Computers & Education 63 (2013) 259–266

Contents lists available at SciVerse ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Electronic versus traditional print textbooks: A comparison study on the influence of university students' learning

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ARTICLE INFO

Article history:
Received 31 August 2012
Received in revised form
10 November 2012
Accepted 25 November 2012

Keywords:
Electronic textbook
E-book
E-reader
Test performance
Student perception

ABSTRACT

University students are increasingly choosing to purchase e-textbooks for their mobile devices as an alternative to traditional textbooks. This study examines the relationship between textbook format and 538 university students' grades and perceived learning scores. Results demonstrate that there was no difference in cognitive learning and grades between the two groups, suggesting that the electronic textbook is as effective for learning as the traditional textbook. The mean scores indicated that students who chose e-textbooks for their education courses had significantly higher perceived affective learning and psychomotor learning than students who chose to use traditional print textbooks.

Published by Elsevier Ltd.

1. Introduction

In the higher education classroom, the textbook is one of the many tools used for learning. In some courses, the textbook is central to class discourse. In other courses, the text is supplementary and acts as a guide for segueing among the topics covered. Whatever role the faculty chooses for the textbook to play in the course, instructors and students alike consider the textbook an essential learning tool. In this digital age, the nature of the textbook is changing. Eighty percent of college and university students own laptops, and an increasing number are purchasing tablets, smart phones, and other handheld devices (Smith & Caruso, 2010). Recognizing the increased adoption of mobile devices, publishers are offering an increased number of textbooks in digital format. These digital texts, also called e-textbooks, can be accessed via the Internet and downloaded on tablets, e-readers, smart phones, and laptops. The adoption of e-textbooks, along with the broad range of interactive learning features, is projected to exponentially grow within the next two to three years (Becker, 2010; Reynolds, 2011). Unfortunately, as is true with many technological advances, the educational research to support the efficacy of e-textbooks consumed via mobile devices lags behind development and adoption.

Efficacy of technological tools and mediums has been measured in a variety of ways in education, but student learning is the most frequently used measure of efficacy. Learning has been primarily defined in cognitive terms and measured by a grade or achievement test score (e.g., Frith & Kee, 2003). Although grades and test scores are deemed valid measures and are important to examine, they may not be the most valid measure for higher education learners (Rovai & Baker, 2005). Higher education students' perceptions of their learning may more accurately assess their learning in a course (Chesebro & McCroskey, 2000; Corrallo, 1994). Further, measuring only the cognitive dimension of learning is narrow. Bloom (1956) conceptualized learning as a three-dimensional process, including cognitive, affective, and psychomotor learning. That is, learning consists of not only knowledge about a topic but the feelings and attitudes about a topic and the inclination to behaviorally engage in the topic related experiences.

Learning can be impacted by both the format of the text and the medium through which the text is consumed (Mayer, Heiser, & Lonn, 2001; Morineau, Blanche, Tobin, & Gue'guen, 2005; Nelson & O'Neil, 2001; Vygotsky, 1978). Research in higher education environments has focused primarily upon faculty and student preferences of e-textbook formats (Clark, Goodwin, Samuelson, & Coker, 2008; Kang, Want, & Lin, 2009; Jamali, Nicholas, & Rowlands, 2010; Robinson, 2011; Shepperd, Grace, & Koch, 2008; Woody, Daniel, & Baker, 2010). Only a few

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0360-1315/$ – see front matter Published by Elsevier Ltd.
http://dx.doi.org/10.1016/j.compedu.2012.11.022

studies have begun to examine the effect of e-textbooks on university students' cognitive, affective, and psychomotor learning. Additionally, many have not considered the medium used to access the e-textbook (e.g., mobile-reader, tablet, computer; Woody et al., 2010). A call for more research in this area prior to widespread adoption is needed (Connell, Baliss, & Farmer, 2012). Thus, the purpose of this study is to examine the efficacy of e-textbooks defined as grades and perceived learning as compared to traditional textbooks when used by residential and online university students for undergraduate and graduate coursework.

