculty Opinions of Digital Textbooks

When planning and preparing for teaching a college course, today's faculty have more research-validated information and teaching tools at their disposal than ever before. From using textbook-publisher-prepared instructor resources, such as sample syllabi and test banks, to online

learning management systems such as Blackboard that provide platforms for designing interactive courses, many aspects of planning have become much easier. Textbook publishers frequently court faculty members because each textbook used in a course is chosen by the instructor and publishers want to convince them that their offerings are the best. One concern that faculty have is that by the time paper textbooks are published, the content could be old and outdated (Jeffress & Lyle, 2012). In some fields, such as computers and technology, the publishing cycle is too long and unacceptable to share current information. Also many textbooks try to be the definitive text, encompassing everything that the publisher or authors could muster for the book's content.

Stewart (2009) noted that some students and faculty like the idea of smaller books with specific topics covered that can be offered at a lower cost. An increasing number of college and university faculty members support and encourage the writing of free or open source textbooks (Stewart, 2009). By offering their expertise in writing textbooks and offering these texts for free online or at a nominal printing fee, instructors can ensure specific content for their students while remaining mindful of costs to students. Faculty can also encourage their institutions to support these types of books. Quality control of the content is also met, because other experts and users of the text can comment and provide feedback to the writer in a manner similar to how open source software is written and upgraded (Stewart, 2009).

Future Directions of Digital Textbooks

Some fields of study, such as computers and information systems, change content often. Instructors need to be able to access the most current knowledge. Progressive instructors have started using the Creative Commons licensing and other companies that support free textbooks, such as Flat World Knowledge and CK-12. Higher education, as well as K-12 education, is eager

for more options and lower costs when selecting textbooks. Besides the cost and quality of textbooks, educators are looking for high quality supplemental materials such as videos, audio (mp3), and mobile access for both the instructor and students (PR Newswire, 2009).

In August of 2011, Dennis published a study about a new model of digital textbook adoption, which was started at Indiana University in 2009. Dennis explained that the university bought digital textbooks at wholesale prices and passed the cost of the digital textbook to the students as part of the course fee. The digital textbook was then made available through the university learning management system. Students were given a single set of software programs to access the digital content regardless of the book publisher. The software allowed students and faculty to annotate and mark up the digital textbook and embed additional digital content. In the courses surveyed for this study, 87% of students chose to use the digital textbook over paper. Results of the student surveys given at the end of the courses revealed students used varying devices to access digital textbooks. Of these devices, 63% of the students primarily used laptops, 11% of the students primarily used a desktop computer, 13% switched between laptop and desktop computers, and only 1% used a mobile device or e-reader. About 60% of these students preferred the digital textbook to the paper textbook. Dennis found that upperclassmen were more likely to prefer the digital textbooks than freshman students. Cost was important to students as well as their ability to perform well on their tests and other course assessments and the ability to read the instructor's annotations in the digital textbook (Dennis, 2011). The study suggested that as the availability of mobile devices, such as the iPad, increases so will their use in accessing digital textbooks.

The capability of a digital textbook to support and encourage a sense of facility and connectedness in distance education courses is also important, because many of the online

students feel isolated, and currently instructors have to create materials to help these students feel connected to the campus and their courses (Seidel, 2009). If digital textbooks could be customized to utilize campus learning management software, such as Blackboard, and were flexible enough to allow for the upload of content from instructors, a sense of connectedness may be supported. If content from classroom technology tools such as Tegrity or Elluminate that record live and online class discussions were able to be easily integrated into textbooks and played appropriately by the receiving device, this would help online students feel more connected to the course. Resources could be downloaded into the student's digital textbook reader software and accessed anywhere and anytime a student wants to study. Young (2013) described that the desire of students to be more connected to the courses and instructors will only be increasing as distance education increases in popularity among all levels of education. Young asserted that the creation of massive open online courses (MOOCs) offers a new method, through companies such as Coursera, for universities and other content providers to provide what could be a useful option for students to take classes. Publishers have been working to create personalized learning experiences through buying other companies that bolster their technology capacity to deliver new digital content (Young, 2013).

Waters (2011) reported that the Forrest Research group expected consumers who bought or received a Kindle or iPad during the 2010 Christmas season will have spent over $1 billion on e-books in 2011 and $3 billion by the middle of the decade. The popularity of e-books with general consumers will create demand with students at all levels in education. Waters also stated that the National Association of College Stores expects the percentage of textbooks sold to increase from the current 3% to 10-15% by 2012. It will be critical for booksellers to consider

carefully the competing considerations of ease of access and use of digital textbooks with the very real concerns college students hold in terms of graduating with burdensome debt.

CHAPTER 3

RESEARCH METHODOLOGY

This study determined if there were any significant differences in comprehension test scores of undergraduate students who read a chapter of a textbook in paper compared to digital format. After reading the textbook chapter in their respective formats, participants completed a 16-item comprehension test. The results of the tests between the two formats were compared in light of other demographic data.

Purpose of the Study

This mixed-method study examined the effectiveness of using digital textbooks compared with traditional paper textbooks in undergraduate courses. Student performance comparisons were used to see if the digital versions had any significant influence on students' achievement scores versus paper texts. Moreover, regardless of performance outcomes, features of software and devices were explored to determine if these influenced use of digital texts. This study provides information that could help university administrators and faculty make a determination about the use of digital textbooks for their classes. It provides useful information about the need for digital textbooks to the book publishing companies. Furthermore this study may help libraries decide on whether to increase their holdings of digital or paper textbooks.

Research Questions

This study made use of three basic questions to understand the influence of digital texts on student achievement. The research questions for this study were

1. Are there any significant differences in reading comprehension test scores of undergraduate students when using paper texts versus digital texts?
2. Are there any differences in reading comprehension test scores of undergraduate students with regard to gender? Is there any relationship between text formats and gender on comprehension scores?
3. Is there any relationship between the hours of experience using tablet computers and reading comprehension test scores among study participants?

Null Hypotheses

1. There is no difference in reading comprehension between students using digital texts and those using paper texts.
2. There is no difference in reading comprehension with regard to gender when using digital texts or paper texts.
3. There is no relationship between gender and format of the text.
4. There is no relationship between past experiences using tablet computers and reading comprehension test scores.

Data Collection Procedure

This study sought to test whether the format of a textbook used by undergraduate students affected their comprehension of the course material. Students participating in the study were randomly split into two groups. One group read text in print and students were able to take notes, highlight, and make other study notations on the paper copy. The second group read the text in digital format and could make any study notations allowed in the digital reader software. Both groups took a comprehension test on the content. The purpose of the test was to examine if there were any significant differences in the test scores between the two formats of the text. The group

reading the paper edition received a clean copy of the content in printed form and the digital edition group received instruction on how to access the content on an iPad where the textbook was loaded. The text formatting on the paper text was 12 point, Times New Roman font, with uniform paper brightness on each copy. The digital text was as equal to the settings of the paper copy as possible. The textbook used was Phillips and Gully's (2012) *Organizational Behavior: Tools for Success*, first edition. This study used Chapter 15: Organizational Culture and Organizational Change for the reading and test.

The study had three methods of data collection. One method was a reading comprehension test given to the two sets of students who read a selection of text in either paper or digital format. The test scores were analyzed for any significant differences. The second method was a survey that collected basic demographic information and answers to questions about the students' experiences and perceptions of using paper or digital textbooks. The survey, administered in paper format, was completed by students who took part in the reading comprehension test. The data collection was open for four months. The third collection method was two small focus groups of three to five study participants from each group (paper and digital text) with the goal of recording firsthand feedback of their experiences during the study. The data gathered further revealed students' perceptions of the use of paper or digital textbooks.

Selection of Sample Procedures

The procedures for the completion of this study were as follows:

1. Participants were recruited in undergraduate student classes with instructor approval. Classes were chosen by enrollment numbers. The study had access to at least 15 iPads, so classes of 20-30 students were the ideal target size. Undergraduate students

were also recruited by personal invitation. The faculty recruitment letter is in Appendix A and the undergraduate student recruitment letter is in Appendix B.

