Open Textbooks and Increased Student Access and Outcomes

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Abstract

This study reports findings from a year-long pilot study during which 991 students in 9 core courses in the Virginia State University School of Business replaced traditional textbooks with openly licensed books and other digital content. The university made a deliberate decision to use open textbooks that were copyrighted under the Creative Commons license. This decision was based on the accessibility and flexibility in the delivery of course content provided by open textbooks. More students accessed digital open textbooks than had previously purchased hard copies of textbooks. Higher grades were correlated with courses that used open textbooks.

Introduction

In the spring of 2010 the School of Business at Virginia State University (VSU) initiated steps to implement an integrated core curriculum. As part of this process the school began to explore ways to improve the student experience around course content. While students generally view textbooks as an important element of their courses and associate helpful textbooks with helpful classes (Besser et al., 1999), VSU faculty members were concerned because an internal survey reported that only 47 % of students were purchasing textbooks for their courses. The most frequently cited explanation for not purchasing textbooks was affordability. This same survey reported that many students at Virginia State University receive little or no support from home and must work one or more jobs besides carrying a full 15 credit semester load. Faculty members reasoned that without textbooks, students would quickly fall behind and potentially fail or drop their courses. Speaking of students not having textbooks, Buczynski (2007) states, "This trend introduces inequality into the classroom, in that some students have the required learning materials to succeed in the course while others either do not, or have unreliable borrower access to the materials. Student success is directly impacted by this inequality in the learning environment" (p. 170). Faculty members determined that the most obvious solution to the problem was to find a way to make textbooks more affordable.

Faculty members began looking at e-books, with the understanding that, generally speaking, they are less expensive than print materials. Though Shepperd (2008) had already suggested that grades did not differ for students using e-books and traditional textbooks for a course, faculty members believed that e-books could potentially be more useful to their students, because, as Prensky (2001) has argued, in the information age many of our students are "digital natives." They have grown up in an era where access to information is easier than it has ever been. A Google search will instantaneously turn up an overwhelming amount of information on almost any subject and so students have learned to navigate digital resources. "Digital natives move quickly through information and prefer to seek out answers actively, rather than wait passively" (Zimmerman and Milligan, 2008, p. 3). One way to accommodate the digital native is to leverage their expectations for digital course content by using material that allows for word-level search, bookmarking, digital comments, and even note sharing.

From a pedagogical perspective, digital content also has a number of potential advantages. Brown and Edelson (2003) present "a professional development model aimed at increasing teachers' capacity for designing learning activities by customizing and combining online learning resources to fit their local needs and context" (Recker et al. 2007, p. 118). For instance, content which can be accessed through the web allows instructors to create links in their LMS that will not only guide students to a digital textbook, but can also send them to a specific chapter or page within that textbook. Digital content is also easy to modify or supplement and instructors can make changes that reflect their point of view or relevant recent events. This gives an instructor unprecedented flexibility to incorporate digital content into their course design.

However, although e-textbooks were often less than half the price of traditional textbooks, many of these titles required students be connected to a specific Internet platform for access. This made the content less portable and less accessible. There were also time limits on many of these products; meaning that students would not be able to access a textbook after the prescribed time. VSU faculty members wanted students to have the flexibility to capture their digital textbook in a variety of formats and have permanent access to

these materials. The ability to digitally transfer information that once required a physical form has led to a transition from what Benkler calls the “industrial information economy” to the “networked information economy” (Benkler, 2006). However, because of published-enforced copyright protection they found there were significant limitations on how, where, and for how long content can be accessed and used by students.

