



EMPIRICAL RESEARCH

Electronic Textbooks: Antecedents of Students' Adoption and Learning Outcomes

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ABSTRACT

Faculty and students are increasingly faced with the opportunity to use electronic versions of textbooks (e-texts). Despite the advantages of e-texts and recent advances in technology, evidence suggests that students are still reluctant to adopt and use e-texts. This situation leads us to investigate two research questions: What factors contribute to students' acceptance of e-texts? Are there differences between hardcopy texts and e-texts when it comes to course grade? We draw on a variety of perspectives (i.e., psychology, management information systems, economics, environmental studies) to build a framework that allows us to determine the motivations of students for adopting e-texts, and the learning outcomes of e-text adoption. Data was collected via a survey administered in the business school of a metropolitan university with approximately 20,000 students, located in the western United States. Results suggest that perceived ease-of-use and the price of e-texts relative to hardcopy texts are two key motivators in e-text adoption, while perceived usefulness, Internet self-efficacy and environmental concerns are not significant motivators. However, there was no significant difference in the grades of e-text adopters compared to hardcopy adopters. We conclude this paper by discussing the implications of our findings for educators.

Subject Areas: Technology and Innovation, Content Areas, Pedagogical Approaches, Operations Management, Content Areas, Administrative/Structure Leadership, Academic Areas.

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INTRODUCTION

Faculty and students are increasingly faced with the opportunity to use electronic versions of textbooks (e-texts)—some of which are utilized entirely online, as well as others which are downloadable and are read using computers or dedicated e-readers. E-texts have several potential advantages over their hardcopy competitors. As printing and shipping cost account for thirty-three cents of every dollar spent on (new) hardcopy texts, e-texts have the potential to lower costs to students (Alkadi, 2009). Indeed, publishers have reportedly been lowering prices for e-texts relative to new hardcopy texts (Johnston, 2011). Furthermore, the e-text format may allow updates that are more frequent than the standard three year revision cycle employed by most conventional textbook publishers. E-texts also afford authors and publishers more flexibility to embed content, such as maps, dictionaries, video and simulations directly into the text—features which potentially contribute to greater understanding and more engaged reading (Young, 2001, Unsworth, 2004; McFall, 2005; Aust, Kelley, & Robey, 1993). E-texts allow readers to easily search for key terms, and to cut key passages and paste them into other documents, such as study notes (Shepperd, Grace, & Koch, 2008). Lastly, e-texts can allow more modularity, potentially allowing instructors to pick and choose chapters or sections from a variety of texts to create a customized text, a function that is available with many conventional texts, but that is more readily achievable with e-texts (Blumenstyk, 2001).

Many universities also have an interest in reducing their environmental footprints (Perry, 2004; Weber, Bookhart, & Newman, 2009). The manufacture and distribution of conventional texts accounts for a substantial portion of universities' footprints (Jones, 2010; Ahmed, 2007), whereas e-texts eliminate emissions and other environmental effects associated with these activities. Depending on how hardcopy texts are used (and resold) and students' behaviors with respect to e-texts texts (e.g., how much students print from the e-text, or the type of device that they use for reading the e-text) e-texts can be an effective way for universities to reduce their greenhouse gas footprints (Gattiker, Lowe, & Terpend, 2012).

Based on the above observations, one might expect that e-texts would have already achieved wide-scale adoption. However, e-text adoption reportedly remains, low with the majority of students still expressing preferences for hardcopy texts (Nelson, 2008; Foasberg, 2011; Murray & Pérez, 2011; Johnston, 2011; Shepperd, Grace, & Koch, 2008). For example, a recent study of statistics students finds that even though students express a preference for online homework (as opposed to paper-based homework), they prefer hardcopy texts to e-texts, and do not believe that e-texts offer a good value (Cutshall, Bland, & Mollick, 2012). The relatively slow increase in e-text adoption makes this issue a worthwhile one for researchers to investigate. E-text adoption is likely a multifaceted problem involving decisions made by publishers, administrators, and faculty.

Student behaviors and preferences are a key part of the puzzle. Since faculty often make both the hardcopy text and the corresponding e-text available to students and allow the students to decide which one to purchase. Furthermore, in those cases in which the instructors (or administrators) mandate e-texts, outcomes (in terms of learning, morale, etc.) are likely to be unfavorable if students are not accepting of the technology, as suggested by organizations' experiences with other

non-volitional technologies (Rivard, 2012; Kim, 2009). Several studies (Vernon, 2006; Miller & Baker-Eveleth, 2010) document that the most common behavior of students who are forced to use an e-text is to simply print out the e-text onto paper. Robinson (2010) found that even when an e-text was made available free of charge (along with a low-priced hardcopy equivalent), only half of students chose to utilize the e-text. These issues and empirical evidence lead us to formulate our first research question: *What factors contribute to students' acceptance of e-texts?*

There are numerous perspectives from diverse disciplines on why individuals adopt (or do not adopt) different technologies when adoption is volitional. We draw on four of these perspectives. In particular, from the general psychology area, we investigate the role of students' self-efficacy (Bandura, 1977). From the information systems field, we consider students' perceptions of the usefulness and ease-of-use of e-texts (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989). From environmental studies and related disciplines we consider students' environmental values (Dunlap, Van Liere, & Mertig, 2000; Stern, Dietz, Kalof, & Guagano, 1999). Finally, taking an economics perspective, we consider the role of the price of e-texts versus available substitutes (Chevalier & Goolsbee, 2009).

As noted above, e-texts have some distinctive advantages over conventional hardcopy texts. They also have potential disadvantages. For example, when reading on the computer, students can be subject to email and other distractions as well as numerous technological problems including dead batteries and internet outages, which can hamper availability when students are ready to learn. This motivates the second research question: *Are there differences between hardcopy texts and e-texts when it comes to student outcomes?* In particular, we examine students' end-of-semester grades. In the business and education literature, there are surprisingly few studies that address this question. Therefore the comparisons we make are a major intended contribution of this paper.

In the next section we review the relevant literature and present our hypotheses. We then describe how the hypotheses were tested using data from a survey of undergraduate students. Finally we discuss the results, limitations, and future research.