2. Each participant was given the consent form with three identification labels with a unique ID. One label was attached to the consent form (see Appendix C), another attached to the comprehension test and the third to the follow-up survey.
3. Students who volunteered for the reading exercise were randomly assigned to read Chapter 15: Organizational Culture and Organizational Change from the textbook *Organizational Behavior: Tools for Success*, (Phillips & Gully, 2012) in either paper or digital format.
4. The students completed a 16-question comprehension test created from a test bank provided by the textbook publisher. The reading comprehension tests were administered on paper and scores were transferred to digital format for aggregation and analysis.
5. The students completed an anonymous survey (see Appendix D) on their perceptions and experiences of using digital texts.
6. Voluntary participants were invited for a focus group to provide further information about their experiences during the study after they completed the perception survey. Two groups of three to five students from each group (paper or digital) were chosen. The focus groups answered three questions (see Appendix E) based on themes or similar topics that emerged from analysis of the survey data.

Description of Sample

The participants for this study were undergraduate students enrolled at Indiana State University. The age range of these students was generally 18-25 years of age with nontraditional

students generally ranging from 25-65. All undergraduate students in this group were invited to participate in the study on a volunteer basis. There were no individuals under 18 years of age in this study. See Appendix D for the follow-up survey and Appendix B for the student recruitment letter.

Descriptors of the Variables

Independent Variable

The independent variable is the delivery platform of the text: digital or paper.

Influence Questions

Textbook format

1. Which textbook format was used in order to take the comprehension test?
2. Which text format does the student prefer?

Personal attributes

1. Gender: male or female students.

Perceptions of digital textbooks

1. Has the student read or used a digital e-book or textbook previous to this study?
2. What device(s) has the student used to read a digital text on in the past?
3. What reason(s) would a student use a digital textbook over a print textbook?
4. What option(s) would students want in a digital textbook reader?
5. Thinking about the price of an e-textbook reader or a device that has e-reader functionality, what price would a student be willing to pay to purchase one?

Statistical Analysis

The data collected were analyzed using frequencies, crosstabs, and factorial analysis of variance (ANOVA). Variables used for the study were comprehension test score, gender, text

format, text preference, and tablet computer experience level. A 2 X 2 factorial ANOVA was used to test differences in comprehension test scores between text formats and genders as well as providing a test of the interaction between format and gender. Text preference differences in comprehension test scores were tested using a 2 X 2 factorial ANOVA. The relationship between past experiences using tablet computers and reading comprehension test scores was tested using the Pearson correlation. Crosstabs of the demographic information of gender, textbook, digital e-reader, and text format preference were used to summarize participants' opinions and perceptions of digital texts and e-readers.

Theories of cognitivism and constructivism help to explain the success the participants had in taking the comprehension test. Using their past experiences in a classroom setting, the participants were able to use learned study and test-taking skills to read and find the answers to the test questions (Duffy & Cunningham, 1996). The participants were able to fully engage in completing the study and completed their tasks in a 30-50 minute period.

Qualitative Analysis of the Focus Group

In order to investigate any additional relationships between past experiences using tablet computers and reading comprehension test scores, open-ended qualitative questions and focus groups were used in this study. The focus group participants were selected based on their categorization of format preference, paper or digital text. Participants were chosen based on the comments they gave in Questions 12 and 13 from the follow-up survey. Input from these two questions was also used for qualitative analysis. Responses from the focus group were analyzed using a coding system and organized into common themes and patterns. There were two groups based on the treatment they were assigned; paper or digital text. The interview questions were

derived from the survey data. The focus groups were recorded using audio-only for accuracy. The main questions are included in Appendix E.

Emergent theory based on analytical themes discovered in the responses was used as a framework for the qualitative questions in the follow-up survey and focus groups. Short of the emergence of a theory, themes were used for descriptive purposes.

Validity and Reliability of the Comprehension Test

The comprehension test given to the participants in this study utilized a test bank of questions provided by the publishing company. These questions were written to meet the Association to Advance Collegiate Schools of Business curriculum and accreditation standards. The questions were extracted from all sections of the chapter in order to test whether participants read the entire chapter. The comprehension test comprised 16 questions, eight rated as easy and eight rated as moderate difficulty according to the publisher. All of the multiple choice questions required a single answer; there were no “all of the above” or true/false questions. There were no reliability statistics available for the comprehension test used from the publisher.

CHAPTER 4

RESULTS

This chapter describes the results of both the quantitative and qualitative research performed to determine if any significant differences between test scores existed when students used paper or digital texts and to understand perceptions of using digital textbooks, challenges, and the recommendations students offer for using digital textbooks. Student performance comparisons were used to see if the digital versions had any significant influence on students' achievement scores compared with paper texts. Other factors that were examined include the effects of gender, age, and device preference when using paper or digital textbooks.

The research questions for this study were

1. Are there any significant differences in reading comprehension test scores of undergraduate students when using paper texts versus digital texts?
2. Are there any differences in reading comprehension test scores of undergraduate students with regard to gender? Is there any relationship between text formats and gender on comprehension scores?
3. Is there any relationship between the hours of experience using tablet computers and reading comprehension test scores among study participants?

Each section examines the following null hypotheses:

1. There is no difference in reading comprehension between students using digital texts and those using paper texts.
2. There is no difference in reading comprehension with regard to gender when using digital texts or paper texts.
3. There is no relationship between gender and format of the text.
4. There is no relationship between past experiences using tablet computers and reading comprehension test scores.

Participants

The undergraduate students who participated in this study during the fall 2012 semester were enrolled in various education classes at Indiana State University. A total of 233 students participated in all parts of the quantitative part of the study. A total of 10 students from the initial 233 also participated in the qualitative focus groups.

There were 70 men and 163 women in the study. This unbalanced sample shows a limitation in testing education students as the majority of students are women. In the two test groups, 114 participants completed the study in the paper format and 119 completed the study in the digital format. In examining ages, the three largest groups were 62 participants (26.6%) who were 21 years of age, 52 participants (22.3%) who were 22 years of age, and 41 participants (17.6%) who were 20 years of age. An interesting note from the participants' ages is that 34 participants (14.6%) were 25 years of age and over. In testing for normality between genders, there was an imbalance due to the lower number of men than women. This is mainly due to testing undergraduate students who are majoring in education. The ratio of women to men majoring in undergraduate education is 2:1. The ratio of women to men in this study is 2.23:1.

This demonstrates as close to normal distribution of genders as possible given the students who participated. Participants were from the freshman through senior levels.

Comprehension Test Results

The first research question examined any differences in comprehension test scores between the paper and digital formats. The combined results of the comprehension test range from a low score of four points to a perfect score of 16 points possible. The lowest score of the digital text was four points and the highest was 16 points. The lowest score on the paper text was seven points and the highest was 16 points. A summary of comprehension test scores by age is shown in Table 4.

Table 4

Summary of Comprehension Scores by Age (N=233)

Age	*N*	*M*	*SD*
18	2	16.00	0
19	18	12.67	2.61
20	41	13.15	2.34
21	62	13.87	1.78
22	52	13.04	2.42
23	19	13.37	1.98
24	5	13.40	1.95
25 and over	34	13.50	2.43

A factorial ANOVA was used to answer the first research question regarding significant differences in comprehension test scores between paper and digital texts. There was no significant difference, $F(1, 229) = .440$, $p > .05$. Thus, I accepted the null hypothesis of there being no difference in reading comprehension between students using digital texts and those

using paper texts. Figure 1 shows the comprehension scores between the formats of paper and digital.