As the faculty continued members continued search for an affordable, digital, and easily accessible textbooks, they eventually discovered Flat World Knowledge (FWK). At the time of their search, FWK published open textbooks that use Creative Commons copyright licenses, which permit anyone to access and use the textbooks for free and provide significantly more flexibility for the reuse of the textbooks (Hilton and Wiley, 2011). On August 23, 2010 Virginia State University and Flat World Knowledge issued a joint press release announcing that the Reginald F. Lewis School of Business would utilize FWK’s in several of its courses. In addition to the free online textbooks, VSU agreed to pay a “seat license” per enrolled student that would allow students to freely access all of the associated supplementary materials (such as flash cards, practice quizzes, audio files, etc.). Thus students were able to download content to e-readers, computers, mobile phones or even flash drives. Faculty members were able to provide chapters for download in their Blackboard accounts. Once downloaded, students could use all of these educational resources whether they were on or off line. All of these materials were free to students.

Instructors teaching nine courses from the Reginald F. Lewis School of Business Core Curriculum chose to adopt Flat World Knowledge textbooks in fall 2010 and spring 2011. This article discusses what happened during this adoption, specifically in terms of how adopting open materials from FWK increased student access to educational materials. As a by-product of employing a web-based platform to deliver digital content we were able to gauge the relative success of the Flat World initiative in terms of access to materials by determining how many students registered a seat-license for each course and tracking the files they downloaded. We also surveyed students to gain their perspective on the pros and cons of using online learning resources.

Our aims and objectives in the present study are to describe how in this case study open textbooks provided benefits to students. In this paper we describe how providing free learning materials increased student access to those materials. We also provide data on how students perceived these materials, and how the use of open textbooks correlated with improved educational outcomes.

Access to educational materials

A key aspect of what VSU hoped to accomplish was to increase student access to educational resources. Thus, on the first day of class each student was given a registration form with a unique registration number. The form provided a URL where the students could register to gain access to all the supplemental materials available for that specific course (textbooks could be accessed and used without registration). Each instructor handed out the registration forms, gave an explanation of the Flat World initiative, and discussed the implications for that specific course. Instructors were provided with a PowerPoint presentation which illustrated how to register a seat-license, how to access content at the FlatWorldKnowledge.com website, and how to download files in various formats. Students taking multiple courses with FWK seat-licenses would need to complete a separate registration for each course.

An additional procedure was introduced in the spring semester. Based on feedback from a student survey administered at the end of the fall semester, a student intern was trained and introduced to the process. The intern visited each class and made herself available to help students with any questions or issues they had accessing the FWK material.

Flat World Knowledge provided running updates on student registration for FWK materials. We captured student registrations at four distinct times during each of the semesters, as illustrated in Table 1. Time 1 shows the number of registrations at the end of the first week of classes. It was reasoned that students might use the first weekend to get organized so T2 shows the number of registrations after the Monday of the second week of classes. T3 shows the number of registrations at the end of the second week of classes.

At this point, instructors reconciled the registered students with their class lists and made a point of reminding students who hadn’t registered their seat-license to do so. In some cases students had not been in class when the registration forms were distributed and others had misplaced their registration forms. By the end of the third week registrations had slowed dramatically and, except for a final tally at end of semester, we stopped tracking registrations (T4) in the middle of the fourth week of classes.

Table 1: Class enrolments compared with registration for textbooks

Time	Fall10 Enrolled	Fall10 Registered	%	Spring11 Enrolled	Spring11 Registered	%
Time 1 – end 1st week	794	361	45.5%	718	400	55.71%
Time 2 – 2nd week	794	507	63.85%	718	514	71.59%

Time	Fall10 Enrolled	Fall10 Registered	%	Spring11 Enrolled	Spring11 Registered	%
Time 3 – end of 2nd week	794	652	80%	718	603	84%
Time 4 – mid 4th week	794	671	84.5%	718	655	91.23%
Time 5 – end semester	794	690	87%	718	681	95%

Table 1 shows the FWK registrations at five time periods for the fall and spring semesters. These numbers represent a registration, not necessarily a distinct, individual student. While some students have only one course with a FWK textbook, others may have 3 or 4 courses. In fall 2010 this translates to 504 students having registered 690 FWK seat-licenses. In the spring semester there were 484 distinct student users who had registered 681 seat-licenses.