LITERATURE REVIEW AND HYPOTHESES

The study of e-text adoption in the literature can be described as fragmented and generally atheoretical in nature. Existing studies about e-texts tend to have a narrow focus on specific issues, such as usefulness (e.g., Lam, Lam & Naught, 2009; Shepperd, Grace & Koch, 2008), patterns of utilization (e.g., Simon, 2002; Vernon, 2002), pricing (Koch, 2006), or learning outcomes (e.g., Shepperd, Grace & Koch, 2008; Siebenbruner, 2011). Although the results from these studies have been insightful, the studies tend to lack robust theoretical foundations. The proposed hypotheses are often rooted in intuition and common sense rather than in established theories. In this paper, we introduce a framework that centers around two key aspects of e-text adoption: 1) adoption patterns and 2) learning outcomes. The framework draws on a variety of perspectives (i.e., psychology, management information systems, environmental studies, and economics). The hypotheses that comprise the framework are developed in the subsequent sections.

Antecedents of E-Text Adoption

Self-efficacy can be defined as “people’s judgments of their capabilities to organize and execute courses of action required to attain designated types of performance” (Bandura, 1986, p. 391). Building on the work of Bandura (1977) and others, researchers have shown that self-efficacy is an important construct across a vast range of domains. Self-efficacy is predictive of the adoption of numerous technologies and behaviors, ranging from birth control usage to exercise (Buckley, 2011) to smoking cessation (Elfeddali, Bolman, Candel, Wiers, & De Vries, 2012). Closer to the present study, the role of self-efficacy has been examined in the areas of computerized technology and in education. Applying the self-efficacy concept to information systems, Compeau and Higgins (1995) define computer self-efficacy as “an individual’s perceptions of his or her ability to use computers in the accomplishment of a task” (p. 191). Several researchers (e.g., Torkzadeh, Chang, & Demirhan, 2006; Tsai & Lin, 2004; Wu & Tsai, 2006) have further refined the construct by measuring and evaluating Internet self-efficacy, which can be defined as “Web users’ self-perceived confidence and expectations of using the Internet” (Wu & Tsai, 2006). Computer self-efficacy has been shown to influence individuals’ willingness to undertake particular information technology (IT) tasks and their probability of success at IT tasks (Oliver & Shapiro, 1993; Torkzadeh, Chang, & Demirhan, 2006), including those related to the Internet, such as business-to-consumer electronic commerce (Pavlou & Fygenson, 2006). In the education field, students’ self-efficacy in general and Internet self-efficacy in particular are associated with numerous positive outcomes in academic learning processes (e.g., Manstead & van Eekelen, 1998; Lane, Lane, & Kyprianou, 2004; Wu & Tsai, 2006). Because e-text technology is relatively new, we anticipate that Internet self-efficacy will play an important role in the adoption of e-texts. For instance, students with higher Internet self-efficacy (e.g., Millennials) may be more inclined than others to embrace e-texts.

Since self-efficacy is positively associated with individuals’ choices to engage in activities, the effort that they expend, and their ultimate success, we propose that the greater an individual’s self-efficacy with respect to the Internet, the greater the likelihood that they will adopt an e-text. More formally:

H_{1a}: A student’s likelihood of adopting an e-text is positively associated with his or her Internet self-efficacy.

E-texts are a form of computerized technology. Within the field of business, there are a number of models that seek to explain an individual’s adoption of such technologies. None of these is more utilized than the technology acceptance model—or TAM (Davis, 1989; Venkatesh & Davis, 2000). Although TAM was originally focused on the workplace (i.e., enhancing one’s *job* performance), the model has been validated on a wide range of IT adoption decisions, ranging from mobile consumer banking (Teo, Tan, Cheah, Ooi, & Yew, 2012) to individual participation in online communities (Wang, Chung, Park, McLaughlin, & Fulk, 2012). In TAM, two key predictors of adoption (through their effect on intentions to adopt) are perceived usefulness and perceived ease-of-use.

Perceived usefulness is “the degree to which a person believes that using a particular system would enhance his or her job performance” (Davis, 1989,

p. 320). It is a feature of many other technology adoption models in addition to TAM. Indeed, perceived usefulness or similar constructs appear in most other major models of technology adoption—e.g., job fit (Thompson & Higgins, 1991), relative advantage (Moore & Benbasat, 1991), and outcome expectations (Compeau & Higgins, 1995). For e-texts, usefulness may manifest in several ways. First, e-texts may enhance students' learning with features that are not available in traditional textbooks. For instance, e-texts feature built-in search capabilities, indexing capabilities, note-taking capabilities and URL links to external content on the Internet (i.e., dictionary or multimedia content) (Shepperd, Grace, & Koch, 2008). These features are appreciated by many students (Simon, 2002; Lam, Lam, & Naught, 2009; Internet2, 2012). E-text portability also makes reading more efficient by optimizing students' reading time when traveling or otherwise frequently changing locations (Lam, Lam, & McNaught, 2009). Conversely, students might perceive the technological aspect of e-texts to be cumbersome and may thus be reluctant to adopt e-texts. Technology issues may include Internet connectivity problems, computer breakdown, software bugs, and setup issues (Shepperd, Grace, & Koch, 2008; Lam, Lam, & McNaught, 2009). Lack of familiarity with e-text features may also create a hurdle, especially for students who are new to the technology (Simon, 2002). These issues may negatively affect students' performance in class when compared to those who use traditional textbooks. In summary, we predict that perceived usefulness has an effect on e-text adoption:

H_{1b}: A student's likelihood of adopting an e-text is positively associated with the degree to which he or she perceives that e-texts are useful.