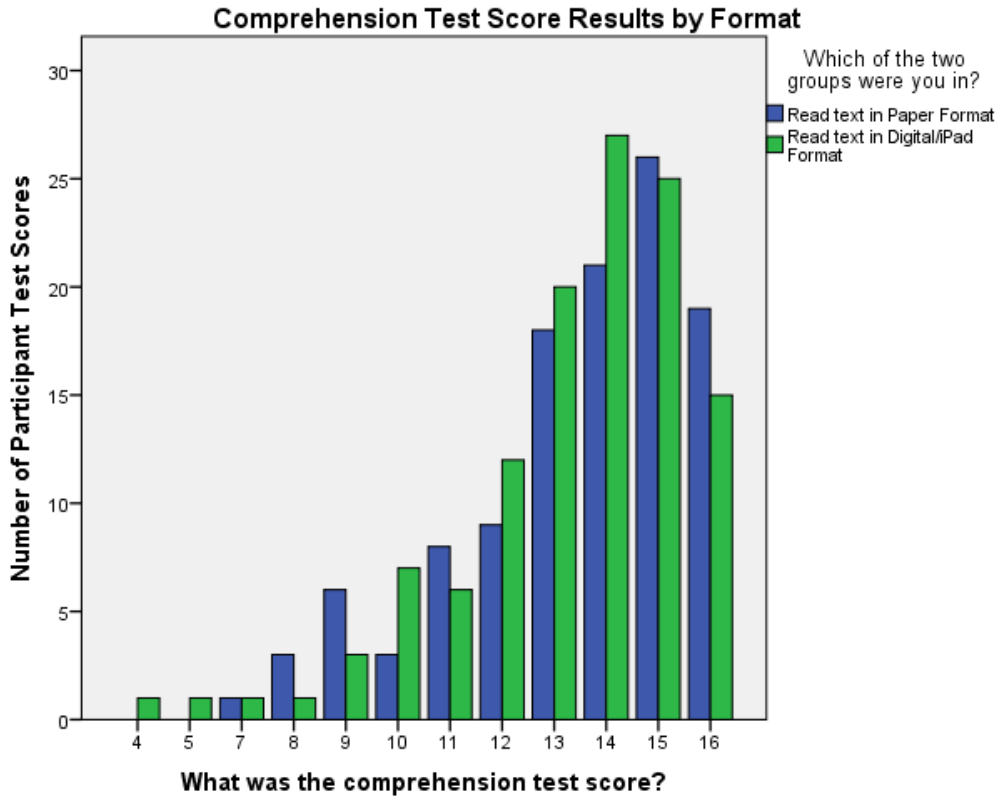

Figure 1. Comprehension scores between text formats.

Comprehension Test Scores and Gender

The second main research question was if there were any differences in reading comprehension test scores with regard to gender. The mean score of men in both formats was 12.87 points, $SD = 2.65$ and the mean score of women in both formats was 13.60 points, $SD = 1.99$. There was no significant difference, $F(1, 229) = .5.23$, $p < .05$. Because of violation of normality and homogeneity of variance assumptions, the Mann-Whitney U Test was used. This indicated no significant difference on comprehension across genders ($p = .101$). Thus, I accepted the second null hypothesis of there being no significant difference between genders on

comprehension test scores. The comprehension scores of each gender grouped by textbook format are represented in Table 5.

Table 5

Comprehension Test Scores by Gender and Textbook Format (N=233)

Which of the two format groups were you in?	Gender	*N*	*M*	*SD*
Read text in paper format	Men	35	13.06	2.44
Read text in paper format	Women	79	13.62	2.08
Total of paper format	Both	114	13.45	2.20
Read text in digital format	Men	35	12.69	2.87
Read text in digital format	Women	84	13.57	1.92
Total of digital format	Both	119	13.31	2.26
Total of both formats	Men	70	12.87	2.65
Total of both formats	Women	163	13.60	1.99
Grand Total	Both	233	13.38	2.23

The secondary research question of whether there is any interaction between text format and gender on comprehension test scores was answered by a 2 x 2 factorial ANOVA, which revealed no significant interaction between gender and format of the text. The result of Levene's test of equality of error of variances was $F(3, 229) = 2.81$ $p < .05$. Onwuegbuzie and Daniel (2003) described if the group sizes are very different, a one-way ANOVA should be used with the Welch test option. The result is an adjusted test of equality of means showing a Welch's $F(1, 104.02) = 4.21$, $p < .05$. The effect of these tests does not have practical importance on the results of the interaction between gender and text format because the difference in size of the groups is not 4-5 times larger. The factorial ANOVA summary of the interaction between gender and textbook format with effect on comprehension score is shown in Table 6.

Table 6

Factorial ANOVA Summary of Gender and Textbook Format Relationship

Source	*SS*	*df*	*MS*	*F*	*Sig*
Gender	25.69	1	25.69	5.23	.02*
Text Format	2.16	1	2.16	.44	.51
Gender x Text Format	1.27	1	1.27	.26	.61
Error	1124.61	229	4.91		
Total	42,851.00	233			

Note: * Significant at the $p < 0.05$ level

When looking at the distribution of comprehension scores, the mean of score of men (M = 12.87, SD = 2.65) is not very different from the mean score of women (M = 13.6, SD = 1.99), but the men had the lowest score (four points out of 16). The range of men's scores is shown in Figure 2.

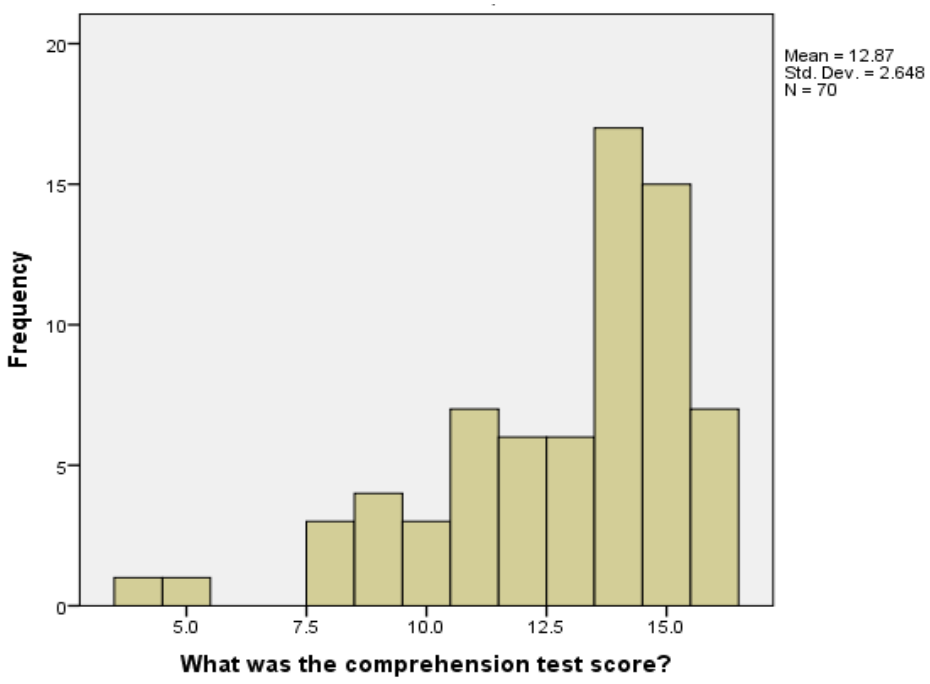

Figure 2. Comprehension scores of men.

The lowest score of women was seven points out of 16. The range of comprehension scores of women is shown in Figure 3.

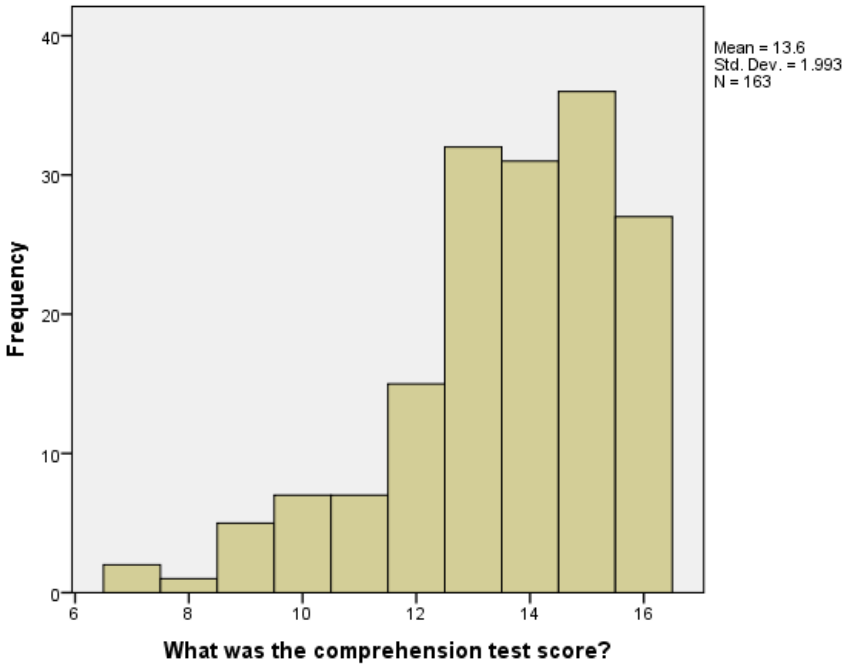

Figure 3. Comprehension scores of women.