2. Defining e-textbooks

Throughout the literature, e-books have been defined and described in numerous ways. Most research on e-books defines them as texts that are digital and accessed via electronic screens. There are two formats in which e-textbooks exist. These are page fidelity e-textbooks and reflowable digital e-textbooks (Jeong, 2012; Nelson, 2008; Vassiliou & Rowley, 2008; Chesser, 2011). Page fidelity e-textbooks are simply scanned pictures of the print version of the book. An example of this is a PDF file with no dynamic media, no active web links, and no capability to manipulate font or pictures. Page fidelity e-textbooks can be cumbersome and are often unavailable on handheld mobile devices. Reflowable e-textbooks use a flexible format system that includes dynamic media and allows the user to modify both the layout and interactive features of the e-textbook to suit the display medium (Chesser, 2011).

Students can access e-textbooks in a static location such as a stand-alone computer or on a mobile device. The research of Shepperd et al. (2008) demonstrated the examination of the e-textbook in a static location. The e-textbook was distributed on a CD and installed on a local computer. This limited the user to accessing the e-textbook in a single location and eliminated the potential access to the e-textbook on handheld devices (Shepperd et al., 2008). Students who used the e-textbook rated the usability positively but rated convenience unfavorably due to the lack of mobility – the static format offered even less mobility than a paper textbook because it tethered the student to a computer (Shepperd et al., 2008). The interaction of readers with e-textbooks in a static environment may soon be considered obsolete, as current mobile delivery technologies have created more options that are potentially more viable.

Current and emerging technologies for e-readers offer reflowable text to support academic use of electronic textbooks on all electronic devices, including handheld devices (Hoseth & McLure, 2012; Reynolds, 2011). However, much of the available e-textbook research has been conducted using static computer screens and page fidelity text (Berg, Hoffmann, & Dawson, 2010; Jeong, 2012; Morineau et al., 2005; Murray & Pérez, 2011; Shepperd et al., 2008; Shamir & Shlafer, 2011; Sun, Flores, & Tanguma, 2012). Although psychological theories on learning purport that there is a relationship between cognition and context (Thelen, Schoner, Scheier, & Smith, 2001), limited research exists on reflowable text and enhanced features of e-textbooks on newer mobile technologies (Connell et al., 2012). It is necessary to examine how learning is impacted by the electronic format and also by the technological medium, specifically handheld devices. As Boroughs (2010) purports, new digital devices and e-text have the potential to change the way college and university students perceive and engage with books.

3. Existing research on E-textbook

Past research on e-textbooks focused primarily on reading speed and comprehension of individuals accessing text content through a stand-alone computer. The literature suggested that reading time is consistently longer when reading on screen as compared to reading a printed text. Higher levels of reading comprehension and learning were also reported using traditional textbooks (Dillion, 1992; Mayer et al., 2001). Conversely, electronic book users tended to read a chapter or less at a time and often print longer chapters and sections of the book to read offline due to high levels of eyestrain when reading from a screen (Nelson & O'Neil, 2001). Initial experimental studies suggested that reading long passages of information took longer when using an electronic format compared to reading a paper text (Dillion, 1992; Mayer et al., 2001). Dillion (1992) found reading from a screen increased the length of time it took to read a text by 20–30%. Mayer et al. (2001) confirmed that readers had faster reading rates for paper text when compared to screen text during 25 min reading sessions.

More recently, researchers have supported previous findings by reporting a slightly, although not significantly, longer reading time for e-books on handheld devices when compared to paper text (Connell et al., 2012; Kang, Wang, & Lin, 2009). In the research of Morineau et al. (2005), 40 adults were randomly assigned to read text from either paper or electronic formats. Results demonstrated that participants in both groups had similar recall and ability to reinterpret information that they read, suggesting that retrieval of information is not effected by format. In 2012, Connell et al. studied 201 undergraduate students who were randomly assigned access to course content using either an iPad or Kindle e-Book reader e-textbook, a tablet computer e-textbook, or a print version. On one posttest, there was no significant difference in reading comprehension across delivery options. Aust, Kelly, & Roby (1993) and Kang et al. (2009) found the similar results. These findings substantiate that there is little difference in learning rates between using a stand-alone computer and using a handheld device.