Perceived ease-of-use is "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320). Indeed, some of the more widely publicized features of e-texts include portability, availability, and functionality, (Roscoria, 2013; EDUCAUSE, 2013) all of which are purported to make using e-texts a pain-free experience. Another criterion likely affecting students' perception is the ease/difficulty of reading on a computer screen rather than on paper. For instance, a small screen size may negatively impact ease of reading. Many students report that long sessions on a computer screen contribute to eye strain and fatigue (Lam, Lam, & McNaught, 2009; Wilson, 2003; Internet2, 2012). Students may circumvent this hurdle by printing parts of the assigned reading material (Vernon, 2006). Gattiker et al. (2012) found that 21.5% of students printed part of the assigned material, and those students printed an average of 55% of the content. Another barrier resides in the learning curve associated with mastering a new technology (Vernon, 2006). According to Simon (2002), 18% of students described setup and use of e-texts as somewhat or very difficult. The perceived difficulty in using e-texts may be lower for younger students (i.e., Millennials) than older generations of students, but based on empirical evidence, we propose:

H_{1c}: A student's likelihood of adopting an e-text is positively associated with the degree to which he or she perceives that e-texts are easy to use.

E-texts have been identified as a way for individuals to potentially reduce their environmental footprint (Hannon, 2008; Gattiker, Lowe, & Terpend, 2012).

This notion has surfaced not only in the academic and public policy literature but in the popular press, thus potentially sensitizing students and other consumers to the idea that online reading might be an environmentally responsible behavior (Hutsko, 2009; Koerner, 2008). We might therefore expect students who are concerned about the natural environment to be relatively likely to adopt e-texts.

Environmental concern is an antecedent of a large range of green behaviors. Environmental beliefs and attitudes correlate with the perceived seriousness of environmental problems, and with support for pro-environmental policies (Dunlap, Van Liere, & Mertig, 2000) such as support for corporate environmental accountability (Shafer, 2006), environmental regulations (Attari, 2009), household energy conservation (Brandon & Lewis, 1999), and water conservation (Corral-Verdugo, Bechtel, & Fraijo-Sing, 2003; Corral-Verdugo, Carrus, Bonnes, Moser, & Sinha, 2008). Focusing more narrowly on individuals' *purchase* decisions, the preponderance of studies in marketing and consumer behavior shows that environmental concern is associated with actual buying behavior; however these associations are somewhat weak (Shrum, 1994; Schwepker & Cornwell, 1991; Granzin & Olsen, 1991).

Based on this reasoning and empirical evidence, we hypothesize:

H_{1d}: A student's likelihood of adopting an e-text is positively associated with his or her level of environmental concern.

College students typically face constrained budgets which impact their educational expenditures. Nearly 60% of college students choose to forego at least one of their required textbooks in any given academic term (Kinzie, 2006). Publishers typically control e-text prices since e-texts are usually purchased directly from the publisher. Hardcopy text prices (both new and used) vary based on the retail channel (with campus bookstores commanding a premium over off-campus sellers and Internet sellers), edition life, and other factors. E-texts are typically priced at a discount to new hardcopy texts, but the magnitude of the price spread as well as the premium or discount relative to used texts depends on the prevailing prices of the hardcopy texts. Since many college students have constrained budgets, it is likely that the price of e-texts relative to hardcopy text prices will affect which option the students select. This relationship has received some empirical support (Robinson, 2011; Siebenbruner, 2011). For example, students on financial aid are more likely to adopt e-texts (when they are priced less than hardcopy texts) than other students (Miller, Nutting, & Baker-Eveleth, 2012).

H₂: As the price of an e-text decreases relative to the price of conventional texts, a student's likelihood of purchasing an e-text increases.

Student Outcomes

As discussed previously, e-texts have a number of advantages compared to hardcopy texts but also have disadvantages. Technical glitches can prevent access, especially when e-texts are only accessible via the Web (as opposed to being downloaded onto a computer or dedicated reader) (Shepperd, Grace, & Koch, 2008; Lam, Lam, & McNaught, 2009). E-texts that are downloaded onto dedicated e-readers may lack integration with Internet resources (resources that would

be available in an online e-text). Many students find e-texts difficult to access and navigate. Moreover, working on an Internet-enabled device is always fraught with potential distractions, such as checking email and visiting non-task-related websites.

Given the many potential advantages and disadvantages between hardcopy texts and e-texts, it is likely that there may be differences in the tangible outcomes that students experience. However, there is startlingly little published data on the effect of e-texts on student outcomes, such as time spent reading and performance on exams; and the limited empirical results are equivocal. Shepperd et al. (2008) found a small but statistically significant difference in the amount of time undergraduate e-text and hardcopy text adopters spent studying (2.0 vs. 2.3 hours per week respectively). Simon (2002) found no difference between e-text and hardcopy formats relative to time spent reading among undergraduates. Siebenbruner (2011) found no difference in overall course preparation time, but she found that hardcopy readers tend to read a higher percentage of the assigned readings than e-text readers. Neither Shepperd et al. (2008) nor Siebenbruner (2011) found significant differences in course grades. A study of undergraduates learning a foreign language found that students reading a foreign language e-book with hypertext references to unfamiliar words were twice as likely to look up the definitions of words as students with a non-hyperlinked book and a conventional dictionary. However, there were no differences in comprehension (Aust, Kelly, & Roby, 1993).

Although the difference between hardcopy textbooks and e-texts has proven elusive with regards to student performance, we anticipate that differences in terms of features and attributes will translate into performance differences for students. The small number of existing studies on this topic makes it especially important to investigate. We propose that the choice of a textbook (hardcopy vs. e-text) may have a direct effect on the overall course grade.

H₃: E-text adoption has a significant effect on the final course grade received by students.