The distribution of the comprehension scores between textbook formats and gender are very similar in that the test scores were very high. The median score for both men and women was 14 points out of 16. Given that the content of the textbook chapter should have been new material to the students tested, the outcomes may support the conclusion that the format of the content does not matter in test scores.

Textbook Format Preference and Comprehension Test Scores

The next data point is whether participants were assigned to the textbook format they preferred. In examining the two textbook formats, 78% (n = 89) participants assigned to the paper group preferred paper and 22% (n = 25) were not assigned to their preferred format. In the digital text group, 36% (n = 43) were assigned to their preferred format and 64% (n = 76) were

not assigned to their preference. This is important because even though the majority of the digital text format group students were not assigned to the format they preferred their comprehension scores were still very good and comparable with the paper text group.

When examining the comprehension scores with regard to whether participants were assigned to their preferred text format group, most of the scores were evenly split in half with regard to text preference. Participants who were assigned to their preferred text scored a range of four points to 16. Those who were not assigned to their preferred text score a range of five points to 16. A 2 x 2 ANOVA resulted in no significant difference between assigned text format and text preference, $F(1, 231) = 2.42$, $p > .05$.

Another data point examined whether participants prefer print text or digital text and to which text format participants were actually assigned. The number of participants who preferred paper text and were assigned to the paper text format was 95 out of 173 (55%) and those who preferred paper and were not assigned to paper format was 78 out of 173 (45%). The participants who did not prefer paper text (preferring digital format) and were assigned to their preference was 36 out of 59 (61%), and 23 out of 59 (39%) were not assigned to their preferred group and were assigned to read in paper format. These results support the conclusion that no matter what text format participants were assigned and even if it was not their preference, comprehension test scores were not significantly affected.

Past Experiences Using Tablet Computers and Reading Comprehension Test Scores

In looking at the third research question, is there any relationship between the hours of experience using tablet computers and reading comprehension test scores, participants answered that they have used many different devices to read digital texts. The data collected help to illustrate what past and current usage participants had and possible relationships as to how well

all students scored on the comprehension test. When a one way ANOVA was run, there was no significant result, $F(1, 231) = .533$, $p > .05$. Thus, I accepted the null hypothesis of no relationship between past experiences using tablet computers and reading comprehension test scores. The delivery method did not have a significant impact on the comprehension scores, so students were able to achieve high scores overall. This question is also addressed in the qualitative section of this study to further discuss undergraduate students' past experiences in using tablet computers.

Participant Feedback on Digital Textbook Devices

As part of the follow-up survey, participants were asked about their past experiences and opinions about digital textbook readers. These outcomes help to show what devices students have used in the past, what devices they would like to use, the features they would use, and what students are willing to pay for digital textbook readers. The results in Table 7 show that participants had used several devices to access digital text and content for reading.

Table 7

What Devices Have You Used to Access Digital Textbooks, Online Readings or E-books

Devices Used by Participants	*n*	Percentage
E-book Reader (Kindle, Nook, etc.)	78	33.5%
iPad, iPhone, or iPod Touch	119	51.1%
Laptop, Netbook, or Desktop Computer	207	88.8%
Cell Phone	84	36.1%
Other (Answered: Android Tablets)	4	1.7%
None	9	3.9%

Participants were asked what devices they would like to use to access digital textbooks. The responses are listed in Table 8, and these show a similar pattern of participants desiring to use multiple devices to access digital text and content. Comparing Table 7 with Table 8, participants expressed a greater desire (14.6%) to use an e-book reader to access digital textbooks than what they actually used for access. Participants expressed a greater desire (18%) to use the Pad, iPhone, or iPod Touch for access, and a lesser desire (20.1%) to use laptops, netbooks, or desktop computers for access than what they actually used. Finally participants expressed a lesser desire (15.1%) to use a cell phone to access a digital textbook. There was also a greater number of participants (2.5%) who did not want to use digital text devices at all. This may indicate they have used a device in the past and did not like the experience.

Table 8

What Devices Would You Like to Use to Access Digital Textbooks, Online Readings or E-books

Devices Participants Would Like to Use	*n*	Percentage
E-book Reader (Kindle, Nook, etc.)	112	48.1%
iPad, iPhone, or iPod Touch	161	69.1%
Laptop, Netbook or Desktop Computer	160	68.7%
Cell Phone	49	21.0%
Other (Answered: Android Tablet and TV App)	3	1.3%
None	15	6.4%

Participants were asked to rate the importance of digital text reader options which could be used to enhance a digital textbook or class experience. The results are shown in Table 9.

Table 9

Ratings of Digital Textbook Reader Options and Percentage of Respondents

Options	Very Important		Somewhat Important		Not Important	
	n	%	*n*	%	*n*	%
E-Ink print	71	30.5%	88	37.8%	56	24.0%
color screen	116	49.8%	87	37.3%	27	11.6%
cheapest price	146	62.7%	79	33.9%	5	2.1%
ability to use multiple e-reader applications	118	50.6%	91	39.1%	18	7.7%
ability to read email	164	70.4%	50	21.5%	15	6.4%
ability to browse the Internet	174	74.7%	44	18.9%	13	5.6%
ability to watch videos	108	46.4%	96	41.2%	26	11.2%
ability to listen to music	88	37.8%	96	41.2%	45	19.3%

Participants also had the opportunity to share what price they would be willing to pay for a digital text reader. The optimal price range according to 57.1% the responses from participants was $100-$249. Table 10 provides the summary of device price information.

Table 10

Prices Students are Willing to Pay for a Digital Textbook Reader

Price	*N*	Percentage
$1-99	32	13.7%
$100-149	47	20.2%
$150-199	47	20.2%
$200-249	39	16.7%
$250-299	20	8.6%
$300-349	16	6.9%
$350-399	17	7.3%
$400 and up	12	5.2%

Determining Past Tablet Computer Experience

The participants in this study had the opportunity to provide qualitative feedback about their experience using tablet computers through two methods. The first method was two open-ended questions in the survey that asked about their experiences and opinions of using digital textbook software and digital textbook hardware. The second method of feedback was from two focus groups based on the text format they were assigned to, either paper or digital. The participants quoted will be identified as Participant (P). A number will be added to clarify the individual participants. Participant 1 will be identified as P1, the next participant will be P2, and so on.

Survey Question Results

The qualitative questions used in the follow-up survey were

1. If you would like to post additional comments or feedback about your experience with digital textbooks (using the software), online readings (like a PDF) or e-books, please enter it below.
2. If you would like to post additional comments or feedback about your experience with digital text readers (using the hardware), please enter it below.

The major themes that came out of the survey feedback questions included

1. Possible or perceived eye strain due to reading from a digital device (iPad.)
2. The cost of paper textbooks versus the digital textbooks.
3. The heavy weight of paper textbooks and the convenience and portability of the digital device.
4. The desire to hold and read from a physical textbook.
5. The potential distractions of using a digital device when trying to read their books.
6. The concern for reliable technology (the reader hardware) and support for the devices. Battery life and software availability was important as well.

Eye strain during reading on the iPad was a complaint of many participants, and there was one participant who could not complete all parts of the study due to physical discomfort. P1 stated, “This gave me a headache from looking at the screen.” P2 provided a similar response, “I get migraines from looking at the screen too long, so this is not good for me.”

Many of the participants also said they had a history of difficulty in reading digital content from other devices such as a laptop. P3 stated, “The only thing that bothers me about digital textbooks is reading from a computer screen display. However, easy access and ability to search within the text is amazing. Even though I prefer paper text, I would use digital in a heartbeat.” P4 said, “Hard to read, glare from lights, gives me a headache.”