Although the literature suggested that learning rates are similar from paper to e-text, some studies have demonstrated that recall and retrieval is poorer when reading from an e-text as compared with a print text (Jeong, 2012; Mayes, Sims, & Koonce, 2001; Noyes & Garland, 2003; Berg et al., 2010). Several reasons for the mixed results have been documented in the literature and have implications for the study of the efficacy of e-textbooks in a higher education environment. Passage length is one difference that appears to impact the results. Studies involving shorter reading sessions indicated no substantial variance with respect to reading comprehension and understanding (Morineau et al., 2005; McFall, 2005). Conversely, studies involving longer reading passages indicated poorer comprehension. When reading longer e-texts, eye fatigue and mental workload are also concerns (Kang et al., 2009; Mayer et al., 2001). In fact, Kang et al. (2009) suggested that the notably lower contrast on computers and handheld electronic device compared to print versions may contribute to eye fatigue when reading for long periods of time. This research implies that university students who choose to read hundreds of pages of textbooks on a screen – whether on a computer or on a handheld device – may experience more eye fatigue and increased mental workload than their peers who choose traditional textbooks. The consequence eyestrain and mental fatigue could be poorer comprehension and have a negative impact on learning.

On the other hand, recently developed e-reader products and mobile devices are more advanced and, thus, may be more suitable for academic use and may continue to change the reading experience. Current and emerging technology and software are now offering

reflowable text and features to support academic use of electronic textbooks (Hoseth & McLure, 2012; Reynolds, 2011). The flexibility of reflowable text and increased accessibility features in newer devices removes many of the potential negative consequences once documented in the literature on digital texts.

There are a limited number of studies that have examined the impact of e-textbooks on academic outcomes and student experience using a computer or laptop (Berg et al., 2010; Jeong, 2012; Morineau et al., 2005; Murray & Pérez, 2011; Shepperd et al., 2008; Shamir & Shlafer, 2011; Sun et al., 2012). Even fewer have examined the how accessing the e-textbook via handheld devices impacts learning (Connell et al., 2012). Sheppard et al., (2008) examined 392 undergraduate psychology students who were given the choice to use either electronic or paper based text for reading and study. Ninety percent of the students chose to purchase the paper text, while only 10% chose to purchase the electronic text. A comparison of student achievement in final grades showed no difference between groups, and the e-textbook group reported spending less time reading the text. Although though the findings indicate a potential ability to achieve similar levels of performance with reduced effort when using an e-textbook, the researchers warn students and educators to use caution in choosing e-textbooks because the users of e-textbooks in the study did not rate their experience favorably. Rather, they reported that they would not recommend adoption (Sheppard et al., 2008). In a later study at Kennesaw State University, Murray and Pérez (2011), compared the exam scores of 68 online students taking an asynchronous, online class. Thirty-two students were assigned to read the printed textbook, and 36 students were assigned to read the e-textbook. Their results substantiated the comparable effectiveness of e-textbooks – students did not differ in the scores on the two exams (Murray & Pérez, 2011). The review of the literature therefore concluded that further study is needed to better understand and generalize results of the effectiveness of e-textbooks versus print text in the learning process.

4. Measure of efficacy: grades and perceived learning

Throughout the literature, learning is often used as a measure to determine the efficacy of educational strategies and tools, and grades are most commonly used to measure learning (Coldwell, Craig, Paterson, & Mustard, 2008; Dumont, 1996; Plant, Ericsson, Hill, & Asberg, 2005). Yet, using grades to operationalize learning may present a limited view of this construct. Researchers purport that grades are not always a good reflection of what higher education students have learned (Rovai, Wighting, Baker, & Grooms, 2009). For example, grades of graduate students are limited in their range and often demonstrate above average achievement. Conversely, many higher education students are challenged to balance work, school, and family. A family or job responsibility may take precedence and negatively affect a grade while learning has still taken place. Over two decades ago, Pace (1990) endorsed the validity of students' self-report learning measures based on research over time and across diverse populations. Current research demonstrates that self-report continues to be a valid measure of learning (Chesebro & McCroskey, 2000). Although higher education students may overestimate or underestimate their learning, previous educational experience provides them with a solid basis to evaluate their learning and to do so with accuracy (Chesebro & McCroskey, 2000).