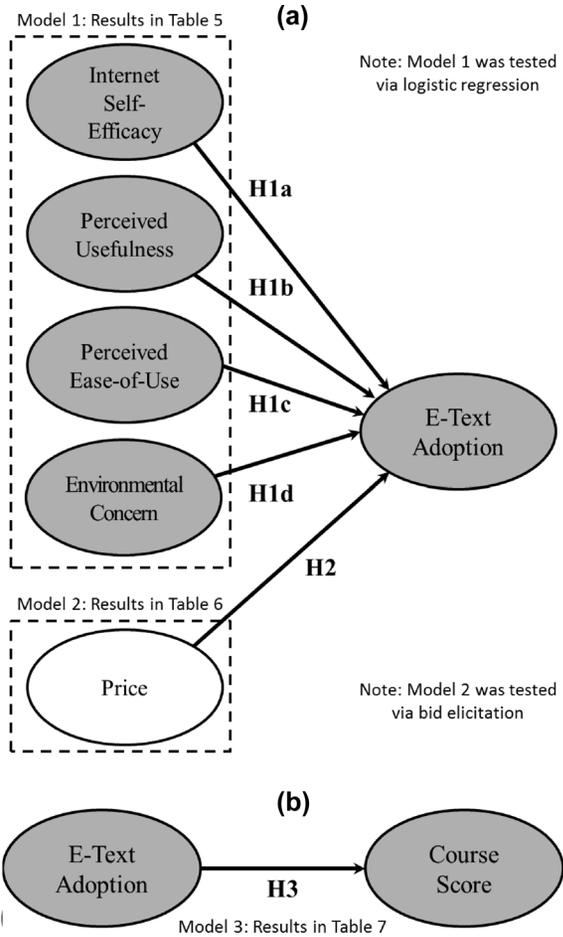
METHODOLOGY

Figures 1(a) and 1(b) summarize the research hypotheses. We were not able to test all of the research hypotheses in a single model for two reasons. First, Structural Equation Modeling (SEM) methodology has limitations with regards to dichotomous variables due to violations of the normality assumption (Hipp & Bollen, 2003; Bentler 2006; Kupek, 2006). Second, we relied on hypothetical purchase intentions to test hypothesis H2 (quasi-experimental design), while other hypotheses were tested using actual purchase decisions. Consequently, testing all hypotheses required three separate models and two different statistical methods: logistic regression, and simple regression. The following sections describe the methodology used.

Survey Development

Multi-item scales were used to measure the latent variables associated with hypotheses H1 and H3. After surveying the extant research, it was determined that existing scales were designed for domains that are quite dissimilar to the domain

Figure 1: (a) Conceptual Framework – Antecedents of E-Text Adoption. (b) Conceptual Framework – Effect on Students' Grades.



of interest in the present study. For example, Torkzadeh et al's (2006) Internet self-efficacy scales reflect skills (e.g., encrypting email messages, creating a home page, editing a scanned picture) that are not relevant to learning from an online e-text. The perceived usefulness scales in Davis (1989) and Davis et al. (1989) were written from the perspective of an employee considering the effect of a system on job performance. Previous scales were thus adapted to reflect the context of this specific study.

Evaluating the influence of price on textbook adoption (hypothesis H2) presented a challenge. Our theoretical model suggests that e-text adoption is partially a function of the price differential between the e-text and the hardcopy text. From an empirical testing perspective this presents a problem. The price of the e-text is fixed by the publisher. However, students face a spectrum of prices for the hardcopy text because of the variety of book sellers (on-campus, off-campus, internet, student to student transaction) and variety of conditions (new, like new, heavily used, old

edition, etc). Using a survey, it is difficult to establish the price differential that the student actually faced when making his or her text purchase decision (i.e., a single value for price differential that can be used in a logistic regression equation). Moreover, it is likely that the range of price differentials (i.e., hardcopy vs. e-text differentials) encountered by students in the marketplace was relatively narrow. This makes it challenging to evaluate the effects of price differentials that are not usually encountered in the marketplace (e.g., when the hardcopy is very expensive compared to the e-text, or when the hardcopy is priced less than the e-text). Fortunately (or unfortunately) it is not unusual for researchers who are interested in understanding price elasticity to face issues of this type. We therefore used a contingent valuation method to elicit the students' willingness to pay, an approach that is common in economics research (Mitchell & Carson, 1989; Dickie, Fisher, & Gerking, 1987; Diamond & Hausman, 1994). Doing so allows us to evaluate the demand function for textbooks based on the price of e-texts relative to the hardcopy texts.

Bid elicitation questions were incorporated into two of the surveys (Appendix A). Specifically, students who adopted the hardcopy text were presented with a series of questions in which they were informed of the price of the e-text for their class, and were given a hypothetical "best price" that they could find a hardcopy textbook for. The hypothetical hardcopy textbook prices ranged from 115% to 350% of the price of the e-text. The students were then asked if they would purchase the hardcopy textbook instead of the e-text given the stated hypothetical price of the hardcopy textbook. On the various survey instruments that were distributed, fifteen different hardcopy prices, ranging from 115% to 350% of the price of the e-text, were presented (each student was presented with a sequentially increasing series of the price comparison questions across two surveys, until they indicated that they would switch to the e-text).

Data Collection

Data was collected using a series of surveys administered at multiple times during a single semester (Spring semester of 2009). The survey was administered in the business school of a metropolitan university with approximately 20,000 students located in the western United States. Data was collected from students in six undergraduate class sections—four sections of an introductory course in supply chain management and two sections of intermediate microeconomics. All six sections had a required text. However students had the option (as described in their course syllabi and in various announcements) of purchasing either the conventional hardcopy version of the text or a subscription to the e-text. The e-texts essentially consisted of online reproductions of the pages of the hardcopy texts (The e-texts did not include "enhancements," such as hyperlinks to additional content or embedded video). The same texts were required in both sections of the economics course and in all four sections of the supply chain management course. The mean purchase price for the hardcopy supply chain management and economics textbooks were \$89 and \$96 respectively (Table 1). A subscription to the e-text for the supply chain management classes was \$57, and a subscription to the e-text for the economics classes was \$70. These subscriptions lasted for 6 months, after which the license and associated access key expired.

Table 1: Textbook price comparison.

	New Hardcopy at BSU Bookstore	Used at Bookstore	Used Online	E-text	Mean Price Reported
Economics	\$178	\$135	~\$90	\$70	\$96
Operations	\$140	\$104	~\$72	\$57	\$89

Two sections of the supply chain course were taught online. Since reading may be a larger component of total learning in an online course compared to a traditional lecture and discussion course, incorporating online courses into the study increases generalizability. Surveys for the online sections were administered via a Web-based tool (Qualtrics), whereas the conventional face-to-face class sections received pencil and paper surveys. Survey participation was voluntary and confidential. Students were offered a small amount of extra credit for participating. 220 students (all the students in each section) were invited to participate. Surveys were administered five times during the semester at two to three week intervals. The reasons for this multi-stage data collection were two-fold. First, students are more likely to provide an accurate account of their text utilization when asked at different times (e.g., it is easier to remember and quantify how much of reading was performed during the last three weeks than during an entire semester). Second, the bid elicitation method necessitates multiple rounds of solicitations in order to fine-tune the price elasticity estimates. Each survey had an identifier so that all five surveys from each respondent could be linked together to create one record for each respondent.

