To E or not to E…

A literature review comparing electronic and traditional print books in higher education

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Introduction

In 2015, the History Department at the United States Military Academy at West Point proudly released a digital course textbook simply titled *The West Point History of Warfare.* Developed and produced in collaboration with Rowan Technology Solutions, this "70-chapter digital interactive textbook [spans] centuries of warfare from ancient Greece to today" (Rowan Technology Solutions Press Announcement, 2016). The textbook creators claim it "has revolutionized the way military history is taught to cadets at West Point and students across the country" (Rowan, 2016). In many respects, this modern, digital history book does what a conventional print history book cannot. Namely, it has numerous multimedia elements for engaging the user, such as "animated maps, custom data visualization graphics, manipulatable 3-D models, digitally annotated artwork and source documents, tactics demonstrations, and other[s]" (Rowan). As a synthesized fusion of historical archives and modern media technology enablers, *The West Point History of Warfare* could represent the future standard for the development of educational course references. This digital text spans the gap between traditional paper-based text and modern technological multimedia resources, expanding engagement pathways in a manner not possible with a traditional, standalone textbook. Alternatively, perhaps this repackaging of archived materials across an array of disparate mediums like "newsreels, radio broadcasts, era-appropriate music, and video introductions" will be surpassed by some future conceptual broadcast method with less direct recognition as a textbook and more similarity to highly processed, experiential educational materials.

Even in its current state, it may be that some find the distractions and multiplicity of digital textbooks not conducive with cogitation of more complex concepts. Posed as a question, is the traditional textbook at risk of extinction, soon to be replaced by the electronic, interactive textbook? Or will the traditional textbook always possess a venerable and utilitarian position in the pedagogical process, with digital media serving a supporting role in presenting course material to students in select alternative, more engaging forms. With respect to qualitative attributes and quantitative measures, which form is better for student and educator, traditional print textbooks or digital electronic textbooks? More simply, which is worthier and why?

For many college subjects, the course textbook serves as the foundation for which the majority of the curriculum is built upon. When authored by esteemed members of an academic discipline, a well-written textbook provides a cogent, nested framework that the collegiate educator can use to develop a syllabus, build lesson plans, assign readings, and even create homework assignments. Prior to the development of the Gutenberg printing press, print materials were labor intensive, hand reproduced works of literary art, both in form and function. Automated,

highly efficient printing methods reduced the cost and directly contributed to tremendous numerical growth in literacy rates. In a similar revolutionary way, as more print media moves digital, the growing utilization and continuing development of electronic books or e-books is changing the framework of educational course materials. Digital materials have a transmissivity and a permanence not attainable with printed or paper based learning materials. But despite these advantages and observed trends over the past decades, print books survive and even thrive in several markets.

Background and Approach

The college textbook industry is experiencing major changes in product development and business models. First, digital or electronic media has provided access to an abundance of less expensive legal (e.g. international versions) and illegal (pirated) textbooks in both print and electronic form. This, along with other business factors, has created a negative feedback loop that have driven the cost of textbooks up at rates far exceeding inflation and even college costs at large. In turn, this trend has driven more students to seek alternate forms of course textbooks, some in digital form with either legally purchased electronic texts or illegally acquired scanned copies. Second, a generation of millennial learners or "digital natives" with greater skill and more comfort operating in an electronically driven world have created greater demand for course materials in electronic form. The conveniences, capabilities, and costs of electronic textbook versions are attractive to modern students. Lastly, learners in exciting, emergent technology fields are witnessing changes at rates not conducive with traditional textbook production rates. More simply, in some fields traditional print material is outdated before it can even reach the college bookstore shelf. For these and many other reasons, the traditional print textbook market is experiencing disruption and turbulence associated with a subtle shift toward digital or electronic textbooks.