It is important to note that defining learning as only a cognitive construct is limited. Bloom (1956) conceptualized learning as three-dimensional: cognitive, affective, and psychomotor. These dimensions are interrelated (Oyesola, 1986) and may be assessed in a variety of ways, including self-report (Rovai et al., 2009). Cognitive learning is conceptualized as having multiple dimensions, including acquiring knowledge, understanding, applying, synthesizing, and evaluating (Bloom, 1956). However, perceptions of learning are more complex than this and cognitive growth is usually accompanied by and interrelated with perceived affect and changes in behavior (McKeachie, 1976; Vygotsky, 1962). Affect includes the emotions, attitudes, and opinions derived from beliefs experienced during learning (Anderson & Krathwohl, 2001; Rovai et al., 2009). Affect may change through a learning experience itself and impacts the acquisition of knowledge leading to behavioral change (Caspi & Blau, 2008). For example, if a student has a fear of reptiles and is asked to read about dissecting a frog in preparation for a biology lab, the fear may inhibit the student from completing and fully understanding the material. This is the behavioral aspect to learning – psychomotor learning is required in order for the student to successfully dissect the frog, thus learning is impeded when behavior gets in the way (Bloom, 1956). Because learning includes students' cognitive, affective, and psychomotor experiences, this study focused on the efficacy of e-textbook and print texts to enable learning in the three domains to occur.

5. Purpose statement

To date, research has demonstrated that students find digital textbook formats to be generally usable but not convenient due to lack of availability in mobile formats and restricted linear navigation inherent in the majority of older versions of mobile e-reader devices (Foasberg, 2011; Reynolds, 2011; Sheppard et al., 2008). The key to widespread adoption of e-textbook technology appears to rely mostly on the development of mobile devices and student exposure to academic reading using these devices (Connell et al., 2012). Currently, little research exists on how the use of mobile devices to access e-textbooks in reflowable format over a course semester impacts learning. This study sought to extend previous findings and contribute to the body of literature and provide an improved understanding of how a text format impacts the learning of university students. For the purposes of this study, efficacy of textbook format is defined by grades and student perceptions of cognitive, affective, and psychomotor learning. This research study investigated the following questions: (a) Is there a difference between participants' perceived learning based on the format of textbook they choose for a course? (b) Is there a difference between participants' learning (e.g., final grade) based on the format of textbook they chose for a course? The study also examined students' use and study behaviors related to the chosen textbook to insure that results for the two research questions were not mediated by study habits and use of the text. The e-textbook group was also asked about future desire to use an e-textbook.

6. Methodology

6.1. Participants and setting

The present study examined a convenience sample of 538 undergraduate and graduate (i.e., masters, EdS, and EdD), residential, and online students at a private university located on the eastern United States. During the Spring 2012 semester, participants in 59 education courses were sampled as they were enrolled in a course that offered the primary textbook in both a traditional print format and an electronic

format. Students participating in the courses chose their textbooks prior to the beginning of the course. Content, activities, and assessments within each course were the same across the treatment and control groups; the only difference was the type of textbook being used. The purpose of this present study was to analyze perceived learning and grades. Therefore, the sample was surveyed for a second time regarding perceived learning as applicable to the present study. The volunteer rate for the study was 53.2%.

The participants self-identified ethnicity as Hispanic ($n = 17$, 3.2%), African-American ($n = 79$, 14.7%), and Caucasian ($n = 442$, 82.2%). The participants ranged from ages 20 to 69. Of the total number, 142 (26.4%) of participants were ages 20 and 29, 126 (23.4%) participants were ages 30 and 39, 137 (25.5%) participants were ages 40 and 49, and 133 (24.8%) participants were ages 50 and over. Undergraduate ($n = 93$, 17.3%), masters and post-masters (EdS) ($n = 277$, 51.55%) and doctoral ($n = 168$, 31.2%) students were each represented in the sample population. Four hundred and thirty two (80.3%) students chose to use traditional print textbooks while one hundred and six (19.7%) students chose to use e-books. A chi-square analysis demonstrated that there was no significant difference in the proportion of undergraduate, masters and post-masters, and doctoral student classifications per group, $\chi^2 = .38$, $p = .56$, phi −.03. Additionally, there was no significant difference in the proportion of age clusters per group.