A total of 198 records were collected. After eliminating 18 partial records, the final data set represented 180 students, a response rate of 82%. Of the 180 respondents, 21% (38 students) reported that they only had access to the e-text while 56% (107 students) reported using a hardcopy textbook only. Of the remaining students, 16% (29 students) had both a hardcopy and an e-text copy (16%), and 3% (6 students) chose not to purchase either version of the textbook. The analysis focused on the 145 students who purchased either a hardcopy text or an e-text but not students who reported having both versions. This avoids possible confounding results and makes it possible to run analysis on mutually exclusive groups. Moreover, we did not collect information about how students who have both options utilized those options (i.e., did they use both? or only hardcopy text?). Of the 107 students who used a hardcopy text, 83% purchased it while the remaining 17% reported borrowing it from a friend (Table 2). Of those who purchased it, 29% bought a new copy and 71% a used copy. A majority of the books (new or used) were purchased from online sellers (46%). The campus bookstore accounted for 43% of purchases, and the remaining 11% were purchased from other local bookstores.

Survey Validation

Exploratory factor analysis (EFA) was used for data reduction and to verify the construct validity of the scales. Factor rotation was applied in order to improve

Table 2: Source of the Hardcopy Texts.

17%	Borrowed from friend				
100%		New or Used?	New Used	29% 71%	100%
83%	Purchased	Origin?	Campus bookstore Other local bookstore Internet purchase	43% 11% 46%	100%

Table 3: Exploratory Factor Analysis Results.

Factors		F1	F4	F3	F2
Internet self-efficacy	ISE06	.874	.026	-.061	-.011
	ISE07	.871	.163	.060	-.015
	ISE03	.869	-.090	-.075	.014
	ISE05	.851	-.087	-.074	-.001
	ISE02	.808	.058	.011	-.051
	ISE01	.801	-.052	-.034	.036
	ISE04	.781	-.152	.076	.160
	ISE08	.759	.396	-.012	.052
	ISE09	.757	.381	.012	-.015
	ISE11	.753	.183	.082	.029
	ISE10	.664	.326	.148	.074
Perceived usefulness	PU3	.083	.785	-.264	.145
	PU2	.126	.782	-.244	.003
Perceived ease-of-use	PEU2	.038	-.252	.848	-.002
	PEU3	.021	-.026	.846	.024
	PEU1	-.005	-.185	.818	.052
Environmental concern	ENV7	-.029	.014	.045	.844
	ENV8	-.004	-.080	.008	.820
	ENV6	.037	.123	.022	.804
	ENV5	-.010	-.027	-.021	.762
	ENV1	.124	.135	.028	.712

the readability and interpretation of the factors. The nature of the constructs and past empirical results in the literature suggest that the factors of interest are not orthogonal and thus may exhibit some level of correlation with one another. Thus, it is theoretically appropriate to apply an oblique rotation. A Promax oblique rotation was selected in SPSS.

The EFAs resulted in statistically significant factor loadings (Table 3). Four survey items were discarded either because of a low factor loading, low communality or significant cross loading across factors. Reliability was assessed by calculating the standardized Cronbach coefficient alpha (Cronbach, 1951) for each construct. Values of alpha ranged from .749 to .941, denoting a satisfactory level of reliability. A reliability of 0.7 is typically recommended (Hair et al., 2006; DeVellis, 2003; Nunnally, 1978). The final scales and reliability results are shown

Table 4: Correlations and Descriptive Statistics for Independent Variables*.

		Mean	S.D.	1	2	3	4
1.	Internet self-efficacy	4.61	.557	1.00			
2.	Perceived usefulness	3.46	.797	.237	1.00		
3.	Perceived ease of use	2.63	.951	.018	.401	1.00	
4.	Environmental concern	4.11	.683	.054	.108	-.056	1.00

*Bolded correlations are significant at the .01 level

in Appendix 1. Convergent validity was assessed by computing the Average Variance Extracted (AVE). For all scales, an AVE of >50% provided support for the existence of convergent validity (Fornell & Larcker, 1981). Discriminant validity was assessed using the paired variance extracted method proposed by Fornell and Larcker (1981). Discriminant validity is assumed to exist if the square-root of the AVE of a given construct exceeds the absolute value of the correlation of the given construct and all the other constructs. This criterion was met for all constructs providing evidence of discriminant validity.

Based on the reduced set of variables extracted from the EFA, we created surrogate variables by averaging the variables in each scale. Descriptive statistics and correlations of surrogate variables are provided in Table 3. The average scores served as surrogate variables in the logistic regression and simple regression analyses (Hair et al., 2006).

RESULTS

Influence of perceived ease-of-use, perceived usefulness, environmental belief and Internet self-efficacy on e-text adoption

A binary logistic regression (Model 1) was used to determine whether the adoption of an e-text is significantly influenced by its perceived usefulness (PU) and perceived ease-of-use (PEU), and the environmental beliefs (EB), and Internet self-efficacy (ISE) of students (hypotheses H_{1a}-H_{1d}). The dependent variable is the logarithm of the probability of adopting divided by the probability of not-adopting an e-text. This function is used to assess the parameters of the regression for the four independent variables (Table 5). Since data collection encompassed sections taught by three different instructors, dummy variables were included for each instructor to control for the possibility that the instructor influenced the students' adoption decisions (Miller, Nutting, & Baker Eveleth, 2012). Two variables were also added to control for the possible influence of age and gender of the students. The analysis was run with SPSS 19.

The logistic regression results appear in Table 5. They indicate that the perceived ease of use of e-texts is significantly associated with e-text adoption ($p < .05$), thus supporting H_{1c}. However, hypotheses H_{1a}, H_{1b} and H_{1d} are not supported. It is also interesting to note that gender, although not significant at $p < .05$ was significant at $p < .1$ level ($p = .069$), which seems to indicate female students are less likely to adopt e-text than their male classmates.