FWK download activity reports provided the number of distinct users who were downloading these files. There was an upward trend between semesters here as well. In fall 337 of the 504 distinct users, or about two-thirds of the registered students, downloaded at least one file. The following spring, 410 of the 484 distinct student users downloaded at least one file. This represented close to 85 % of the students; an increase of 21 % in the second semester of FWK usage. Comparing this information with previous research indicating that only 47 % of students purchased textbooks, textbooks. Thus this shift to free digital content did increase access to educational materials for the course.

Download patterns

The seat-license program provided students with a number of choices about how they could access the digital content. It was important to allow for flexibility in the mode of delivery and to make sure that students had access to the material even when they had no Internet access. It was also important to determine which resources the students were using and, if possible, when they were using them. Students needed to access their registered accounts to download files and FWK kept track of which files were downloaded. As with the registrations, we chose to look at the download numbers multiple times each semester. Downloaded files were recorded mid-semester and at the end of each semester.

In order to determine what types of files students wanted to access we not only tracked the total number of downloaded files, but also the format of the file being downloaded. The file format or type provided an indication to how the files were being used. PDF files, for instance, only contained individual book chapters. MOBI files, used with Amazon Kindles and the Amazon Kindle app, and ePub files, which could be used with iPads, iPods, and iPhones, provided complete textbooks and had more features than PDF files. MP3 files, available in a limited number of textbooks, were similar to PDF files in that each file represented audio versions of only a single chapter.

This review is limited to downloaded files. We were not able to isolate online access to the FWK website and therefore did not track how frequently students viewed the online textbook, nor how often they took advantage of online study aides such as flashcards and quizzes. For this we have had to rely on self-reported behaviours elicited through a questionnaire administered at the end of the semester. In the student surveys approximately 90 % of responding students, in each semester, report reading their textbooks online at the FWK website. This additional usage information provided a more complete picture of how students were accessing the open textbooks.

Tables 2, 3 and 4 show the total number of files downloaded each semester in the various formats. Table 2 compares file downloads for the two semesters just after the middle of the term. Table 3 provides the number of downloads from mid-semester to the end of the semester, and Table 4 gives total downloads for both semesters. There was only a 9.61 % increase in total downloads between fall 2010 and spring 2011, but there are more dramatic differences reflected in the number of downloads before and after the midway point in each semester. It is also meaningful that, while PDF downloads were stable from one semester to the next, there was a significant increase in MOBI and ePub files in the spring.

Table 2: Downloads by file type from the beginning of each semester through midterms

Media	Midterm F10	Midterm S11	% increase
PDF	1208	1810	49.83%
MOBI	59	271	359.32%
ePub	110	252	129.09%
MP3	142	187	31.69%

Total	**1519**	**2520**	**65.90%**

Table 3: Downloads by file type from the middle of each semester through finals

Media	Midterm F10	Midterm S11	% increase
PDF	1243	642	-48.35%
MOBI	67	30	-55.22%
ePub	63	286	-46.03%
MP3	83	222	-57.83%
Total	**1456**	**741**	**-49.11%**

Table 4: Total downloads by file type for each semester

Media	TTl F10	TTL S11	% increase
PDF	2451	2452	0.04%
MOBI	126	301	138.89%
ePub	173	286	65.32%
MP3	225	222	-1.33%
Total	**2975**	**3261**	**9.61%**
Distinct Users	337 of 504	410 of 484	21.02%

We next turn to a discussion of the different types of file formats that students chose to download.

PDF files

PDFs have long been in use as a format of choice for exchanging information while preserving layout and design. Almost all computers and other digital computing devices such as smart phones and tablets have software that will render PDF files without compromising the original formatting. Since students are familiar with PDF files, it was not surprising that, initially, PDF downloads were overwhelmingly chosen by students as the preferred method of retrieving digital content available through their FWK seat license.