Regarding the cost of textbooks, participants remarked that there needs to be a larger cost savings to encourage students to move to digital textbooks and more interactive content, not just simple text without study aides. P5 said, “I have a tablet and find it is easy to use with digital textbooks but I am use to paper copies. I will purchase a digital book if it is cheaper.” P6 stated, “I like the ability to have electronic texts, but they are not available in discounted prices, like used books, which can make them more expensive.”

Features such as the ability to search text, highlight text, and comment in the text was important. Participants favored the ability to carry multiple textbooks, having extra productivity tools available, and the portability of digital devices. P6 said, “I just prefer using an actual textbook. I feel like I get much more out of it. I can concentrate better while reading it & can underline key things/make notes in the margins.”

A common concern of the participants, especially ones who preferred paper textbooks, was the desire to have a physical book that they could hold and write in. This “low-tech” version book allowed for better comfort levels in reading and reliability for these participants. The distractions that digital devices created were also reasons participants chose not to use a digital reader. Many felt that the extra features such as email and games, among others, could keep students from getting their reading and homework done. The concern of having enough technical support from the institution and the digital reader manufacturer, as well as battery life, highlighted participants’ thoughts and experiences with digital textbooks. One participant commented that her digital reader had a technical problem during class and “luckily not during an open book test.”

Focus Group Results

The focus groups were asked the following three guiding questions

1. Please describe your experience in completing the study and survey.
2. Describe your level of comfort in completing the assignment for the study.
3. What textbook improvements would you suggest to book publishers regardless of format?

Paper textbook focus group. The paper textbook group thought that paper textbooks were more useful for making visual notes and highlighting as well as bookmarking and saving places in the book to return to for review and further study. Remarks about ease of use also addressed the ability to skim and flip through the pages to find answers and to find charts and figures. One participant indicated preference using a paper textbook for schoolwork but might want to use a digital reader for novels and other pleasure or "non-school work."

The paper focus group all agreed that their comfort level during the study was high. They felt confident because many of them were assigned to the format group they preferred. Several also said they were good test takers and they thought that helped.

When the group discussed possible improvements for textbooks, they focused on improvements for digital textbooks. They all agreed that many digital textbooks and resources are not fully developed to take advantage of the technology available in current digital devices. Features such as highlighting, text and keyword searching, adding multimedia, and hyperlinked text to outside sources were top features the participants wanted to see in digital texts. Another suggestion was that the pricing for digital content should be much lower than the price for the paper edition due to not needing to print the hard copy. One participant stated, "Since classic novels are typically available free because of no copyright issues, publishers could create materials for these books and have a lower price point."

Strong feelings voiced by the participants included their displeasure at not being able to sell back digital textbooks. They noted that renting digital and paper textbooks offers no better solution for them. They felt that publishers also pressure schools and faculty to buy their books and resources and publishers continue to push updated editions that charge full price with little additional benefit to them. A participant shared, “I think digital textbooks would be better cost effective and easier to carry around all your materials.”

Regarding students who use digital devices, several participants commented on the problem of students being distracted with access to the Internet, email, social media, and games. If students are not paying attention in class, digital devices can have a negative effect on their grades or even distract other students. Also the limitations of digital devices can be an issue. If batteries have a short life and drain or the device crashes, students may not be able to fully participate in class activities. As one participant said, “I also feel like an electronic book causes more problems in the classroom with the dead batteries, distraction, and not everyone being on the same page.”

The participants agreed that the immediate feedback digital resources offer would be useful. Having interactive testing embedded in the digital text after reading sections of content could help students gauge their understanding of what they just read. A participant opined, “I think they are useful for people who like technology. However, I feel as though they would negatively affect my performance.”

Finally, participants mentioned the importance of having multiple resources to support their learning. Several participants were concerned that the option of getting a paper textbook might disappear in the near future. As one participant said,

> I don't like having multiple technology items to haul around. I like to keep it simple, everything in one place. I don't feel the need to take on the expense of an e-reader, when I can use a laptop. I don't like being at the mercy of internet providers or being crippled when power goes out, or if the provider/source is down.

Another participant stated, "I hope that paper textbooks continue to be available as an option throughout my college career. Whenever I have online readings, I always print them out on paper instead of reading them online."

Digital textbook focus group. The digital textbook focus group indicated that their experiences during the study were enjoyable and easy to complete. They said that the iPad, which was used as the digital textbook reader, was easy to read from and made it easy to scroll between pages. They found it easy to adjust the screen brightness on the iPad and no one in the focus group had physical trouble reading and finishing the assignment. One participant said, "The ability to manipulate the page is extremely important to me. Because of sight issues, being able to increase the font accordingly makes studying and reading far more comfortable."

When the participants were asked about their comfort level during the assignment, they repeated that their comfort level was good and they had no problems. They were able to find the answers they needed to answer the comprehension test. One participant gave valuable insight saying, "A student needs to actually read and process the text, not just search for a keyword and copy the answer. Digital textbooks are making it too easy for people to not actually read."

Finally, in answering the third question about suggestions for textbooks, the digital group focused on feedback on digital textbooks just as the paper group did. The features needed to make digital textbooks more attractive to students included better pricing and the ability to resell a digital textbook. Participants did not like renting digital textbooks, but the reduced weight by

not carrying paper textbooks was attractive. The price of the digital devices was a concern, too. The need for a touch-screen interface was important. Participants agreed that students would want to use a device similar to an iPad or Kindle for the touch-screen ability, but if a laptop had touch-screen capability they would prefer to use the laptop. One participant said, “I would like to have an e-reader that is affordable, functional, and very versatile.” Another added, “The Kindle was great—until I had an iPad. Now I can hardly imagine going back. I prefer the larger, though still convenient, size.”

CHAPTER 5

SUMMARY, DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

The transition from paper-based texts to digital-based texts is gaining momentum in education and in the general public. In K-12 schools, the transition to digital texts is happening more quickly than in higher education. In public K-12 schools, textbook funding that was traditionally designated for paper-based texts is now being used for the purchase of netbooks, tablets, and digital textbooks and resources. Nelson (2008) stated that only 18% of college undergraduates were using digital textbooks, and programs like the Ohio Library and Information Network (Ohio-LINK) supported the notion that student performance was not affected by the delivery format of the textbook. This study sought to gather more data and background on the delivery formats of digital texts using a popular digital reader, the Apple iPad, as compared to using the common paper text.

Summary

This study was conducted during the fall 2012 semester with the purpose of examining whether undergraduate students could master unfamiliar text content using a digital text reader as well as those using a traditional paper text. Furthermore, purposes included gathering student experiences with digital tablets, digital textbooks, and opinions about using these devices for their courses. Data were also gathered about students' experiences during the study.

The research questions for this study were

1. Are there any significant differences in reading comprehension test scores of undergraduate students when using paper texts versus digital texts?
2. Are there any differences in reading comprehension test scores of undergraduate students with regard to gender? Is there any relationship between text formats and gender on comprehension scores?
3. Is there any relationship between the hours of experience using tablet computers and reading comprehension test scores among study participants?

The rapid increase in popularity of digital tablets and their use in education have posed the question as to whether these tablets have the capability to increase student productivity and performance. As previously discussed in Chapter 2, research completed by Taylor (2011) determined that student learning was comparable with paper or digital textbooks. The Taylor study used laptops to deliver the digital textbook and students. This study helped to extend our understanding by testing content delivery on tablet computer such as the iPad used in this study.

Many K-12 and postsecondary schools are moving to digital textbooks or trying to determine whether they should convert or offer them to their students. In the state of Indiana, many K-12 school corporations are using textbook funds to buy netbooks or digital tablets for their students to use in their classes. Dennis (2011) began a research study in 2009 at Indiana University to determine how students chose digital textbooks, to understand students' perceptions about using them, and to explore the impact of digital textbooks on learning. The students interviewed favored switching to digital textbooks and using a device such as a laptop with the hope of utilizing tablets as they are refined. This study combined both the Dennis and

Taylor studies' concepts in order to examine student performance and reactions to using a tablet to access text.

The study test and survey instrument were administered in a group setting by invitation of the instructors of each undergraduate class and the focus group questions were administered in two small groups. Two hundred thirty-three students completed the reading and comprehension test as well as the follow-up survey. There were five participants in the paper text focus group and five participants in the digital text focus group.