Table 5: Model 1 – Logistic Regression Results for Antecedents of E-text Adoption.

Variables	β_i	Standard Error	Wald	Significance
Constant	-5.152	3.780	1.858	.173
Internet Self-Efficacy (ISE)	-.400	.588	.464	.496
Perceived Usefulness (PU)	.206	.527	.153	.696
Perceived Ease-of Use (PEU)	1.188	.460	6.668	.010
Environmental Behavior (EB)	-.012	.539	.000	.982
Instructor1	2.117	.902	5.512	.019
Instructor2	.746	.766	.950	.330
Student's Age	.013	.038	.111	.739
Student's Gender	-1.258	.691	3.314	.069

Model 1:

$$Logit(Y_i) = \beta_1 + \beta_2(ISE) + \beta_3(ENV) + \beta_4(PEU) + \beta_5(PU) + \beta_6INSTR1 + \beta_7INSTR2 + \beta_8AGE + \beta_9GEND + \varepsilon_i$$

Table 6: Model 2 – Results of Regression – Influence of e-text price on e-text adoption.

Variables	β_i	Std. Error	t	Sig.	R ²	F	Sig.
Linear Model					.773	44.225	.000
Intercept	1.116	.108	10.352	.000			
Ratio of hardcopy price to e-text price	-.357	.054	-6.645	.000			
Power Fit Model					.971	443.42	.000
Intercept	.224	.066	3.383	.005			
Ratio of hardcopy price to e-text price	-2.042	.098	-20.819	.000			

Linear Model: $y = a + bx + \varepsilon$ with a = intercept, b = slope

Final function: $y = 1.116 - .357x$

Power Fit Model: *Linearized function* : $Ln(Y) = Ln(a) + bLn(x) + \varepsilon$ with a = intercept, b = slope

Power function: $y = ax^b$

Final function: $y = 1.251 x^{-2.042}$

Influence of Price on E-text adoption

At each of the hypothetical price levels presented in the bid elicitation survey, we counted the number of students who indicated that they would select the e-text (as opposed to the hardcopy text). To analyze the data, the hardcopy text prices were converted from dollars into percentages of the e-text price, and the number of students who chose the e-text at each particular hypothetical price was converted into a percentage of students. H₂ was tested by regressing the second variable (% adopters) on the first variable (relative price ratio) (Table 6, Model 2). Price is highly significant ($p < 0.001$) thus providing evidence in support of H₂.

Table 7: Model 3 – Regression Analysis for Outcomes of E-text Adoption.

Dependent Variable	Predictors	β_i	Standard Error	t	Sig.	R ²	Sig.
Final grade						.074	.113
	Constant	75.231	6.121	12.291	.000		
	E-text adoption	-5.011	3.684	-1.360	.178		
	Instructor1	6.138	4.208	1.459	.149		
	Instructor2	6.749	3.979	1.696	.094		
	Age	.034	.196	.174	.862		
	Gender	-5.625	2.951	-1.906	.060		

Effects of E-text Adoption on Student Performance

Hypothesis H₃ on the effect of e-text adoption on the final course grade, was tested via regression analysis (Model 3). Dummy variables were added to control for a possible instructor-level effect as well as for the age and gender of the respondents (Table 7). Hardcopy adopters received a higher final course grade (78.5%) on average than e-text adopters (73.7%). However this difference is not statistically significant, thus H₃ is rejected. Analysis of the control variables reveals that gender seems to have a significant impact ($p < .05$) on the final course grade, highlighting a lower grade performance by female students. The difference between male and female students was 6.7 points on a 100-point scale.

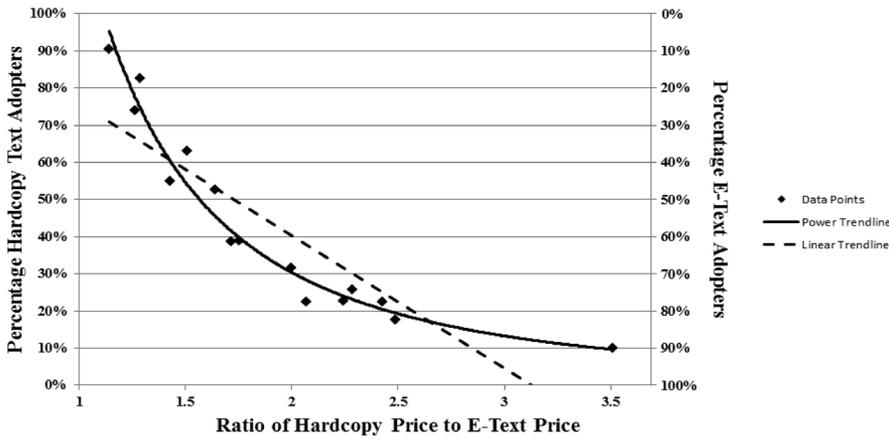
DISCUSSION AND CONTRIBUTIONS

In this paper, we developed and tested a framework that allows us to shed light on the factors that motivate students to adopt e-texts as opposed to hardcopy texts. According to the results, there are two main drivers of e-text adoption: 1) the perceived ease-of-use of e-texts and 2) the prices of e-texts relative to hardcopy textbooks.

Students are more likely to purchase an e-text if they are comfortable reading on a screen and if they perceive that both buying and using an e-text are easy. The prominence of the ease-of-use construct is consistent with an earlier study (of Statistics students) which found that students' preferences for an e-text were linked to their perceptions that the e-text was easy to use (e.g., easy to navigate, easy to find information) and was not linked to student perceptions regarding information quality, usefulness or helpfulness (Cutshall, Bland, & Mollick, 2012). Similarly, a British study examining a library of freely available e-texts found that convenience was the most important reason for usage (Nicholas, Rowlands, & Jamali, 2010).

