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# Undesirable Difficulties: Investigating Barriers to Students' Learning with Ebooks in a Semester-length Course

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# Undesirable Difficulties: Investigating Barriers to Students' Learning with Ebooks in a Semester-length Course

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## **Abstract**

Our ability to make informed decisions about ebooks is constrained by our limited understanding of how students perceive and use them. A team of librarians and a professor in learning sciences asked graduate students to serve as informants on student experience with ebooks. In two semester-long studies we analyzed student work, focusing on barriers and affordances they identified. In the first cohort, students who chose to explore ebooks uncovered affordances. In the second cohort, student comfort levels with PDF formats increased, while comfort with ebooks decreased. We discuss strategies for minimizing challenges and increasing desirable difficulties to support ebooks as learning tools.

## **Introduction**

There have been calls to fill gaps in understanding how students perceive and use ebooks.<sup>1</sup> For instance, little is known about why and when students switch between electronic and paper formats<sup>2</sup> or what affordances and barriers ebooks present.<sup>3</sup> Affordances refers to the idea that any object or technology can *afford* myriad uses, but these must be perceived as such by the user.<sup>4</sup> This study reports on a collaboration between librarians and a learning scientist that investigated these questions in an academic program focused on adult learning, instructional design, and

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technology, including elearning. According to the Network of Academic Programs in the Learning Sciences (NAPLeS), most learning science programs are housed in colleges of education.<sup>5</sup> In contrast, this program is part of the university library, resulting in frequent discussions of common issues between the librarians and program faculty.

As librarians, we invest in ebooks for many reasons. Ebooks are often acquired in packages, making them an affordable alternative to title-by-title selection. Ebooks are especially convenient for online students and they require no shelf space, thus not adding to perennial space problems. Librarians' contact with ebooks after they have been added to the collection is often limited to addressing access difficulties.

As teaching faculty, we choose texts based on content, but as more of our students need to access texts remotely we are often forced to use whatever formats or interfaces are available for the text. And because of the high cost of texts, we are often encouraged to consider more affordable options. Unaware of the research on ebooks and issues related to eplatform navigation, faculty commonly adopt ebooks because of the high cost of textbooks,<sup>6</sup> even though many students reportedly prefer—and would pay more—for paper versions.<sup>7</sup>

In 2015, we began a partnership in which we asked students to apply what they were learning in their instructional design class to evaluate ebooks and eplatforms. The goal of the course is for students to learn the instructional design process; this includes objectives such as identifying learning needs, analyzing tasks that learners need to be able to accomplish as a result of training, and developing instructional designs based on their analysis. We present a research study about this approach. Our research questions were to learn what affordances and barriers students noted about ebooks and eplatforms (RQ1), and how student perceptions of ebook affordances and

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barriers changes over time (RQ2). The objective was to analyze which platforms promoted learning and presented the fewest problems, and to use that knowledge to guide future ebook acquisitions decisions and interactions with faculty as they selected ebooks for their classes. As the study progressed, we became increasingly interested in how principles of instructional design might be employed to promote use of ebooks as academic resources.

## Literature Review

To frame our work, we consider past research on student perceptions and use of ebooks, focusing deliberately on recent research. As our research is unique in following two sections of a graduate instructional design class throughout the semester, we build on research conducted with undergraduate and graduate students in a variety of disciplines and study durations.

The year 2010 could be considered “Year Zero” for ebooks,<sup>8</sup> as this was when the iPad was introduced, significantly changing how users interacted with ebooks, especially as the purchase price soon started to decrease for all tablets. Thus, our review focuses primarily on post-2010 publications related to ebooks. We review studies that provide insight into the relationship between perceptions about ebooks and ebook use. We also examine barriers to ebook use, and the use of specific tools within ebooks that may be of benefit. We consider the instructional conditions that help students make effective use of ebooks, grounded in research on how people learn. We note that few studies report on student ebook experience; those that do tend to focus on undergraduate students. Therefore our choice of a graduate instructional design setting provides a productive space to consider ebooks at the intersection of learning, technology and design.