In the fall of 2010 VSU students downloaded 2,451 PDF files; each representing a single chapter in an FWK textbook. Although this number seems high, considering that each textbook has an average of 16 chapters, this only represents about 150 full textbooks. Not all students chose to download every chapter in a textbook, although the download of PDF files was particularly brisk when instructors assigned students to write chapter summaries.

It is also noteworthy that, of the 2,451 PDF files downloaded in the fall of 2010, more than half were downloaded after the midpoint in the semester. This behaviour changed markedly in the second semester of FWK usage. In the spring there was a 50 % increase in the number of PDF files downloaded by the midpoint of the semester. So, while the total number of PDF downloads remained the same, students downloaded more files earlier in the semester.

ePub and MOBI files

While total PDF downloads were flat over the two semesters, the interest in ePub and MOBI files grew significantly. Total ePub and MOBI file downloads are much smaller than that of PDF files, however, each ePub and MOBI file represents an complete textbook; containing much more information and functionality than a PDF file. A student downloading one MOBI file has retrieved as much digital content as a student who has downloaded 16 PDF files from the same textbook.

MOBI files are indigenous to Amazon's popular Kindle e-reader. They can also be used on any computer tablet or smart phone with a Kindle e-reader application installed, such as an iPod or iPad. In the fall of 2010, 126 MOBI files were downloaded. A semester later, students downloaded 301 MOBI files; representing a 139 % increase. ePub file downloads increased 65 % over the same period.

MP3 files

Early in the process a number of instructors believed that students would take advantage of the MP3

podcasts of book chapters. It was reasoned that students would find listening to their textbook a convenient way to do some work while driving or performing some other task. As it turned out, students did not download very many MP3 files. In spring, while other non-PDF file downloads were increasing, the MP3 downloads decreased slightly. That semester only 222 MP3 files were downloaded. The MP3 format was less popular than any other file format.

Student experiences with digital textbooks

At the end of each semester a Qualtrics survey was emailed to students who had registered a Flat World Knowledge seat-license. In the fall 167 students (33 %) responded to the survey. In spring 148 students (30 %) completed the survey. Survey data confirms a semester to semester increase in student awareness of various methods by which they could access their FWK digital content. In the survey taken at the end of the fall semester fully 90 % of responding students reported reading course material online at the FWK website. That same semester only 8 % of students responding had reported downloading a MOBI or ePub file. The following spring 90 % of students again reported accessing their FWK digital content through the Flat World website but now 23 % reported downloading MOBI or ePub files. The reported use of PDF files remained constant at 29 % in both semesters. This is consistent with the actual download reports.

In the spring survey we asked students to report whether they had registered an FWK seat-license in the fall, or whether this was the first semester they were using the FWK digital content. There were an almost identical number of students in each group with 72 reporting that they had used FWK content the previous semester and 76 reporting it was their first experience. Figure 1 shows the results from the spring survey for first-time FWK users and Figure 2 shows the results for students who reported having used a FWK textbook in the fall.

The percentage of first-time users reporting that they read the material online is slightly higher, at 93 %, than the students with previous experience using an FWK textbook, 87 % of whom reported reading the material online. PDF downloads were almost identical for the two groups. But 28 % of experienced FWK users reported downloading MOBI or ePub files versus 18 % of new users. While this differential is noteworthy, is equally noteworthy that even first-time users in the spring semester reported downloading MOBI and ePub files more frequently than first-time users in the fall of 2010 (18 % vs. 8 %).

#	Answer	Response	%
1	I read the material Online	68	93%
2	I have downloaded Mobi or ePub for e-Readers (ex; Kindle,iPad, iPhone, Android phone)	13	18%
3	I have downloaded PIY (print-it-yourself) PDFs of individual chapters	21	29%
4	I have dowlcaded MP3 study guides	5	7%
5	have downloaded MP3 chapters	7	10%
6	I have made use of Flashcard Study Tools	15	21%
7	I have made use of Study Quizzes	15	21%

Figure 1. First Time FWK Users Spring 2011

Experienced users also reported making more use of the study aides provided on the FWK website. Only 21 % of new users reported having made use of Flashcards as opposed to 37 % of the experienced users. The numbers were almost identical for the Study Quizzes with 36% of experienced users taking advantage of that resource as opposed to 21% of first time users. Since study aides are accessed at the FWK website and are not downloaded we do not have actual data to corroborate these numbers.