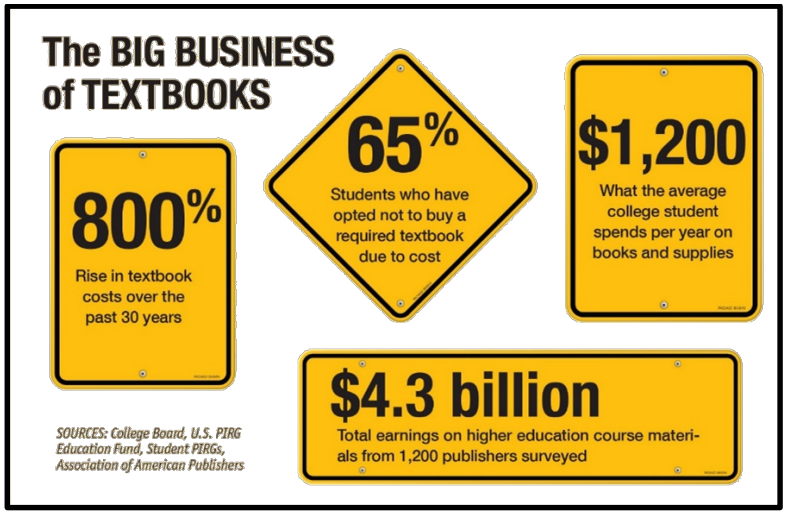

Figure 1: Statistics depicting trends associated with increased textbook costs. (source: Opidee, 2014).

To explore this topic further, a literature review comparing electronic and traditional print books in higher education was conducted. The basic approach was to analyze three aspects of this admittedly contentious subject. First, what work has been done to analyze the student and faculty ***performance*** differences between those using electronic texts and those employing a traditional text? If one wishes to make an informed decision on whether to utilize a print or electronic text, it is logical to look at the data that has been collected and the analysis that has been completed comparing and contrasting performance and outcomes with traditional versus digital or electronic texts. Second, regardless of the quantitative results, what are the qualitative ***preferences*** of the users, considering both students and educators alike? Some educators are prescriptive in what the course reference will be, i.e. print or digital. Others support student preferences in acquiringcourse texts. The divide between print and electronic books is emotional and perhaps not purely logical for some. Recognizing and appreciating the perspectives and views of teacher and learners is useful in developing a qualitative sense of both supporters and opponents. It is also of helpful in educating both sides of the digital divide. And third, what are the ***trends*** associated with the textbook industry. By appreciating the quantitative or results-driven distinctions as well as the qualitative or preference-based differences between the two textbook forms, it was appropriate to look at how the industry is responding between the two textbook forms.

Performance

To explore the topic of performance as it relates to comparing traditional textbooks and electronic books, literature was sought that used analytical approaches toward quantifying the differences between these two forms of instructional media. Journals including *The Internet and Higher Education*, *Computers & Education*, and *College Teaching* provided numerous articles on this topic. The literature was fairly complementary and not all that surprising. Students that read the course material do better, and students will read more in a preferred, engaging media. Layered atop these trends and preferences are economic incentives, i.e. student finances driving purchases. In other words, the greatest factor for some students when considering whether to purchase or rent, be it a traditional text or an e-text, is cost. A brief summary of five articles reviewed in the general category of traditional versus electronic text performance is provided.

Historically, prior academic achievement has been the strongest predictor of student outcome in higher education. Those students that have done well in previous courses are expected to continue to excel, and the data supports this logical assumption. Self-reporting, especially of time and effort associated with lesson preparation is found to be highly inaccurate. For this reason, Junco and Clem conducted a study using digital textbook analytics as a “new method of collecting student-generated data in order to build predictive models of student success” (Junco, 2015). Specifically, they collected data on student engagement with electronic materials and found through their modeling techniques and regression approach that they could develop a “stronger predictor of course outcomes than previous academic achievement” (Junco, 2015). Conversely,

they were able to identify at-risk students, not based on prior academic challenges, but by leveraging unobtrusively gained insights on student engagement (or lack thereof) with the learning materials, i.e. the digital textbooks. Perhaps not surprisingly, "reading a textbook is directly related to course outcomes" (Junco, 2015). What was novel about their approach is the investigators were able to more accurately collect and hence more definitively predict academic achievement as it relates directly to the engagement students had with the material. The Engagement Index Score (EIS), a value representing the time a student spent reading the material, "was a significant positive predictor of course GPA when taking into account student demographics, course enrollment, and prior academic achievement (Junco, 2015). Just as striking, other collection studies showed that "50% of students didn't read the text-based components of the course ebook" (Junco, 2015). This data might not be seen through traditional, self-reporting, methods. In ways not practically possible with traditional texts, "digital textbook analytics allow instructors and institutions to evaluate time on task for the academic task of reading as well as how much students are engaging with active learning using their textbooks" (Junco, 2015).