Many studies and review articles have investigated students’ attitudes toward ebooks.<sup>9</sup> One study reports that graduate students’ pre-existing attitudes towards ebooks in general are a strong

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predictor of how they perceive and use academic ebooks.<sup>10</sup> Similarly, Revelle, et al's study of faculty, staff, graduate and undergraduate students identified four reader profiles—book lovers, pragmatists, technophiles, and printers—whose traits influenced their acceptance and use of ebooks.<sup>11</sup> Another study found that undergraduate students who had an aesthetic love of print books had a negative perception of ebooks.<sup>12</sup> These students described feeling satisfaction with the tangible aspects of the physical book, for example, the sense of progress associated with turning pages, something a scroll bar does not seem to replace.<sup>13</sup> They also viewed ebook content as more ephemeral and lacking the authority of print.<sup>14</sup> Perhaps related to this, faculty and graduate student ebook users in another study characterized their engagement with ebooks as less intellectual.<sup>15</sup>

Instructor support may mitigate negative student perceptions about ebooks. A study of undergraduates found that allowing students to choose whether or not to use an ebook can actually encourage them to try an ebook.<sup>16</sup> Another study of undergraduate and graduate students found that prior course-based use of an ebook predicts preference for ebooks over print.<sup>17</sup> Other surveys of undergraduates and graduates found that increased awareness of ebooks promoted greater rates of use.<sup>18</sup> One study reported that students who perceived ebooks to be easy to use tended to use them more.<sup>19</sup> Despite these findings, other researchers note that student preference for accessing academic content in print remains strong,<sup>20</sup> even with increased exposure and less reliance on dedicated ereaders.<sup>21</sup> Students report a preference for print when reading complex texts and attribute this preference, despite initial enthusiasm for the electronic text, to the complexities of using electronic formats and documents effectively.<sup>22</sup>

Perceptions of ebooks may be shaped by negative experiences with use of this format. There is no shortage of studies reporting on barriers encountered by ebook users. Ebook use is impacted

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by various factors, such as accessibility, cost, and reading complexity.<sup>23</sup> Comfort is another factor. Students in multiple studies report an aversion to reading long texts as ebooks in an effort to avoid eyestrain.<sup>24</sup> Other barriers identified in a metasynthesis of research on ebook and print-book usage include hardware and software issues, battery life, and ability to print.<sup>25</sup>

Ebook interfaces often perplex users. Studies have investigated how students navigate ebooks.<sup>26</sup> In one study of undergraduates, students expressed frustration when trying to navigate ebooks, use toolbars, and copy text.<sup>27</sup> Other studies found that the undergraduate subjects tended to use ebooks differently from print, searching for information rather than reading.<sup>28</sup> Because eplatforms differ, locating the search box is not always straightforward, nor is interpreting the results. One study of undergraduates found that once students located a term, it was not clear where it was located within the text, a factor that is important when attempting to piece together understanding.<sup>29</sup> Similarly, another study which surveyed graduates and undergraduates shared comments on how display choices made by vendors made it difficult for students to find terms and understand context.<sup>30</sup> Muir and Hawes noted that student perceptions of a platform's usability relied heavily on what they wished to do (such as accessing, printing, and sharing content) and whether the particular platform made it challenging to do so.<sup>31</sup>

Some vendors seek to improve the experience of ebook use by offering tools (e.g., highlighters, annotation features). Yet several studies show low rates of tool use,<sup>32</sup> despite findings that students appreciate these tools.<sup>33</sup> In a study of ebook usage across 12 courses, fewer than 10% of students used the highlighting or annotation tool substantively.<sup>34</sup> Platform differences may explain low tool use. Given the lack of standardization across platforms, students must always do some navigation,<sup>35</sup> suggesting they need to be knowledgeable about the tools ebooks afford and need to view the tools as useful. Each platform may offer different tools with unique names and

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screen placement, presenting a challenge to students who are trying to understand what they can do and how they can do it.<sup>36</sup> This may explain students' struggles to find highlighting and annotating capabilities within ebooks.<sup>37</sup> It may also clarify why prior ebook usage does not predict greater likelihood of tool use in subsequent ebook experiences.<sup>38</sup>

Researchers have also investigated whether students learn differently using ebooks versus print books. Early studies found that students learned less well with ebooks, hypothesizing that this may have been due in part to eyestrain.<sup>39</sup> Students in a later study reported overall satisfaction with their ebook use, but also described how fatigue after reading on-screen undermined their comprehension.<sup>40</sup> Recent experimental studies suggest that students have better recall when working with print.<sup>41</sup> When learning and comprehension are the goal, students appear to perform better with print books.<sup>42</sup>