#	Answer	Response	%
1	I read the material Online	58	87%
2	I have downloaded Mobi or ePub for e-Readers (ex; Kindle,iPad, iPhone, Android phone)	19	28%
3	I have downloaded PIY (print-it-yourself) PDFs of individual chapters	20	30%
4	I have dowlcaded MP3 study guides	3	4%
5	have downloaded MP3 chapters	5	7%
6	I have made use of Flashcard Study Tools	25	37%
7	I have made use of Study Quizzes	24	36%

Figure 2. Experienced FWK Users Spring 2011

The spring survey contained a series of statements regarding the usability of FWK digital content and the comparative value of FWK digital content and traditional textbooks. Students were asked to agree or disagree with each statement on a seven-point Likert scale. Figure 3 shows the percentage of all respondents who either agreed or strongly agreed with each statement. On the whole, the responses to all statements were fairly positive. This was particularly true of the most basic usage statements. Almost 95 %

of responding students strongly agreed or agreed that “Flat World Knowledge textbook was easy to use”, 93 % agreed “the Flat World Knowledge textbook was easy to read”, and almost 90 % of responding students agreed that they “could use the Flat World Knowledge textbook in a variety of study environments”.

Students also responded positively to statements that referred to specific features and characteristics made possible by digital content delivery. More than 80 % of students agreed “the features within the digital learning materials (e.g. illustrations, video, audio, glossary, quizzes/practice tests, supplemental reading) help me understand the concepts introduced in the course.” Over 78 % of respondents “liked how the textbook linked to other resources” and believed that the FWK digital content “provided access to more up-to-date material that is available in my print textbooks.” Approximately 72 % agreed with the statement “I prefer the portability of Flat World Knowledge digital content over that of traditional textbooks”.