6.2. Textbook definition

For the purpose of this study, e-textbooks were defined as texts that are digital and accessed through computer screens or mobile devices (Jeong, 2012; Nelson, 2008; Vassiliou & Rowley, 2008). The study focused on reflowable digital e-textbook format rather than static print format (Chesser, 2011). Traditional textbooks were print on paper. All of the textbooks examined in this study were publisher produced and purchased through a university book distributor. On an online survey, participants were asked, "What device did you use most often to read your electronic text? " They could choose: "Print," "Laptop," "Tablet (e.g., iPad, Google Android, etc)," "E-reader (e.g., Nook, Kindle, etc.)", or "Smartphone," students self-reported which electronic devices they most often used for accessing the e-textbook. As reflected on Table 1, almost 90% of the students reported accessing their e-textbook through a mobile device such as an e-reader, laptop, or tablet (Table 2).

6.3. Instrumentation

Students completed a web-based assessment that consisted of questions related to their textbook choices, textbook use and study habits, and learning. Grades were obtained from the Blackboard© grade book. In each course, a 1000-point grading scale was used. Students' course scores could range from 0 to 1000.

The web-based assessment consisted of demographic and textbook related questions. The survey consisted of the questions about participants' perceptions and use of their textbooks. The following question was asked about textbook choice, "What type of text book did you purchase or rent to use in this course?" Students were given two options: electronic textbook or traditional print textbook. The students' answer to this question determined their grouping for the independent variable. The Perceived CAP Learning Scale (Rovai et al., 2009) was used to assess students' perceived learning. The instrument included nine questions on which students reported perceived learning. The instrument used a 7-point Likert type scale where students rated learning ranging from score of 0 (Not at All), to a score of 6 (Very Much So). The Perceived CAP Learning Scale is a nine-item scale with three subscales, cognitive learning, affective learning, and psychomotor learning. The composite score ranges from a 0 minimum to a 54 maximum; each subscale score ranges from a 0 minimum to an 18 maximum. Rovai et al. (2009), in their validation study, provided evidence of the instrument's validity and reliability to measure perceived cognitive, affective, and psychomotor learning in traditional and online settings. Construct validity was examined and confirmed using a confirmatory maximum likelihood factor analysis (Rovai et al., 2009). The reliability of the original scale was high, .79 (Rovai et al., 2009). In this study, the Cronbach's coefficient alpha coefficients for the each subscale were reported as cognitive (.49), psychomotor (.25), and affective (.77). The Cronbach's coefficient alpha coefficient for the full scale was .55. As the scale had fewer than 10 items, inter-item correlations were analyzed and found acceptable according to Briggs and Cheek's (1986) recommendations of no less than .20 value.

6.4. Procedures

During the last three weeks of the identified course, students were sent e-mail messages from the researcher forwarded by their course instructor. The e-mail requested that they complete an informed consent and web-based assessment. Grades of participants who signed conformed consent were obtained from the instructor's online grade book upon the finalization of grade for the term.

7. Results

This casual comparative research study used a one-way multivariate analysis of variance (MANOVA) to examine if university students' cognitive learning, affective learning, psychomotor learning, and grades differed based on their textbook format choice. Descriptive statistics disaggregated by group are presented in Table 3, and the correlations among the variables are displayed in Table 4. Correlation analyses yielded significant low to moderate correlations among all most of the dependent variables, $p > .05$.

Table 1
What device did you use most often to read your electronic text?

Device most frequently accessed for reading	Frequency	Percent
No Answer	4	3.8
Desktop computer	8	7.5
E-reader (e.g., Nook, Kindle, etc.)	17	16.0
Laptop	52	49.1
Tablet (e.g., iPad, Google Android, etc)	25	23.6

Table 2
Descriptive statistics disaggregated by dependent variable.