Past research has demonstrated that under some conditions, students engage with ebooks in a shallow manner,<sup>43</sup> in part because distractions are abundant when reading on a web-enabled device, and students report that they tend to multi-task while reading ebooks.<sup>44</sup> Students tend to skim or scan rather than read for understanding.<sup>45</sup> Students also report that they are more likely to revisit and restudy previously read materials if they are in print rather than ebook format.<sup>46</sup> Yet other studies have found no difference in comprehension from ebooks versus print,<sup>47</sup> and have found equivalent performance from ebook and print book users on course learning outcomes.<sup>48</sup> Some studies suggest that students who choose to use ebooks over print may even have better self-directed learning skills.<sup>49</sup> These divergent findings may reflect the different ways that students interact with ebooks, some of which are more productive for learning than others.<sup>50</sup>

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An overall challenge to understanding ebook use, as well as the potential for ebooks to better support learning involves the scarcity of studies reporting qualitative data about the ebook use experience, and particularly how it is shaped over time. In a review of 75 studies of ebooks focusing on usage,<sup>51</sup> over 57% were restricted to surveys, with an additional 17% that supplemented surveys with usage statistics and 5% that focused only on usage statistics. Very few studies (8%) involved interviews about usage, and only 9% involved process data of actual usage, either in an experimental or naturalistic setting. Understanding how ebooks might support learning requires data about student processes. For instance, in a study that used photo-elicitation and interviews, we are afforded a glimpse into student point-of-view.<sup>52</sup>

Even when instructionally relevant materials are used in studies, most such studies have been focused on a short duration (an hour or less).<sup>53</sup> Most semester-long investigations of ebooks in courses have been limited to survey and usage statistics,<sup>54</sup> sometimes supplemented with instructor interviews.<sup>55</sup> In such cases, the outcome of interest is typically course grades, which are problematic because of their multidimensional nature (many things are measured in a course grade) and their susceptibility to bias and variability across instructors.

Finally, most studies, particularly those that investigate how students use ebooks, have focused on undergraduate populations. Our study addresses these gaps, spanning two semester-long investigations that include multiple forms of data drawn from work with graduate students.

To better understand differences between learning from an ebook versus print, Ackerman and Lauterman compared recall on three types of tasks (untimed, timed, and interrupted) across the two conditions (ebook versus print).<sup>56</sup> They found that student recall was lower on the timed and untimed tasks for ebook compared to print. Yet, there was no difference between conditions for



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the interrupted task, in which students were stopped earlier than they expected to be. The authors inferred that students are able to effectively plan self-regulation strategies when working with print, but not when working with ebook materials. This finding suggests that it may be possible for ebooks to better support learning if students can be directed—through instructional design supports and learning tasks—to effectively engage the format.

Scholars have called for ebooks and eplatforms to be “developed and implemented according to the principles of sound instructional design”.<sup>57</sup> Supporting student use of ebooks means considering the kinds of scaffolds instructors may need to provide,<sup>58</sup> and therefore, the kinds of supports librarians may want to focus on in their interactions with faculty.

As we explored student descriptions of affordances and barriers and how those changed over the course of a semester, we also considered how instructional design could better support effective ebook use. The ways we design instructional tasks shape how students engage with resources, including ebooks.<sup>59</sup> For instance, researchers have argued that students benefit from practice tests that allow them to calibrate their perceptions against their actual comprehension from ebook reading, although the benefits of this may depend somewhat on student preferences;<sup>60</sup> while students who preferred ebooks improved in comprehension as a result of the testing, those with an expressed preference for paper did not. Studies have also demonstrated potential value of ebook tools, which may be thought of as scaffolds. Students who annotated their ebook tended to receive higher grades.<sup>61</sup> The instructor’s use of the ebook can shape student use; when instructors annotated an ebook, students tended to use the tools more.<sup>62</sup> New tools, such as visual timelines that make working with annotations easier, can also improve recall.<sup>63</sup>

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However, we also caution that research on learning has clarified that some actions produce “deceptive clarity.”<sup>64</sup> For instance, simply highlighting text or adding bookmarks does not lead to greater learning, and further, can lead students to think they have learned something simply because they highlighted or bookmarked. This is evidenced in a study that found students who bookmarked many pages tended to receive higher grades, but only if they also *read* those pages;<sup>65</sup> those who bookmarked without reading actually got lower grades. This may explain students’ tendency to be inaccurate when judging whether they learned from ebook reading, compared to print.<sup>66</sup>

In order to support student learning, rather than focusing on making the learning more efficient, we should introduce “desirable difficulties.”<sup>67</sup> By introducing a need to intentionally recall information, students’ memories of the information are enhanced. Typically, this means introducing a task or goal.