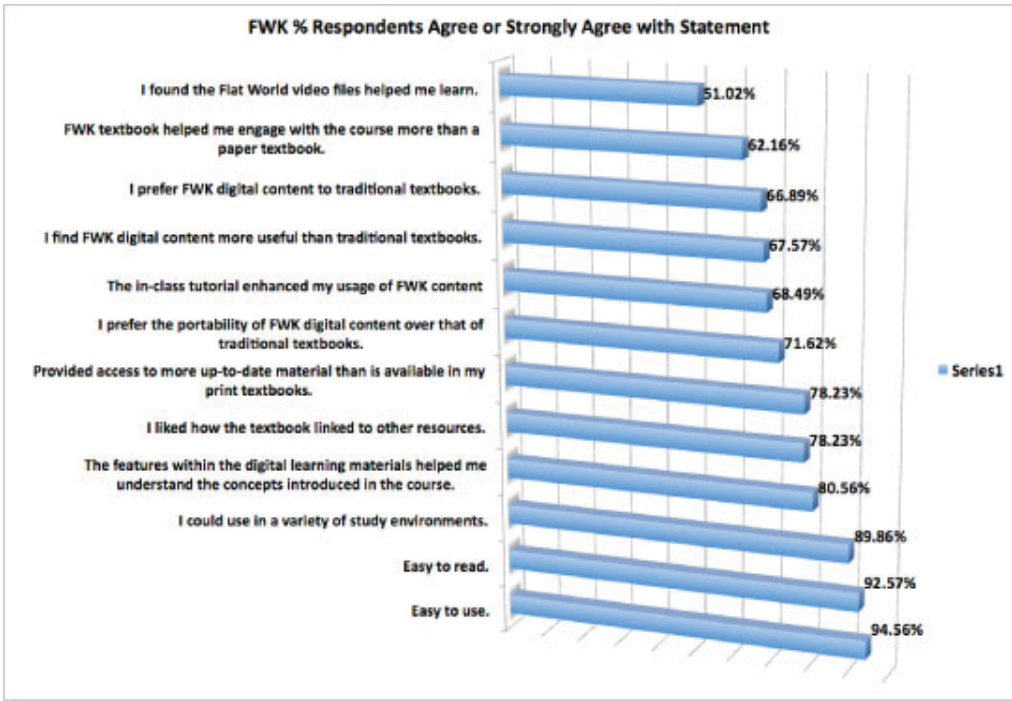

Figure 3. Student statements regarding FWK materials

There was also agreement for three potentially controversial statements which asked students to make a comparative judgment between traditional textbooks and digital content. While these percentages are lower, almost 68 % of students agreed with the statement “I find Flat World Knowledge digital content more useful than traditional textbooks” and just under 67 % agreed with the statements “I prefer Flat World Knowledge digital content to traditional textbooks.” The comparative statement that garnered the least agreement was “The Flat World Knowledge textbook helped me engage with the course more than a paper textbook”, yet 62 % of the students agreed or strongly agreed with that statement as well. The less positive response might be meaningful since, of the three questions in this grouping, this one touches exclusively on the student’s engagement with the content. Responses to the other two questions, which asked about usefulness and preference, might have been influenced by the fact that the FWK seat-licenses were free to the students. It would not be surprising if students preferred a free alternative irrespective of other features or quality issues.

There is also a less than obvious interpretation for the statement, “I found the Flat World videos helped me learn” receiving the lowest agreement of all. Here we need to point out that video was rendered differently depending on the format of the file the student downloads. If, for instance, a student was viewing the textbook on a Kindle that was not connected to the Internet or from a PDF file, they would not have had access to the video content. Therefore utility, in this case, might be interpreted as lack of accessibility as opposed to quality or utility of the videos.

Student outcomes with digital textbooks

While increased access to educational materials is an important goal, it was not the end objective of the faculty members at VSU. Ultimately the hope is that this access to materials lead to better student outcomes, both in terms of learning that takes place and student performance. Such outcomes are difficult to measure, and this study had some particular challenges; nevertheless, we believe we can provide some tentative results.

Beginning with the rollout of the FWK textbooks, VSU initiated a new core curriculum. Some of the

courses comprising this new core curriculum used FWK texts, while others did not. In total there were seven courses that used FWK textbooks (COBU101, COBU200, COBU201, COBU210, COBU300, COBU301, COBU302, COBU310, MISY350), and ten courses that did not use FWK textbooks (COBU110, COBU111, COBU155, COBU170, COBU202, COBU260, COBU304, COBU342, COBU343, COBU400). While these were clearly different courses, they were roughly equivalent in terms of course difficulty. Table 5 illustrates how many students received the grades A, B, or C in the course, versus those who receive a D, F, or W (withdrawal).

Table 5: Grades in courses using FWK text versus courses not using FWK texts

	ABC in core courses using FWK	DFW in core courses using FWK	Total	DFW % with FWK	ABC in core courses w/o FWK	DFW in core courses w/o FWK	Total	DFW % not using FWK
Fall 2010	611	151	762	24.7%	830	270	1100	32.5%
Spring 2011	531	100	631	18.8%	834	242	1076	29.0%

Thus students in courses that used FWK textbooks tended to have higher grades and lower failing and withdrawal rates than those in courses that did not use FWK texts. These results have statistical significance (Fall 2010: z-value =-3.636, $p < 0.000$, Spring 2011: z-value = -4.684, $p<0.000$). As stated previously, because they are different courses, these data cannot be used to establish causality, but nevertheless provide an interesting correlation.