	E-textbook group ($n = 106$)		Traditional textbook group ($n = 432$)	
Variable	*M*	*SD*	*M*	*SD*
Cognitive Learning	11.78	2.97	11.37	2.11
Affective Learning	13.73	4.22	12.09	3.95
Psychomotor Learning	11.64	5.79	10.62	10.62
Grades	954.52	32.34	954.14	35.08

Preliminary assumption testing indicated minor violations in assumptions. Histograms demonstrated that univariate normality was not tenable; there were modest violations in normality across all variables. Since univariate normality was not tenable, multivariate normality could not be assumed; however, when sample sizes are large (i.e., when both groups have > 25 subjects), the MANOVA robust against violations of the normality assumptions (Tabachnick & Fidell, 2007). Thus, a non-parametric alternative was not considered. The assumption of the homogeneity of variance-covariance was not tenable based on the results of the Box's test, $M = 270.51$, $F(10, 156877.79) = 26.66$, $p = .00$. The results of Levene's test of equality of error provided evidence that the assumption of homogeneity of variance across groups was not tenable for any of the dependent variables. Thus, a more conservative alpha level of .025 was set (Tabachnick & Fidell, 2007). Additionally, Pillai's trace was used as the reported statistic as it is a more robust when assumptions are violated (Tabachnick & Fidell, 2007).

Results on the MANOVA yielded that statistically significant differences existed between the two groups on the combined dependent variables, Pillai's Trace = .07, $F(8, 538) = 4.56$, $p < .01$, partial$^2 = .03$. The observed power was high at .99. When results for the dependent variables were considered separately, using a Bonferroni adjusted alpha level of .005, affective learning and psychomotor learning between groups were found statistically significantly, $F(2,539) = 9.75$, $p < .01$, partial$^2 = .04$, power = .98; $F(2,539) = 12.88$, $p < .01$, partial$^2 = .05$, power = .99, respectively. The mean scores indicated that students who used e-textbooks for their education courses had significantly higher perceived affective learning and psychomotor learning than student who choose to use traditional print textbooks. Grades and cognitive learning did not reach statistical significance, $F(2,539) = 19.80$, $p = .02$, partial$^2 = .01$, power = .67 and $F(2,539) = 1.12$, $p = .328$, partial $^2 = .01$, power = .25, respectively. Students' perceived learning and grades did not differ based on the textbook format they choose for their courses.

7.1. Participants' self-reported behaviors in regard to the text

Students were asked about their behaviors related to their chosen textbook via an online survey with open ended and multiple choice questions. Open-ended responses from the survey were analyzed using a qualitative analysis based on the emerging design approach (Lincoln & Guba, 1985; Guba & Lincoln, 1994; Patton, 1990). A three-stage approach (i.e., induction, deduction, and verification) was used and two coders were used to increase credibility of analysis. The coders separately analyzed the data for categories for each questions and met to discuss and solidify the categories to be used to code the data. The coders then separately provided one category to each open-ended response. A high degree of agreement was found, and disagreement was discussed until an agreed upon category was decided upon. Categories were then verified and descriptive statistics were computed.

Students in both groups were asked to respond to the question, "What best describes the reason you adopted the textbook format (e-book or traditional print) that you did? Name one primary reason." Students who used the traditional textbook format reported that they chose it for portability ($n = 35$, 8.1%); familiarity ($n = 247$, 57.2%); and useful features such as note taking, dog earring pages, etc., ($n = 36$, 7.7%). Students also indicated other factors such as the fact that the cost of used/texts purchased online was lower than the e-textbook ($n = 42$, 9.7%); the ability to keep the traditional text after the course ($n = 17$, 4%); the inability to buy the e-textbook with loan money ($n = 16$, 3.8%); difficulty reading from the screen ($n = 16$, 3.8%); and learning preference or style ($n = 8$, 1.9%) impacted their decision to use a traditional textbook. Fifteen students explained that they liked using e-textbooks, however, e-textbook formats differ and they did not like the format offered for the present course. Nine of these students commented that the format was "too restrictive."

Students who used the electronic book format reported that they chose to adopt the electronic version for portability ($n = 17$, 16%) and the price (less expensive; $n = 67$, 63.2%). Twenty-two students (20.8%) reported that they adopted the e-textbook because the textbook company recommended it as an alternative and they wanted to try it.