Studies investigating such approaches have found students first search for information in ebooks, and then work to develop understanding.<sup>68</sup> Likewise, when students were given a goal to apply what they were learning in an ebook, those who spent more time reading relevant concepts in their ebook tended to achieve higher learning outcomes, regardless of reading comprehension and prior knowledge.<sup>69</sup>

## Methods

### *Study design & research purpose*

We report on two cohorts’ experiences with ebooks. For both cohorts, we positioned students as instructional designers engaged in evaluation of eplatforms *with* us, as informants on their experiences. Students in cohort 1 engaged with a variety of eplatforms (Figure 1). Influenced by

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our observations of cohort 1, students in cohort 2 engaged with one eplatform multiple times before working with a second eplatform. We anticipated students would notice affordances of one eplatform, and then look for similar affordances when introduced to a new platform. We were guided by the following research questions – what affordances and barriers would students note about ebooks and eplatforms and would their perceptions change over time whether they used multiple platforms or just one platform? To address this research question, we employed qualitative methods. While the small sample size indeed necessitated such an approach, more important was our desire to shed light on the particularizability of students' experiences with ebooks and eplatforms.<sup>70</sup> There are no clear rules about sample size, but researchers have argued that as few as six participants may provide sufficient data on key constructs, with 12 providing saturation;<sup>71</sup> these figures are based in a study that included 90 participants and used probabilistic methods to derive these numbers. However, we acknowledge that the contextual nature and small sample size may limit the transferability of our results.

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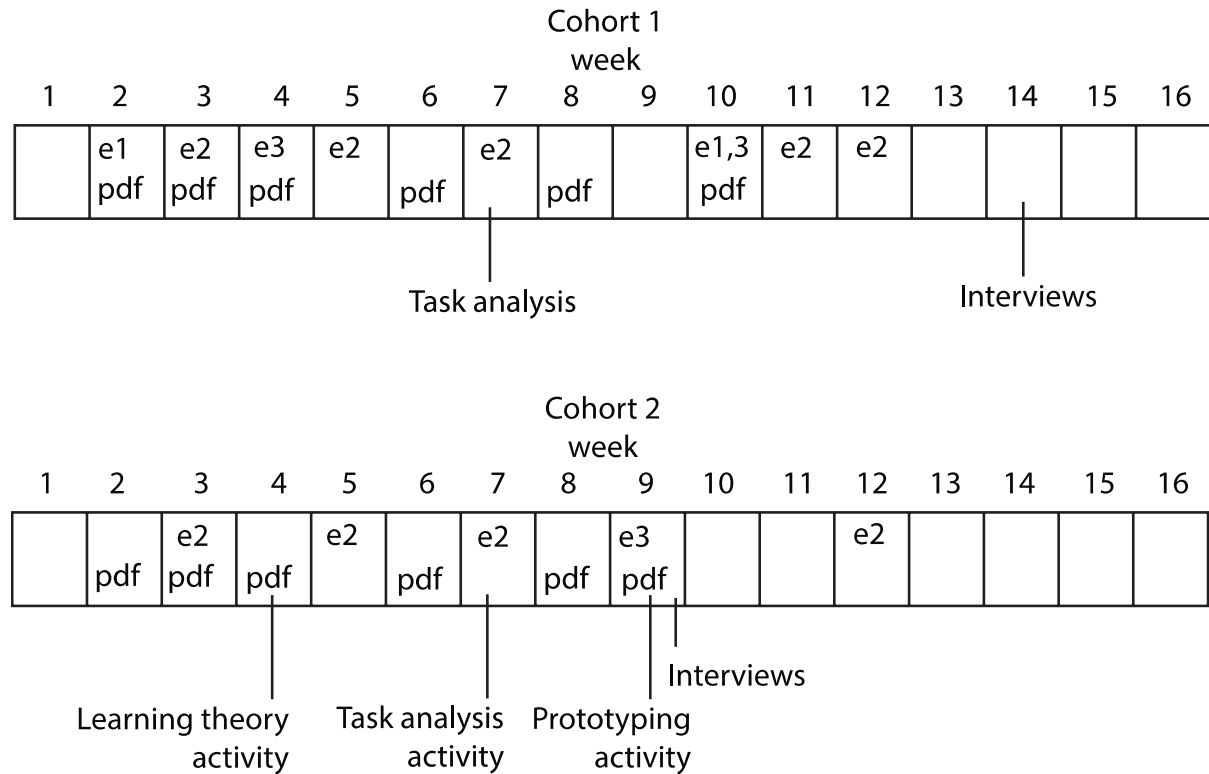


Figure 1. Course structure and study design for cohort 1 and cohort 2.