It is interesting that the ease-of-use, but not self-efficacy (ISE), is significant. The two constructs are similar, indeed, they are somewhat correlated in our results ($r = 0.24$). However, our results suggest that the paramount question going through a student's mind when contemplating the purchase decision is not "would I be good at using this," but rather "would using this be easy for me." On the other hand, we do note the high mean for ISE (4.6 on a 5-point scale) and low standard deviation, so we cannot rule out the possibility that the non-significant results for ISE are

Figure 2: E-Text Adoption as a Function of Hardcopy Text prices.



due to range restriction (lack of variance on a criterion variable (Nunally, 1978)). Additionally, it is possible that ISE would loom larger for other populations of learners, perhaps older students or students in societies where the Internet is not ubiquitous.

Perceived usefulness is not a significant factor in e-text adoption. This finding is somewhat surprising since perceived usefulness has consistently been shown to be an antecedent of a large variety of information system applications (see Venkatesh, Moris, Davis & Davis, 2003 for a review). We do note that perceived usefulness is somewhat correlated to two other variables in the logistic regression model (Internet self-efficacy and ease-of-use) so the effect of perceived usefulness could be masked by multi-collinearity. That possibility notwithstanding, our results paint a picture of adopters who are driven more by price and convenience than by effectiveness.

Because e-texts have been presented as being environmentally preferable to hardcopy texts in the academic literature and in the popular press, we hypothesized that e-text adoption might be driven in part by students' environmental concerns. However, the data failed to show that students with greater environmental concern are any more likely to purchase e-texts. While somewhat surprising, this result is not inconsistent with a large body of existing research showing that the association between individuals' environmental concern and their actual purchases of environmentally preferable products is weak or non-existent (e.g., Shrum, Lowrey, & McCarty, 1994; Alwitt, & Pitts, 1996; Ohtomo, & Hirose, 2007; Kilbourne, & Pickett, 2008).

Price

The other major predictor of e-text adoption is price (the relative price of e-texts and hardcopy). Figure 2 shows the relationship between the ratio of hardcopy text price to e-text price and the percentage of students who stated that they would

adopt the hardcopy text (or not adopt the e-text) at each price. The linear regression explains 77.28% of the variance in e-text adoption. According to Figure 2, e-text adoption appears to be a linear function of price for a price ratio ranging from 1 to 2. However, this relationship does not seem to extend beyond a price ratio of around 2. To take into account the overall pattern, we conducted another regression analysis (Model 2) with a power fitted curve. Results confirm that the power fitted regression captures more of the variance ($r^2 = 97.1\%$) than the linear regression model. The shape of the power-fitted curve highlights the diminishing rate of e-text adoption at high hardcopy text prices. This pattern suggests that a sizeable segment of the student population favors hardcopy texts over e-text regardless of the price differential. For instance, 10 percent of individuals will still adopt the hardcopy text even if it is priced at 3.5 times the e-text. Economists refer to observations of this type as *protest bidders* (Halstead, Luloff, & Stevens, 1992). Protest bidding refers to deviation from stated willingness to pay the "true" value of an item (Halstead, Luloff, & Stevens, 1992, p.160). In other words, these students would always adopt the hardcopy text, regardless of the ratio of hard copy price to e-text price. This effect has been corroborated by a study by Robinson (2011). Robinson's study found that a majority of students report that price heavily influences their (hypothetical) decision to purchase an e-text, but a large portion also reports that price has no influence, with relatively few students in-between.

Using the equation from the power fitted regression ($y = 1.251 x^{-2.042}$), we can estimate the price ratio at which 100% of students would adopt a hardcopy text (at $y = 1$) to be 111.59% of the e-text price. In other words, for an e-text priced at \$100 and a hardcopy text priced at \$111.59 (or less), no student would elect to purchase an e-text. This ratio indicates the price premium students are willing to pay to acquire a hardcopy text. The result shows that for equally priced hardcopy and e-texts, students will select a hardcopy, thus confirming that the perceived value of an e-text is not as high as that of a hardcopy. One explanation for the price premium that students are willing to pay for a hard-copy text may be the potential resale value of a hardcopy. Indeed, students can expect to resell their used texts at the end of the semester for an amount that would probably exceed the 12% premium we found in this study. Certainly there are other students who value being able to keep the text as a reference beyond the current semester and others who simply find that reading (and annotating) a hard copy is preferable. Our results cannot separate out these effects but do give a sense of the value students assign to these types of advantages.

The finding that price is an important driver of e-text adoption is supported by other data collected in the survey. Approximately 45% of the survey respondents indicated that the price of the hardcopy textbook influenced their decision whether or not to purchase the e-text. However, the data revealed a sharp contrast between hardcopy and e-text adopters since 33% of the hardcopy textbook adopters indicated that price was an influential factor compared to 72% of e-text adopters.

Performance

The study provides information about the educational value of e-texts. Data suggest that final course grades of e-text adopters are not significantly different from those

of hardcopy adopters. The textbook is arguably a greater component of student learning in an online course than in a traditional course (where there is a greater lecture/discussion component and students can have a relatively easy, rich, two-way communication with the professor and with peers). However, even in the online course sections in this study, text format was not related to course grade.

It is also possible that e-texts with more enhanced features would do more to advance student learning (as compared to the e-texts in our classes which lacked enhancements). However, the results are not substantively different from those of a study (McFall, 2005) of a feature-rich e-text, which found no relationship between time spent using the e-text and course performance (this study did not compare the e-text with a hardcopy text).

Implications

Our results imply a number of recommendations for faculty and administrators. Faculty and administrators may want to make e-texts mandatory or strongly encourage e-text adoption for a number of reasons including enhanced features, such as embedded video, faster update cycles, modularity and superior environmental footprint. The results demonstrate that ease-of-use is a key lever driving/inhibiting e-text adoption, thus faculty and administrators who wish to motivate students to purchase e-texts (or overcome resistance to e-texts) should discuss ease-of-use of in their messaging to students. This finding also indicates that a key success factor is decided long before the instructor selects the type of textbook, at the e-text design stage. Manufacturers of portable technologies used for reading e-texts should eliminate the perceived discomfort of reading on an e-text. In particular, they should focus on making reading on a screen as comfortable as reading on paper, and work on making the transition from hardcopy text to e-text as smooth as possible. For instance, this could be done by integrating key features in an intuitive interface.