The two groups also used their textbooks in similar manners for studying. Participants were asked to respond the question, "What best describes how you read your text for this course?" and provided with 3 categorical options that included "Read word for word," "Skim," and "Don't read for this course." Sixty-five percent ($n = 281$) of the traditional textbook group reported that they read the text word for word. Thirty-five percent ($n = 151$) reported skimming their traditional textbooks. Conversely, 68 (64.3%) of e-textbook group reported that they read their text word for word and 38 (35.8%) reported skimming their e-textbooks. A chi-square analysis demonstrated that the e-textbook and traditional textbook groups did not significantly differ in the manner in which they approached reading their texts for the courses, $\chi^2 = .43$, $p < .05$, phi −.02. The e-textbook group ($M = 11.18$, $SD = 8.05$) and traditional textbook group ($M = 12.65$, $SD = 9.05$) did not differ in the number of hours per week that they reported using the textbook to study for their courses, $t(1) = 2.34$, $p = .13$, eta squared = 006. It

Table 3
Variable correlations.

Variables	Affective learning	Psychomotor learning	Grades
Cognitive Learning	.31**	34**	.07
Affective Learning	–	.40**	.25**
Psychomotor Learning	–	–	.37**

**$p < .01$.

Table 4
How did you take notes?

Note-taking style	Print	E-textbook
Not Answered	8 (1.9%)	n/a
I did not take notes from the book	85 (19.7%)	8 (7.5%)
Type on Word document	93(21.5%)	9 (8.5%)
Write in textbook/Type in text	49 (11.3%)	33(31.1%)
Write on paper	197(45.6%)	56 (52.8%)

should be noted that overestimation or underestimation might be present in the self-reporting of the number of hours per week students used their text.

Note-taking styles varied considerably per group. E-textbook users were almost three times more likely to make notations directly into the text when compared to print text users. Both groups regularly used handwritten notes on paper; however, print book users were more than twice as likely report, "I did not take notes." Table 4 shows the comparison of participant note-taking styles by print version users and e-textbook.

Students who used e-textbook readers during the study were also asked, "Would you adopt an e-textbook in the future?" and were able to choose yes/no. Fifty-one (48.1%) said that they would not adopt an e-textbook in the future, whereas 55 (51.9%) said that they would.

8. Discussion

As textbook publishers increase availability of electronic versions of textbooks and students become familiar with e-books and handheld devices, a dramatic increase in student selection of e-textbooks is expected (Smith & Caruso, 2010). This study is amongst the first to address efficacy of electronic textbooks during a semester long course, including users accessing the e-textbook on mobile devices. Moreover, this study is significant as it addresses traditional and online students' use of e-textbooks at the undergraduate, masters and post maters (EdS), and doctoral levels in higher education.

The results indicated that students who used e-textbooks for their education courses had significantly higher perceived psychomotor and affective learning than students who choose to use traditional print textbooks. That is, students who used e-textbooks perceived better acquisition of skill (Anderson & Krathwohl, 2001). Also, students using the e-textbook as compared to the traditional textbook had "an increasing internalization of positive attitudes toward the content or subject matter" (Kearney, 1994, p. 81). These findings are consistent with past research that suggested that university students who use electronic books for in class group activities have equivalent or better feelings toward learning than university students who use print books for the same activities (Rockinson-Szapkiw, Holder, & Dunn, 2011). If reading an e-textbook can improve the already negative attitudes higher education students have toward reading textbooks and motivate them to read (Hendel & Harrold, 2004), the adoptions of e-textbooks over traditional textbooks may have implications for improving skills needed for success and persistence in college (Hermida, 2009). For, "[r]eading academic texts published by those disciplinary experts permits students to immerse in the culture of the discipline and facilitates learning its conventions, discourse, skills, and knowledge (Hermida, 2009, p. 21). Reading a text via an e-reader or tablet appears to support cognitive learning in the manner similar to printed text. Grades and cognitive learning did not reach statistical significance in this study, suggesting that the type of text may not impact the cognitive aspect of learning and that the use of electronic textbooks for in and out of class learning is a viable choice for university students. Unlike a stand-alone computer, tablets and print texts are portable and have highlighting and note-taking capabilities. These and other new developments in technology may help overcome previous reported challenges documented in the literature in regards to e-texts and the devices upon which they are read.