When considering which is better, electronic or traditional print textbooks, a study done by Rockinson-Szapkiw et. al. found "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" (Rockinson-Szapkiw, 2013). Prior research had focused primarily on "reading speed and comprehension of individuals accessing text content through a stand-alone computer" (Rockinson-Szapkiw, 2013). This contemporary study was conducted using a casual comparative design where students answered questions as they related to the course and lesson preparation. "No difference in cognitive learning or final grades suggests that e-textbooks may be a viable option for learning" (Rockinson-Szapkiw, 2013). The investigators did find that students using e-books reportedly "learned actively and they liked it" (Rockinson-Szapkiw, 2013). Justifications for choosing the electronic textbook included price (63.2%), suggestion of publisher (20.7%), and portability (16%) (Rockinson-Szapkiw, 2013). Through self-reporting methods, both groups did not significantly differ in the number of hours per week reported for using the textbook.

Students engage with textbooks, both print and electronic in a variety of ways. This includes skimming, reading and rereading, note taking, annotating, related investigations a.k.a. "looking it up", problem solving, and highlighting. Because of the inherent ease at which digital media can be modified and related data interrogated, an exciting area of research is on how the various forms of presentation lends itself to textbook proficiency and learning efficacy. A study by Chen and Yen "explored the effect of different annotation formats, namely in-text annotation, glossary annotation, and pop-up annotation, on hypertext reading comprehension in foreign language and vocabulary acquisition" (Chen, 2013). As digital reading becomes more commonplace, hypertext annotations "stand out as one of the most important tools for aiding" in reading (Chen, 2013). The investigators used three types of annotation in their study. This included the in-text, glossary, and pop-up form. The in-text annotation "refers to additional explanatory

notes embedded within a passage that appear next to the target word", glossary annotation "involves a list of definitions for each target word that appears either at the end of the text or in the margin" and pop-up annotations "are visible only when clicking the mouse on the annotated word" (Chen, 2013). Their results revealed that the pop-up annotation format was the most beneficial to students on the comprehension test. Furthermore, students "generally held a positive attitude toward annotations and acknowledged their usefulness" (Chen, 2013). The methods of collection are encouraging for certain subjects but are presented with some caution as "annotations embedded in the text may interrupt reading flow and breakdown the comprehension process" (Chen, 2013). This is without addressing ancillary distractions associated with reading from a digital device, including surfing the internet, checking email, etc.

Agnostic of the media form, i.e. traditional or electronic, it is important to evaluate the role of the textbook both from a usage and in relation to student outcome. A study done by Eric Landrum et al. assessed textbook usage and the relationship to student course performance. Their work showed that students use textbooks effectively when "study aids and chapter reviews are provided, when an instructor uses a textbook, and when the book is easy to use" (Landrum, 2012). Data collected on electronic study guides as well as online access to a digital and print copy was found to rate high for accessibility. As seen in other studies, there were "significant positive correlations between percent of textbook read and quiz scores, total points earned, and numerical course grade" (Landrum, 2012). Absent from their study, but worth noting as they highlight this observation in the conclusion of their paper is the role of the instructor. Interestingly, they posit that "it could be the case that when the textbook quality is outstanding, and its pedagogical aids are particularly well suited for students, the quality of instruction make little to no difference regarding student learning. It could also be the case that when the instruction is superb, and perhaps the textbook is not well matched to the specific student population, the quality of instruction can negate any potential pedagogical aid effects" (Landrum, 2012). This presents a quandary but also an opportunity for electronic textbooks. It has been noted with some concern that textbook companies are becoming increasingly involved in course development and curriculum advancement. Digital media textbooks can provide both a quality textbook supplemented with commentary and explanation approaching that of an exemplar instructor.