Discussions and Conclusions

The main question of the study was to determine any significant differences in reading comprehension test scores of undergraduate students using paper texts versus digital texts. Through comprehension test scores comparison, the null hypotheses of no significant difference in test scores were supported. Comparisons of test scores were performed between the two test groups, paper and digital. Comparisons were also made on format preference with regard to paper or digital format. Test scores of men versus women were compared. Score comparisons were made in regard to groupings by whether the participant was assigned to his or her preferred textbook format.

There were no significant differences between any of the compared scores. The distribution of scores was sloped towards the right end of a normal curve. Participants, no matter the format they were assigned nor their gender, were able to score within the top third of the maximum score. These results confirm and agree with the results from the Taylor (2011) study that used laptops. The sample text content matter was organizational management, which is taught to human resources majors and some business majors. The students tested were all education majors. Given that the text given to the participants was a subject typically not taught

to most undergraduate education students, this helped to show prior knowledge should not have been a major contributing factor in the high test scores.

An interesting result that was not part of the original research questions was the comparison of comprehension test score and age. The breakdown of scores to age revealed that the age group that scored the best was 21 year olds. The participants in this group were upperclassmen, juniors or seniors. This may indicate this group has more experience in college courses taking tests and reading texts that contain unfamiliar content such as this study asked them to do. The challenge to this notion of upperclassmen being more successful on the comprehension test is that the group aged 22 years old scored the lowest mean of 13.04 points out of 16. One might have assumed the 22-year-old group would have scored better than or close to the 21-year-old group. The mean score is not a major difference though, and some of the lower outlier scores came from this age group. A noteworthy data point was the mean score of the 25 years old and above group. They scored second of the groups with a mean of 13.50 points. This may indicate they took the assignment seriously and could have been more mature in handling the task of new information even if it is presented in unfamiliar delivery methods, such as digital textbooks. Royal (2012) wrote that when colleges develop digital textbook programs, they must address the needs of non-traditional students. These students may have adequate technology skills, but some may not be comfortable with digital textbooks (Royal, 2012). Further study of the non-traditional students would be warranted to see if the non-traditionally aged students would support and use digital textbooks.

The analysis of performance on the comprehension test by gender showed no significant difference. The mean scores were close for overall scores between the two formats, a mean of 13.60 points for women and a mean of 12.87 points for men. The mean scores would be closer

but two of the men's scores (four points and five points out of 16, respectively) were low outliers. There were more women than men in the sample, mostly as a function of there being more women than men majoring in education at the institution. There was no relationship between gender and text format either. Both men and women scored similarly no matter which format they were assigned. An expanded study between gender and any possible relationship with text format may be needed to further test this conclusion. Using the framework of Rogers' diffusion of innovations and the Gartner Hype-Cycle approach may show adoption rates and satisfaction with using digital textbooks (Doering, Pereira, & Kuechler, 2010).

The test results showed that even when participants were assigned to the textbook format they did not prefer, they still scored as well as those who were assigned to their preferences. In the paper textbook groups, the mean scores were 13.69 points ($n = 89$) for those assigned to their preference and 12.60 points ($n = 25$) for those not assigned to their preference. In the digital group the mean scores were 13.35 points ($n = 43$) for those assigned to their preference and 13.29 points ($n = 76$) for those not assigned to their preference. The digital group mean scores were still high and similar to the paper group even with almost double the number of participants not being assigned to the group they preferred. This would indicate that no matter the format students used, they were able to find the answers they sought. Further study of textbook format preferences and effect on comprehension test scores may be needed over a longer period of time, such as an entire semester.

The next data point examined was whether the participants had prior experience in using digital textbooks or e-readers. The participants who had used a digital textbook prior to this study had a mean score of 13.42 points ($n = 203$) out of 16, and those who did not previously use a digital textbook had a mean score of 13.10 points ($n = 30$) out of 16. Such a large number of

participants with previous experience may signify that an increase in the availability and use of digital resources is growing or students are interested in trying digital texts. The comprehension test scores also indicate that past experience using tablet computers could have some influence on test performance, but further testing and research may be merited. Dennis reported that there was no significant difference in preference of text format with regard to gender, and 60% of students surveyed preferred e-textbooks. Dennis did not tie digital textbook usage directly to comprehension test results, only to student self-reported prior grade point average. Further long-term study of comprehension test results and other course grading of undergraduate students using digital textbooks is warranted.

The survey used for this study also collected information about features of digital e-book reader software and hardware that undergraduate students might use or are currently using. As supported by Bedord (2009), Cancino (2011) and Martin (2010), participants are very concerned with cost of digital textbooks. As the cost for a college education continues to rise, students are looking for any possible way to save money and not be crippled with debt upon graduation. The ability to search text was also a concern for participants, which means that they want to be able to find keywords and answer questions from their homework and projects. Two surprising findings from this part of the survey were that participants were not interested in text-to-speech capability in an e-reader. This is a feature many new e-readers like the Kindle Fire HD have built in for reading books, and it is becoming popular. Perhaps if students had the choice, they may change their minds. This would also help students with special needs, such as low-vision students and those students with reading difficulties. Cheng (2010) wrote about the concern students and organizations such as the National Federation of the Blind had about the need for equal accessibility in using digital devices that institutions may require for reading digital

textbooks. Given the economics associated with inclusion of features in textbooks and the devices designed to deliver them, further research is warranted to ensure equity for users.

The other surprise was that the participants were not worried about having instructional support available from the campus information technology areas, such as the library, technology support group, or the campus bookstore. In the open-ended qualitative questions in the survey support was a concern of some of the participants. Only 48 out of 233 students were concerned with having support available. Students may feel they can figure out how to use digital textbooks and e-readers without assistance. This contradicts what some researchers such as Gaffney (2012) and Hickey (2011) have said about the need for technology support and training in the use of digital e-readers made available for students and library patrons. Further research is warranted to determine the extent of the need.

Next, the study asked what devices participants had used to access digital textbooks. The majority of the participants had used a laptop, desktop, or netbook or an iOS device (such as an iPad, iPod, or iPhone) to view their textbooks. That fits with trends in device usage and ownership in tablets and other computing devices (Pearson Foundation, 2012).

Participants shared that they have accessed digital textbooks on their cellular phones, but this was only 36% of the respondents. This lower number is not surprising because most cellular phones (smart phones) that can access digital content are on very small screens. Most smart phones have a 3-4-inch screen, which can cause eye strain, and enlarging the text in order to read it is difficult. Screen size was a reason the iPad was chosen for this study so all participants would have equal screen size when reading. Boettiger (2011) shared recommendations for using digital devices and reducing eye strain. Monitoring the amount of time using devices as well as maintaining a proper distance from a person's eyes are a few of Boettiger's recommendations.

Having students use smaller screens and following Boettiger's advice for using digital devices may be a productive future study.

The next question of the survey asked participants what device they would want to use to read digital content. The number of responses indicating the desire to use the iOS devices and laptops were still the top answers, but the e-book reader number increased by 15% from those who had used these devices to those who would want to use an e-reader. The features and price for devices such as the Kindle have helped to increase demand for e-readers. Students still want to use the traditional PC (laptop, etc.) because of the comfort of past experience and ease of use. The need for a complete workstation with all the software and full tactile keyboard made this a popular choice with the participants. The number of responses for students wanting to use a cell phone as an e-reader dropped 15% from those who had used cell phones as an e-reader. This may be due to unpleasant experiences trying to read on the smaller screens as discussed earlier. Dennis (2011) reported similar concerns and student opinions at Indiana University. Study of a broader population in this regard may be warranted.

The discussion about what options a digital e-reader should have provided insight as to the expectations of the participants. A color screen was rated as a top feature with 84% of the participants. Again, not surprising is the cost of a digital device, with 98% of the participants stating this is *important* and *somewhat important* to participants. Other important features of a digital e-reader included the ability to read email, browse the Internet, and watch videos. These three features are needed to complete coursework in many college classes and for general daily productivity. The ability to listen to music was *somewhat important* but not deemed *very important* by the participants. Dennis (2011) and Foasberg (2011) described several options that students want in e-readers that match many of the opinions of the students in this study. Some of

these options include low cost for devices, portability of devices, and ease of reading text on the screen. Although these preferred options seem intuitive, further study would provide a better understanding of the wider population in general.