However, the results also suggest that widespread acceptance of e-texts is an uphill battle when e-texts are not priced at a significant discount to hardcopy texts. Publishers appear to have made some progress on this. Nevertheless, when it comes to pricing, faculty and administrators may need to use their influence with publishers and local bookstores (who sometimes sell stand-alone rights to e-text access and control the mark-up for this product). Additionally, faculty need to be aware that a segment of the population appears to prefer hardcopy texts at any price. In classes or programs in which e-texts are mandatory, effective strategies for dealing with these students need to be crafted (i.e., assessing the reasons for the resistance to e-texts and devising workarounds when the reasons are deemed legitimate).

E-texts and other computer-enabled components of learning are the subject of widespread attention (e.g., from educators, students, the media and legislators). Our study adds to the small but important body of findings that demonstrate that e-texts and hardcopy texts do not differ significantly on learning related outcomes (e.g., end of course grade). This suggests that, if differences are to be found, a more fine-grained approach will be required. In other words, researchers and

text designers need to shift the focus from whether e-texts create performance differences to what features of e-texts, if any, create differences.

LIMITATIONS AND FUTURE RESEARCH

Overall, the findings paint a picture of an e-text adopter who is highly price-sensitive (thus motivated by e-text price relative to hardcopy price) and motivated by convenience (i.e., ease-of-use). In contrast, potential antecedents of adoption that are (arguably) nobler and more future-directed (environmental concern and usefulness of the e-text) do not appear to affect text purchase decisions. We should point out that the data were collected in an urban university during economically trying times. The adoption drivers that were identified (although perhaps a bit disheartening) are thus not surprising. A corollary is that the results may not generalize to more affluent populations or more affluent times. Collecting data from other populations would be a worthwhile avenue for future research.

It is also important to note that the effective price of a hardcopy text is the retail price minus the resale price at the end of the semester. However, determining resale price *a priori* is a risky proposition—i.e., if the textbook manufacturer has released a new version, or if the instructor opts for a different textbook for the next semester, the resale value may decline or disappear altogether. Furthermore, the student may plan to keep the hardcopy text rather than reselling it. Due to the difficulty in determining retail price minus resale value *a priori* (at the beginning-of-semester when the retail purchase is made or contemplated) hypothesis H₂ focused on retail price only. Further research could examine whether and how students incorporate their estimated of hardcopy resale value when making e-text vs. hardcopy text decisions.

The study also established the key role of perceived ease-of-use in promoting e-text adoption. Future research should seek to identify the key antecedents of perceived ease-of-use from both software and hardware standpoints to provide directions for future generations of e-texts. Another limitation was that our research design was quasi-experimental—i.e., students selected the text format themselves, rather than being randomly assigned to either the hardcopy text or e-text. Future research could randomly assign subjects to formats.

Finally, it was not possible to identify a difference between e-text and hardcopy text adoption in the final course grade. There is a difference between having non-significant results and having unimportant results. The results show that the relationship between e-text adoption and course grade is not significant. Given the current debate about how e-texts affect academic performance, we believe that this is an important result. Future studies might want to focus on determining whether there are other contexts or other types of content for which there are substantive differences in learning outcomes between e-texts and conventional texts. It is also worth pointing out that we focused on one learning outcome (course grade). Future researchers could examine other outcomes such as time spent studying and long term retention.

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APPENDIX A

Internet Self-Efficacy ($\alpha = .941$)		1 Strongly Disagree to 5 Strongly Agree
ISE01	I am confident using the internet	
ISE02	If I encounter problems using the web (internet), I can handle them	
ISE03	I am comfortable using a web browser	
ISE04	I am confident in my ability to print from a computer	
ISE05	I know how to locate resources I need on line	
ISE06	I can get things done using the web	
ISE07	I can use the internet effectively even if there is no one around to show me what to do	
ISE08	I am confident in my ability to use an online text	
ISE09	I can use an online text even if there is no one to call for help	
ISE10	I am comfortable printing materials that are online	
ISE11	If I encounter problems printing from the web (internet), I can solve them myself	
Perceived usefulness ($\alpha = .749$)		1 Strongly Disagree to 5 Strongly Agree
PU1	I know a lot of other people who have successfully used online textbooks for other classes*	
PU2	The online textbook seems useful	
PU3	I believe the online textbook will help me succeed	

Perceived ease-of-use ($\alpha = .820$)		1 Strongly Disagree to 5 Strongly Agree
PEU1	Buying the online textbook seems like more of a hassle than buying the conventional paper Text (R)	
PEU2	Using the online textbook seems like more of a hassle than using the conventional paper text (R)	
PEU3	I prefer to read on paper, rather than on the screen (R)	
Environmental beliefs ($\alpha = .839$)		1 Strongly Disagree to 5 Strongly Agree
ENV1	Our present way of life is too wasteful of resources	
ENV2	Better science and technology are all that is needed to solve our environmental problems (R)*	
ENV3	The threat of environmental problems has been greatly exaggerated(R)*	
ENV4	Environmental problems must not stand in the way of economic growth(R)*	
ENV5	I am concerned about the environment	
ENV6	It is important to conserve our resources	
ENV7	As a society we need to do more to protect the environment	
ENV8	It is likely that there will be an environmental catastrophe if we do not take better care of the environment	
Price elicitation (sample questions)		Yes/No
The electronic textbook costs \$70. Assume that the best price you can find for the hard copy textbook is \$90. Would you still purchase the hard copy textbook instead of the online textbook?		
The electronic textbook costs \$70. Assume that the best price you can find for the hard copy textbook is \$115. Would you still purchase the hard copy textbook instead of the online textbook?		
The electronic textbook costs \$70. Assume that the best price you can find for the hard copy textbook is \$145. Would you still purchase the hard copy textbook instead of the online textbook?		
The electronic textbook costs \$70. Assume that the best price you can find for the hard copy textbook is \$170. Would you still purchase the hard copy textbook instead of the online textbook?		

* signifies an item dropped during the scale purification process
(R) signifies an item was reverse coded