Discussion

It was encouraging to see that 85 % of the students downloaded files. Even more encouraging was the appearance that student outcomes improved, perhaps as a result to greater access to learning materials. The FWK initiative was introduced in order to solve the problem of lack of textbook access. In a perfect world this would mean that all students would now take advantage of the opportunity and embrace the digital textbook initiative. While students had free and open access to the online textbook without registering, only 93 % of students reported reading the textbook online. Additionally, it took almost four weeks for 85 % of students to register their seat license for supplementary materials in the first semester of this pilot program. These were not, inherently, disappointing numbers but they suggest that the situation was not as simple as originally anticipated. We conclude that making textbooks and supplementary materials available to students for free and in multiple formats helps with the access problem, but does not guarantee that all students will use the assigned textbook. Despite a very aggressive campaign, 7 % of students reported not reading online and 5 % of students in the spring term did not even register their seat license. While these results do not demonstrate universal adoption and use by students, free digital content appears to go a long way toward solving the access problem.

There are, however, other possible reasons students don't use textbooks. Some students don't see a need for textbooks. This could be due to previous, disappointing experiences with textbooks that they felt weren't worth the investment. It could also be that they don't want to read a textbook and feel they can get through the course without one. It could be they learned to get by without textbooks because they couldn't afford them and eventually came to believe they were unnecessary. Some students make calculated decisions about which courses they need to invest the time or effort to consume a textbook. Many of the FWK titles were from introductory courses and may have been deemed unnecessary.

Today's students are very familiar with the digital delivery of content since much of the information they receive, from online articles to text messages, is delivered on their computer or smartphone. Survey responses indicate students overwhelmingly find the digital content easy to read and the interface easy to use. This was not unexpected, given the almost constant exposure many students have to digital content in one form or another. This does not mean that digital content will automatically become a student's preferred means of content delivery.

Limitations and future studies

This present study provides a case study of one institution's use of open textbooks and how these textbooks benefitted students. While providing free learning materials increased student access, was positively perceived by students, and was correlated with improved educational outcomes, there are limitations to this study. First, this paper clearly belongs in the realm of action research; there was no attempt to create any type of experimental design or to rigorously determine causality. VSU did intervene at times to encourage students to register for FWK materials in that the purpose of purchasing seat licenses was to help students succeed.

Another weakness in this study is that the choice of courses in which to deploy digital content was more a matter of instructor preference and publisher availability than it was of research design. As it happened, the courses chosen to initiate the Flat World project were also courses that were being taught for the first time as part of the new integrated curriculum. This meant that VSU was limited in its ability to make direct between groups comparisons. In addition, there were likely instructor differences in this process. Although all faculty members expressed confidence in the initiative, there were bound to be differences in how individual faculty presented and delivered the digital content.

Future research also needs to consider subject matter and the level of the material. For instance, some faculty have expressed confidence in the digital delivery of content for more basic, introductory courses but are wary to transition to digital for more complex upper-level courses. This can be attributed to either the nature of the content or to the comfort level of the instructor. Either way, this is an issue that needs to be considered. Similarly, we need to examine possible credibility issues, not only from the instructor point of view, but also from a student perspective. Do students find textbooks a more trusted, authoritative resource than online materials?

With or without this initiative, students are going to be exposed to more and more digital content in an increasing variety of circumstances. As the digital landscape grows and develops students and faculty alike will be exposed to a huge variety of digital content. Already publishers and software designers are competing to come up with better ways for people to view, deliver, and interact with digital content.

Conclusion

The majority of this discussion has centred on the student experience. We have compared, within the scope of this pilot study, the students' first real experience with digital textbooks to their longstanding relationship with traditional textbooks.

The issue of copyright was invisible to the students but it had defined their experience. The ability to download various file formats was essential to the seat-license process but it was only possible because Creative Commons freed the content from its traditional moorings. We were able to track downloads because students were allowed to freely download the content. They were able to store it on the device or devices of their choice and they were allowed to keep it. This level of flexibility and accessibility provided students with unlimited access their textbooks. This feature also changed the value proposition. Since students now had permanent access to content, the value was in the information and not in the textbook as a commodity. This flexibility will potentially create more value as more students and faculty shift towards low-cost, accessible digital content.

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