Descriptive findings of the study also support that the experience with e-textbooks and traditional textbook is similar in some aspects, yet different in others. Students select electronic textbooks due to cost and portability, yet four out of five students overwhelmingly continue to prefer print textbooks due to familiarity with print versions and the ability to highlight text, "dog-ear" pages, and take notes. Students' reports of reading techniques yielded comparable percentages for reading word for word and skimming, and there was no significant difference in course study time based on selected text version. Self-reporting of student use of the two formats indicates that e-textbook users actually interacted with the text to a greater degree through the use of electronic features such as highlighting and note taking.

Although e-textbooks and devices used to consume them have improved over the past few years, it is important to note that e-textbook development is in its infancy. The emergence of accessibility features included in e-textbooks (e.g., embedded reference tools, hyperlinks, instructional videos, and accessibility features such as text to speech) has the potential to raise the level of affective and psychomotor learning even higher and improve cognitive learning (Edyburn, 2010). This would, in turn, raise the number of students who prefer to learn using e-textbooks. According to the 2012 University Horizon Report (Johnson, Adams, & Cummins, 2012), students are already expecting changes in content delivery formats and accessibility options. They want to learn anytime, anywhere. They want access to content on the cloud. They want to be able to collaborate across time and physical space. They want digital media that is interactive, socially based, fully integrated, and inexpensive. The findings in this study confirm current research (Johnson et al., 2012) that students are ready to learn digitally due to the reported increase on affective and psychomotor learning. A major hindrance is not all university content is ready to meet the demands of 21st Century students.

9. Limitations and recommendations for future research

This study used a causal comparative design; thus, the selection threat to validity is an inherent limitation. This limitation was minimized by examining the homogeneity of groups based on variables such as age cluster, degree level, and self-reported study behaviors. However, the selection threat to validity still existed; thus, outcomes could be explained by alternative hypotheses resulting from pre-existing group differences. As learning strengths and preferences contribute greatly to student success (Gardner, 2006), it is possible that students chose to

use e-textbooks or paper based on preference and study habits. Thus, learning preferences may be a moderating or mediating variable that needs to be considered in future research. Experimental research is also needed to determine a cause and effect.

Generalizability is limited. The small number of minority participants limits provides little application to diverse population. The researchers suggest future studies that include a balance in social-cultural representation.

Further, additional areas of e-textbook efficacy should be examined. While grades and self-report measures are deemed valid measures of learning (Chesebro & McCroskey, 2000; Coldwell et al., 2008), they are limited. Dishonest or inaccurate evaluation may limit the validity of self-report measures. Although anonymity of the web format may have reduced the likelihood of dishonesty, the limitation still exists (Van Selm & Jankowski, 2006). Future research should thus use additional measure of learning such as observations of student task performance.

As student use of e-textbooks increases, more relevant research is needed to verify their reliability as educational tools across the variety of electronic platforms available to students. As emerging platforms such as iBooks author enable e-textbooks to be similar in look and feel to traditional paper textbooks, research is needed on changing student perceptions on the efficacy of using robust digital media in e-textbooks over using a paper text. Research on the use of e-textbooks for collaborative learning through access to social networking and bookmarking sites is needed. Research is also needed on the consistency with which e-textbook publishers include robust digital features such as video, embedded research tools, note-taking tools, accessibility tools, and collaborative learning tools.

10. Conclusion

Students who used e-textbooks in the study had higher levels of affective and psychomotor learning – they learned actively and they liked it. No difference in cognitive learning or final grades suggests that e-textbooks may be a viable option for learning. This study is foundational to the emerging research on the use of e-textbooks for student learning at the university level. It adds to the existing knowledge base on learning using e-textbooks as the literature continues to be sparse. As publishers and universities continue to digitize course content and digital devises continue to improve, there will be more opportunities for researchers to examine the use digital resources and choices in textbooks best suited to students' affective, psychomotor, and cognitive learning needs.

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