In this study, the concern over the cost of the textbooks and digital devices has been discussed several times. The last quantitative question asked the optimal price undergraduate students would be willing to pay for a digital device. The options ranged from $1 to $400 and up by $50 increments. The two greatest responses fell between price points of $100-$149 and $150-$199. Just over 40% of the participants thought this was the right price. The third greatest group was $200-$249 (16.7%), which helps illustrate that a digital e-reader device needs to be under $250 for students to feel it is worth purchasing or that the device fits in their personal budgets. Expectation for device options and costs is important to know when marketing to undergraduate students and even to the general population. The findings of Dennis (2011) and Foasberg (2011) agree that cost of digital e-readers is a concern. Further study would confirm the price point ranges that are best tolerated by college students' budgets.

One question not posed in this study was what students would be willing to pay for digital textbooks themselves. This was not asked because there are so many types of digital textbooks for students to choose from that it can be confusing as to what is defined as a digital textbook. Students did answer in the qualitative section of this study that many digital textbooks are not offered at a cost effective level to encourage them to buy digital textbooks rather than the paper textbook.

When reviewing the quantitative feedback from the survey and the focus groups, one sees how strongly students feel about the choice of paper or digital textbooks. Most students were polar opposites when it came to textbook format. Only six participants considered changing their

preference of text format. The participants who preferred the paper text format had strong feelings that they would not switch to a digital text. Issues such as battery life, technical failures, distractions in class, and the need for tactile feedback were top concerns. The digital text format group was pleasantly surprised with their experience, many who thought they would have difficulties answering and completing the test. These participants favored the ability to search the text for key words, to easily scroll between pages, and favored the ease of carrying and holding the iPad during the test period. Dennis (2011) reported that students in the Indiana University study were influenced by their instructor's choice of text format and previous experience using digital textbooks. The Dennis findings agree with this study that students have strong feelings about their text preference based on their prior experience with digital texts.

Recommendations

This research study has shown that, under these conditions, undergraduate students can use digital textbooks to read and complete coursework, scoring just as well as those using paper textbooks. The delivery method revealed no disadvantage in regard to gender and past experiences in using digital textbooks. Almost all of the students in this study, regardless of their personal preference for text format, were able to complete their work at a satisfactory level of performance. None of the material these students were tested on was taught to them prior to the research study, nor was it likely they saw the textbook or comprehension test prior to the study.

Given the study was able to show that digital textbooks should not affect test scores in undergraduate students and should not be affected by gender and textbook format preference, this may help university faculty in determining if they want to use digital resources that could help reduce costs for students. Given new technological resources, faculty could also design textbooks to meet curricular goals. These could be distributed either free of charge or at reduced

prices. Faculty around the country are considering customizing their textbooks by pulling chapters of textbooks from different books and creating one that meets their academic needs. These customized textbooks are proving to be one quarter to one half the price of the printed textbook (Campbell, 2011). The main challenge is the time and effort faculty must take in order to find appropriate chapters and resources. The benefit is not only potentially less expensive books for students but also more updated content in the book. With the timeline needed to print paper textbooks, publish-on-demand textbooks have begun to gain popularity for faculty who choose to use them. Instead of assigning multiple textbooks in class to present all of the information to students, experts are recommending custom-built textbooks (Wiley, Green, & Soares, 2012).

Efforts are being made to create publishing frameworks to help faculty and other textbook authors create standards-based textbooks that meet the common goals of many instructors, even when the textbook may be custom built (Eppelin & Böttcherb, 2011). Even commercial publishers like Amazon offer the Amazon's Kindle Direct Publishing service using the Kindle Development Kit to publish research and even student work and notes (Jeffress & Lyle, 2012).

Finding a stable and consistent hardware and software combination is paramount for successful deployment of digital textbooks. Currently there are over a dozen software applications and hardware combinations students can choose to use just in tablet devices. Publishers and faculty need to find the best content delivery solution for students and at an affordable price to lessen the financial burden of paying for college

Future Research

From reviewing participant feedback, future research should determine how to correct or mitigate any physical distress in reading books on a digital e-reader. Several participants said they felt nauseated, tired, or just sick from trying to read the textbook on the iPad. One participant was unable to finish the study due to physical sickness.

This study only tested students for one chapter in a single setting due mostly to time constraints and availability of students. To further test the methodology and results of this study, instructors may choose to have a class use a digital textbook for the entire semester and compare the results to either previous semesters using paper textbooks or compare students in the same class who are using paper textbooks alongside the digital textbook students. For such a study, use of a pre- and posttest is recommended to further reveal format effectiveness. Using a publisher's or an instructor's custom-made digital materials for teaching might also be an interesting follow-up study to determine whether locally created resources are just as effective as publisher-created ones. Students are also looking for interactive digital resources and textbooks, so the concept of partnering universities and publishers could be utilized to test new multimedia textbooks. Such a study could help determine if students want to use these materials and whether they can perform well on their tests.

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APPENDIX A: FACULTY INVITATION LETTER

Recruitment Letter to Faculty

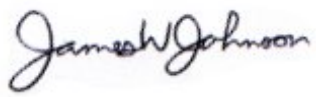
Dear <<ISU Faculty Member Name>>,

I would like to request your cooperation in a research study that will examine undergraduate students' perceptions of using paper or digital textbooks in their courses. This study is being conducted by Mr. Jim Johnson and Dr. Susan Kiger from the Curriculum, Instruction and Media Technology Department at Indiana State University. This study is being conducted as part of a dissertation research project. There are no costs to you or your students for participating in the study. You as the instructor will not have to do anything except allow me to come to your class to conduct the study if you are willing. Data collected in your class will be aggregated with data from all classes that participate so individuals and classes will not be identifiable. Although I will not be able to share data from your classes with you individually, the entire aggregated data set will be available in my dissertation.

The information your students provide will reveal undergraduate students' perceptions of using digital textbooks in their courses. The survey will take about 30 minutes to complete. Students will read a chapter of text called *Organizational Behavior: Tools for Success*. After reading, a comprehension test will be given, and lastly, the students will complete a survey about their experience during this study. If you are interested please email me at jim.johnson@indstate.edu.

If you have any questions about the study, please contact Mr. Jim Johnson, Bayh College of Education, University Hall Room 008M, phone number: 812-237-2921, email: jim.johnson@indstate.edu or Dr. Susan Kiger, faculty sponsor, at the email address: susan.kiger@indstate.edu.

Sincerely,



Jim Johnson, Ph.D. Candidate
Principal Investigator
Department of Curriculum, Instruction and Media Technology
Bayh College of Education

APPENDIX B: STUDENT INVITATION EMAIL/LETTER

A COMPARISON STUDY OF THE USE OF PAPER VERSUS DIGITAL

TEXTBOOKS BY UNDERGRADUATE STUDENTS

Recruitment Email to Undergraduate Students

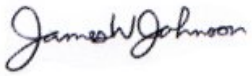
Dear ISU Undergraduate Students,

I am seeking participants for a research study that will examine undergraduate students' perceptions of using paper or digital textbooks in their courses. This study is being conducted by Mr. Jim Johnson and Dr. Susan Kiger from the Curriculum, Instruction and Media Technology Department at Indiana State University. This study is being conducted as part of a dissertation research project.

The survey will take about 30 minutes to complete. If you choose to participate you will be assigned to 1 of 2 groups, paper text or digital text using an iPad. You will then read a chapter of a textbook. After reading the chapter, you will take a 16 question comprehension test followed by a short survey about your experience during this study. In order to limit the influence of prior knowledge on test outcomes, a text that was assumed to be new to most undergraduate students was chosen. Thus, you should not feel uncomfortable if you do not know the content, as it was selected on that basis. There will also be an opportunity to participate in a small focus group if you volunteer for it and are selected. If you are interested please email Mr. Johnson at jim.johnson@indstate.edu.

If you have any questions about the study, please contact Mr. Jim Johnson, Bayh College of Education, University Hall Room 008M, phone number: 812-237-2921, email: jim.johnson@indstate.edu or Dr. Susan Kiger, faculty sponsor, at the email address: susan.kiger@indstate.edu.

