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

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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.

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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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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