The final paper reviewed on the general topic of textbook options and performance was a study done by Daniel and Woody. Their investigation looked closely at the reading behaviors of students engaging with traditional print text and electronic texts. Their data was collected in both a lab environment and at home or in a dormitory setting, the latter being a more realistic study condition. The results showed that students on average spent more time reading electronic texts than print texts. The data and subsequent analysis "demonstrated electronic reading times were significantly longer (i.e. 7% longer)" (Daniel, 2013). This was observed in both the lab condition and at home. In the more realistic home condition, reading times were even longer and were attributed to electronic distractions that were present with the reader, e.g. email, web surfing, social

networking, etc. “Although students in both electronic and print formats report[ed] multitasking as they read, students in the electronic formats were much more likely do so [sic] and, in particular, were more likely to engage in computer-based competing activities” (Daniel, 2013). The paper acknowledged that electronic book sales had recently surpassed print book sales, so their motivation was to better gauge the compatibility of the two mediums as “economic pressure and ease of access make e-textbooks an attractive option for students, faculty, and administrators” (Daniel, 2013). Aside from taking more time, their data showed no performance advantage of either print or electronic texts. Again, time on task was the strongest predictor of success, followed by prior academic achievement. The authors suggested that perhaps future development of electronic mediums should seek to achieve greater efficiency so that students utilizing e-texts would not encounter a time penalty of sorts. In many cases this amounts to having distractions minimized in their engagement with the course materials. Options for fulfilling this goal include a dedicated read mode where ancillary computing functions are placed in a hibernation state, as well as blending e-reader text projection technologies with more modern tablet screens. Ironically, the projection technologies developed and matured to reduce eyestrain on electronic readers have fallen out of favor as users demanded richer graphics and animations not currently compatible with the simpler grayscale known as electronic ink or E ink.

Preference

In most higher education courses, the instructor or course director chooses the course text and course references for the students. As with any decision making event, faculty weigh the pros and cons of textbook options including such factors as quality, cost, availability, and format, i.e. print, e-text, or some combination of both. To support a comparative study on traditional print and electronic books, literature was reviewed that focused on faculty and student preferences on textbooks. Articles from *College Teaching*, *Publication Resources Quarterly*, and *Computers & Education* were referenced on the general topic of textbook format preferences. Interestingly, many textbook companies are adopting a business model with increased focus on content delivery and less on textbooks. As with other industries, the textbook industry has noticeably shifted from goods to services. This has presented practical as well as ethical considerations as faculty consider which reference to direct students to in the execution of course instruction.

Bossaler and Kammer conducted a two-part study on eTextbooks. Their first study focused on student preferences, and their second on faculty preferences. Their approach began with an investigation on college textbook publisher business practices. As noted previously, they identified trends “through acquisitions and mergers, [where] these publishers have positioned themselves as leaders and innovators in the educational technology industry by purchasing learning management systems (LMS), online learning service companies and learning analytic platforms” (Bossaler, 2014). In discussions about textbook options with publishers, the commentary has grown much richer than just a choice between paper or electronic. Textbooks are often presented as part of an

integrated learning system, with inherent tendencies toward a digital approach for course reference and content. The growth and development of this service-based educational product industry has come at a cost, and evidence collected by the United States Government Accountability Office found that "technology development resulted in higher textbook prices, with publishers passing development costs to the students" (Bossaler, 2014).