Sincerely,



Jim Johnson
Ph.D. Candidate
Principal Investigator
Department of Curriculum, Instruction and Media Technology
Bayh College of Education

APPENDIX C: CONSENT TO PARTICIPATE IN RESEARCH

A COMPARISON STUDY OF THE USE OF PAPER VERSUS DIGITAL TEXTBOOKS BY UNDERGRADUATE STUDENTS

You are being asked to participate in a research study conducted by Mr. Jim Johnson and Dr. Susan Kiger, from the Curriculum, Instruction, and Media Technology Department at Indiana State University. This study is being conducted as part of a dissertation research project. Your participation in this study is entirely voluntary. Please read the information below and ask questions about anything you do not understand, before deciding whether or not to participate.

Purpose of the Study

This mixed-method study examined the effectiveness of using digital textbooks compared with traditional paper textbooks in undergraduate courses. Student performance comparisons were used to see if the digital versions had any significant influence on students' achievement scores versus paper texts. Moreover, regardless of performance outcomes, features of software and devices were explored to determine if these influence use of digital texts. This study provides information that could help university administrators and faculty make a determination about the use of digital textbooks for their classes. It provides useful information about the need for digital textbooks to the book publishing companies. Furthermore this study may help libraries decide on whether to increase their holdings of digital or paper textbooks.

Procedures

If you volunteer to participate in this study, you will be asked to do the following things:

The procedures for the completion of this study will be as follows:

1. You will be asked to read a short sample of text in either paper or digital format.
2. You will then complete 16 questions on the content you read.
3. Next you will complete a survey about your experiences during this study and your opinions of using digital texts.
4. You can volunteer for a small focus group to provide further information about your experiences during the study. If you are chosen for the group you will be notified.

You will be randomly assigned to 1 of 2 groups: paper text or digital text. The reading portion of the study should take about 15 minutes and the test should take no longer than 10 minutes. The entire study should take no longer than 30 minutes to complete. You will be asked to complete this procedure only once. The study will take place in one of your classrooms or a room on campus which will be announced it is scheduled.

You will only be audio recorded if you are selected for the small focus group portion of the study. During the focus group audio of the session will be recorded for accuracy of answers and you will not be identified by your answers.

Potential Risks and Discomforts

There are no foreseeable risks for participating in this study. You will be reading a chapter of a textbook in paper format or in digital format on an iPad, taking a paper-based reading test, and then completing a survey. To successfully complete the study you should be able to read 26 pages from the textbook in print or a similar number of pages in digital format. The digital format should be close to the same number of pages depending on the font size used on the iPad. Next you will need to complete the paper-based reading test and the survey in one

sitting. If you can do all three things, there should be no problem participating in this study. There is no compensation for any injuries incurred during this study.

Potential Benefits to Subjects and/or to Society

The goal of this study is to examine whether there are differences between paper and tablet based textbooks in helping students read and comprehend subject matter for their classes. You may not benefit directly from this research but the intention it is inform textbook publishers, universities and other interested parties of any benefits or drawbacks to the use of digital textbooks.

Confidentiality

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of a label identification system that will have only a study number for each person and no names. Only the primary researcher will know your name and it will never be shared with your instructors or anyone else. All study data will be kept locked in a university office with only the primary researcher having access to it. Participants in the small focus groups will be audio recorded only for accuracy of information and the recordings will be deleted when the study is completed. The recordings will be accessed by the primary researcher for educational purposes only.

Participation and Withdrawal

You can choose whether or not to be in this study. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind or loss of benefits to which you are otherwise entitled. You may also refuse to answer any questions you do not want to answer.

There is no penalty if you withdraw from the study and you will not lose any benefits to which you are otherwise entitled.

Identification of Investigators

If you have any questions about the study, please contact Mr. Jim Johnson, Bayh College of Education, University Hall Room 008M, phone number: 812-237-2921, email: jim.johnson@indstate.edu or Dr. Susan Kiger, faculty sponsor, at the email address: susan.kiger@indstate.edu.

Rights of Research Subjects

If you have any questions about your rights as a research subject, you may contact the Indiana State University Institutional Review Board (IRB) by mail at Indiana State University, Office of Sponsored Programs, Terre Haute, IN 47809, by phone at (812) 237-8217, or e-mail the IRB at irb@indstate.edu. You will be given the opportunity to discuss any questions about your rights as a research subject with a member of the IRB. The IRB is an independent committee composed of members of the University community, as well as lay members of the community not connected with ISU. The IRB has reviewed and approved this study.

I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

☐ I WANT TO PARTICIPATE AND INCLUDE MY DATA IN THIS STUDY

_____

Printed Name of Subject

_____ _____

Signature of Subject Date

I understand the procedures described above. My questions have been answered to my satisfaction, but I do not agree to participate in this study. I may complete all parts of the study but my data will not be used in the study. I have been given a copy of this form.

☐ I DO NOT WANT TO PARTICIPATE OR INCLUDE MY DATA IN THIS STUDY

IRB Number: 355592

Date of IRB Approval: 9/21/12

Project Expiration Date: 9/20/13

APPENDIX D: FOLLOW-UP SURVEY

Q1. Which of the two groups were you in?
- ❍ Read text in Paper Format
- ❍ Read text in Digital/iPad Format

Q2. What is your age?
- ❍ 17 and under
- ❍ 18
- ❍ 19
- ❍ 20
- ❍ 21
- ❍ 22
- ❍ 23
- ❍ 24
- ❍ 25 and over

Q3. What is your gender?
- ❍ Man
- ❍ Woman

Q4. Have you ever used a digital textbook, online reading (like a PDF) or e-book?
- ❍ Yes
- ❍ No

Q5. Do you prefer print text over digital textbooks, online readings (like a PDF) or e-books?
- ❍ Yes
- ❍ No

Q6. Were you assigned to the group you preferred?
- ❍ Yes (1)
- ❍ No (2)

Q7. What reasons or features might influence you to use a digital textbook, online reading (like a PDF) or e-book over a print text? (Check all that apply)
- ☐ Cost of digital text would be cheaper

- ❑ Ability to search text
- ❑ Ability to have the text read to you
- ❑ Instructional support available from campus IT group, library, or bookstore
- ❑ None

Q8. What device(s) have you used to access digital textbooks, online readings (like a PDF) or e-books? (Check all the apply)

- ❑ E-book reader (Kindle, Nook, etc.)
- ❑ iPad, iPhone or iPod Touch
- ❑ Laptop, netbook or desktop computer
- ❑ Cell Phone
- ❑ Other _____
- ❑ None

Q9. What device(s) would you like to use to access digital textbooks, online readings (like a PDF) or e-books?(Check all that apply)

- ❑ E-book reader (Kindle, Nook, etc.)
- ❑ iPad, iPhone or iPod Touch
- ❑ Laptop, netbook or desktop computer
- ❑ Cell Phone
- ❑ Other _____
- ❑ None

Q10. Please rate the following digital textbook reader options as to how important you think they are.

	Very Important	Somewhat Important	Not Important
E-Ink print	❍	❍	❍
color screen	❍	❍	❍
cheapest price	❍	❍	❍
Ability to use multiple e-reader applications (apps)	❍	❍	❍
Ability to read email	❍	❍	❍
Ability to browse the Internet	❍	❍	❍
Ability to watch videos	❍	❍	❍
Ability to listen to music	❍	❍	❍

Q11. Thinking about the price of a digital text reader, what price would you expect to pay?

- ❍ $1-99
- ❍ $100-$149
- ❍ $150-$199

- ❍ $200-$249
- ❍ $250-$299
- ❍ $300-$349
- ❍ $350-$399
- ❍ $400 and up

Q12. If you would like to post additional comments or feedback about your experience with digital textbooks (using the software), online readings (like a PDF) or e-books, please enter it below.

Q13. If you would like to post additional comments or feedback about your experience with digital text readers (using the hardware), please enter it below.

Thank you for your time in taking this survey!

APPENDIX E: FOCUS GROUP QUESTIONS

The participants who volunteer to serve in the focus group part of the study will be split into two groups based on their treatment group; paper or digital textbook. The following questions will be used to facilitate a discussion about their experiences during the study.

1. Please describe your experience in completing the study and survey.
2. Describe your level of comfort in completing the assignment for the study?
3. What textbook improvements would you suggest to book publishers regardless of format?