Students consider, among other factors affordability, access, and privacy when making textbook choices. On the topic of affordability, on average the least expensive option for acquiring a course text is to purchase and later resell a used copy, or to simply rent a used copy for the semeseter. The cost of an electronic textbook is typically less than a new text, but often cannot be transferred and in some cases is only viewable on a term basis, i.e. the semester. Furthermore "students preferred print and resented the arrangement because they had previously bought used books or shared books with friends ((Bossaler, 2014). When considering access, it is hard to match the ease and reliability of printed textbooks. "eTexts… dictate *how* and *where* students can read" and "10% [of students] abandoned their etext for print due to slow networks, freezing, and printing problems" (Bossaler, 2014). Furthermore, some e-texts are not available after the completion of a semester due to the integral aspect of course content. The technology that prevents fraudulent sharing also negatively impacts bona fide accessibility and ease of use. Regardless of the intended use, privacy of student activities with an e-text is a concern. "eText software often tracks and collects data on students"… "and some critics believe that students should be able to opt out" (Bossaler, 2014). With respect to privacy, an interesting parallel exists for faculty, as will be discussed in the next paragraph.

In their study on faculty preferences, the investigators used narrative accounts, i.e. interviews characterized as "semi-structured and informal, marked by equality between interview and participant" (Bossaler, 2014). This is a refreshing contrast to traditional survey methods where data is collected and analyzed but may not contain rich, albeit somewhat anecdotal content. Faculty consider, among other factors access, privacy, and outsourcing when making textbook choices. Access, or a lack thereof, presented real challenges to conducting lessons reliant on electronic media. One instructor recounted connectivity issues that genuinely jeopardized scheduled lessons and quiz result recording. As several universities have deepened their reliance on the textbook company to furnish electronic course material, one instructor was not pleased to discover that in addition to analytics being collected on her students, the system was tracking and logging her own activities as the instructor. While the students were somewhat neutral on privacy issues, faculty were generally more concerned about this aspect and saw a need for further clarification on consent and utilization of the data. Outsourcing, i.e. the trending from simply furnishing textbooks to providing full spectrum course services including lesson plans, multimedia content, labs and quizzes, was most controversial for faculty to contend with. In addition to the apparent encroachment into the roles and responsibilities of the college professor, "participants expressed concern over a conflict of interest-that is, the relationship would benefit the private companies at

the expense of education itself" (Bossaler, 2014). In some content arrangements, it is the students themselves that pay for the service. For example, a publisher may offer a textbook package that includes an e-text as well as an electronic course content suite that an instructor can apparently mandate students purchase for course enrollment. Other faculty were concerned with the long term impacts, e.g. becoming reliant upon a company to provide a teaching service. Once competency is lost, academia is potentially at a position of vulnerability in that the relationship must be sustained in the absence of core competency and institutional knowledge.

Assuming that the instructor makes the ultimate selection for the course, Weisberg investigated student preferences in text format. More specifically, his study sought to "add to the collective body of knowledge on student behavior and attitudes relative to the adoption of digital textbooks" (Weisberg, 2011). At the time of his research, e-texts were becoming more popular with digital readers offered by Amazon (Kindle), Sony (eReader Touch), Apple (iPad), and PC (CourseSmart interface). His study showed that student performance was not impacted by format, i.e. traditional or electronic, and that "student attitudes and behaviors are becoming more receptive to and accepting of using digital textbooks each year" (Weisberg, 2011). His study made available electronic readers, and student performance was tracked throughout an undergraduate course. The upfront capital investment was made on behalf of the student. Interestingly, "students also had a traditional paper textbook as backup to ensure that they were able to accomplish the learning objectives of the course, should the eReader not work for them" (Weisberg, 2011). His research showed that students appreciated the convenience, reduced cost, and search abilities of the electronic version. It is worth noting that the researcher provided the electronic reader platforms to the students at no cost and that some readers can cost upwards of $250. Students found traditional textbooks to be superior in that they enable easier concentration, better comprehension, and are simply a personal preference for some students (Weisberg, 2011).

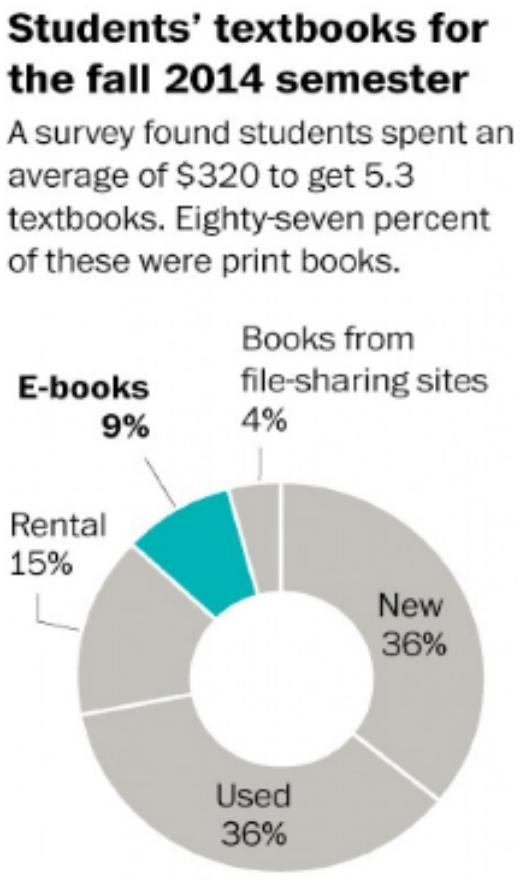

Figure 2: Survey data on student textbook purchase options. (source: Rosenwald, 2015).

An earlier study done by Woody, Daniel, and Baker on e-book and textbook preferences for students was found useful due to recent trends. Early opposition to electronic texts was based

on readability and eyestrain. To address this issue, e-reader developers worked hard to overcome these challenges and create standalone devices that improved the digital likeness to that of paper, albeit at the expense of less utility across other mediums. Their study again demonstrated "no differences between the e-book and textbook groups in learning outcomes" (Woody, 2010). In their study, "despite the ubiquity of computers and interactive technology in their lives, students preferred textbooks over e-books for learning and this preference is not altered by familiarity with the medium" (Woody, 2010). As digital media progresses from a print-text likeness ideal to a multimedia menagerie of materials like those experienced on an iPad for instance, the early criticisms of electronic text references could reappear again.

Trends

The higher education textbook industry is a multi-billion dollar a year enterprise. As such, it was worth investigating literature that focused on the trends and future prospectus of the textbook industry. Articles from *The Chronicles of Higher Education, Ergonomics in Design, Literacy and Technology,* and *Product Design and Research* were referenced on the general topic of trends. Hancock et. al presented work that "indicates a mild yet pervasive preference for traditional books, yet e-readers continue to gain in popularity" (Hancock, 2016). Their work focused on cost, form, ease of use, and even environmental impact. While print remains "easier to use, more useful, and more immersive than e-readers" the textbook industry has a growing presence in the digital reader market as "such devices [and products] are meant to address what are perceived as shortcomings or flaws in the design of traditional paper-based books" (Hancock, 2016). They ultimately predict the "nature of the e-reader's continuing development as an emerging educational tool using Brofenbrenner's ecological systems theory" (Hancock, 2016). Some view the emergence of e-readers as disruptive or revolutionary technology, while others see it as an enabling or evolutionary maturation of the reading, teaching, and learning experience. For environmental and transmission factors, the digital textbook offers accessibility and transmissibility advantages over print versions not unlike the first works made available through the printing press. There is an upfront cost of the reader, but as the digital work price structure stabilizes the prices of digital works could mitigate the challenges and fluctuations present in the market.

The textbook industry and related publishers "have spent hundreds of millions of dollars… buying up software companies and building new digital divisions" and it appears that they are "betting the future will bring an expanded role for publishers in higher education" (Young, 2013). While still representing only a fraction of text offerings, fully digital titles are being offered not as replacements to traditional books but as a part of a learning system. For this reason, "the lines separating publisher, professor, university, and software company are blurring" (Young, 2013). The trends suggest that like many other industries, the college textbook companies are shifting from goods to services, with the latter supported by increasingly digitized course content material of which the textbook is one of several educational elements. Even going back as far as 2010, the

"primary digital textbook providers in US Higher Education-CafeScribe, CourseSmart, Vitalsource, and Xplana-all showed strong sales increases" (Reynolds, 2011). The trend continues today with the rising cost of print textbooks and the availability of textbook content encouraging more to consider digital alternatives to traditional books.

Most textbook companies are currently focused on developing products that are less like digital book clones and more akin to learning and content repositories. The first generation e-readers and the digital books they presented were clearly focused on replicating the experience of a book. This was a logical step in evolving the traditional text in a palatable way. Today digital texts are offering "new possibilities to engage in books and text enhanced with media" (Dalton, 2014). Early ebooks were digitized clones, clunky .pdfs of the paper version. To manage distribution concerns, most were read on security laden interfaces that prohibited basic search access, annotating, or even highlighting. The current trend in ebook development, as seen with the West Point History Departments development and launching of their History of Warfare title is to not be beholden to a paper likeness. Rather the trend is to develop and engage the student in an immersive, interactive, multimedia experience that offers a basic framework for course content but has supplements and expounding material spread throughout.

As part of this new text landscape, Dalton produced a comprehensive guide on how to fully integrate electronic texts into curriculum. She presented a five step plan for "slecting and teaching with e-books and e-text" (Dalton, 2014). In response to trends moving toward increasingly digitized course content, like other works she emphasized that the choice and implementation must be planned and deliberately integrated. Her process included points such as (Dalton, 2014):

1. Select e-books with meaningful enhancements for vocabulary and comprehension
2. Teach students how to use e-text features
3. Create an e-reader community
4. Use professional development and get technical assistance

Dalton's guidance serves as a great framework for those course directors mindful of the trend toward digital textbook offerings. Like many advanced features in a technologically rich environment, proper introduction and instruction to the students will enhance the experience and expand the utility.

Relation to Teaching at the United States Military Academy

The mission at West Point focuses on educating, training, and inspiring the Corps of Cadets so that each graduate is a commissioned leader of character. To successfully educate our cadets, instructors should strive for high levels of intellectual excitement and interpersonal rapport. This is in observation of Lowman's two-dimensional model of teaching and what is typically recognized as exemplary instruction within academia. Are electronic textbooks complementary to

the mission at West Point? In completing our mission and fulfilling our responsibilities as instructors, which is better and why?

In the engineering courses I teach at West Point, either a digital text or print text can be used effectively to convey the course material and achieve two-dimensional greatness on Lowman's model of teaching. I have personally relied on print texts but have made the digital version an option for students in the four courses I have taught and course directed. Network connectivity issues have made many a bit "gun-shy" on being fully reliant on a digital backbone to a course, and I am wholly against requiring students to "pay to play" in a course for features above the cost of the text. Through hard work, independent research, and general resourcefulness, I can build and instruct effective lessons without a heavy reliance on a learning systems provider. There is an upfront cost, but the end result is something I am proud to pass on to my successor and am able to deconstruct and deconflict given my intimate knowledge of design and integration.

Summary

From a ***performance*** perspective, time on task remains the dominant factor in student success. While digital readers present more opportunities for engagement and inherent benefits in creating a multimedia experience for the user, they come at a cost with respect to efficiency. Students can achieve academic excellence, be it with a traditional print text or an e-text, so long as they read the material and intellectually engage with the content. Digital readers offer advantages in collecting and managing learning analytics, but privacy and usability are valid concerns that should be managed. With respect to ***preferences***, both faculty and modern students, even those that are "digital natives" currently still prefer print over electronic. As the content increases in complexity, this trend becomes more pronounced. As financial factors demand greater consideration in student choices, print texts, especially used ones rented and later resold, offer the greatest value. The early criticisms of electronic readers were addressed with the development of advanced viewing technologies, e.g. E ink. Ironically, the demand for enhanced graphics on etexts is forcing many developers back to standard screens. Finally, with respect to ***trends***, the textbook industry is moving toward increased digital content. The textbook is becoming an element in a larger framework of a learning management system. The discussion between publisher and university about which textbook to adopt is maturing into a deeper relationship about various products offered that can service needs in homework assignments, course content, and even student analytics. Guidance and perhaps policies should be developed with respect to the practical as well as ethical considerations of creating arrangements and reliance on third party content managers.

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