### *Participants, setting and study materials*

Participants included students enrolled in a required master’s level instructional design course at a Hispanic-serving research institution in the southwestern U.S. (N=22). In cohort 1 (Fall 2015), 12 students provided consent; of these, nine were enrolled in the MA program, two were prospective PhD students, and one was a prospective MA student. Ten students completed all measures. In cohort 2 (Fall 2016), ten students provided consent; of these, six were enrolled in the MA program, two were prospective MA students, one was a PhD student in another program, and one was a prospective PhD student. The program primarily serves working professionals, many of whom return to graduate school later in life. The class met face-to-face for 16 weeks, 150 minutes per week.

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In the first week of class, the instructor (one of the authors of this paper) invited the three library researchers to visit the class for discussion of the ebook study. The instructor positioned the students as instructional designers, explaining that they had an important role to play in building understanding of students' experiences with ebooks, in particular because they would be learning instructional design practices that would help them consider the affordances and barriers of ebooks. The instructor informed the students that the course readings were instructive guides for the assignments, and that students should refer to them as they worked on their assignments.

### **Cohort 1**

Our approach with the first study was to have students use a variety of ebook readings from different platforms. The rationale was to encourage exploration of ebooks in the hopes that, as students discovered the affordances of a particular ebook platform, they might come to expect and seek out similar affordances in other ebook platforms.

The text chosen by the instructor, *Designing Effective Instruction*,<sup>72</sup> was available through an ebook provider, VitalSource, using the CourseSmart platform. The library team incentivized ebook usage by letting students know that we would cover the costs of renting it. Five students responded to this offer. Other students in the class independently purchased or rented copies of the required text.

The instructor chose additional weekly readings—chapters and journal articles—to support specific learning objectives. Where available, the library team provided links to these readings, using existing vendor platforms offered by EBSCO, EBL, and Books 24x7. As a result, all students in the course accessed and read articles and chapters from multiple vendor platforms,

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and in their weekly reading commentaries addressed format issues related to interface, eplatform tools, etc. Two platforms (e1, e3) were used for no more than two readings (Figure 1).

## **Cohort 2**

After reflecting on experiences from the previous semester, we took a different approach to the second study. We wanted to encourage a deeper exploration of ebook affordances and barriers by requiring regular work with one primary platform and fewer encounters with secondary platforms. Our hope was that a reduced number of interactions with other ebook platforms would position students to provide deeper insights.

The same text was required for the class, but by this point, it was available via two platforms—Amazon Kindle and the VitalSource CourseSmart platform. We required students to use one of these ebook platforms. The library team incentivized use of the Amazon Kindle version by paying the rental costs. Three students responded to this offer. Other students independently purchased or rented the text through the Kindle or CourseSmart platform.

Many of the same weekly readings assigned to cohort 1 were also assigned to cohort 2. We eliminated one of the platforms based on negative feedback from students in cohort 1. Of the remaining platforms, one was used to access four readings (e2) and the other (e3) was used to access one reading (Figure 1). In addition, during four weeks of the course, the students used only PDF readings.

## ***Data collection***

Data included course assignments and interviews as detailed below.

## **Reading responses**

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We presented the format of weekly readings (i.e., ebook chapters from various platforms, PDFs, physical books) as an instructional design problem. As part of their grade for weekly reading responses, students were asked to “explain how you read each article/chapter and if you had any issues or challenges as a result of the format.”

### **In-class activities**

In both courses, students completed in-class activities that introduced them to various instructional design practices. Students completed an activity to learn about the process of “task analysis.” Conducting a task analysis involves depicting the sequence of steps taken to successfully complete a task, and then considering where a novice would need support. For instance, if the task is how to boil an egg, the task analysis would depict in a flow chart expert performance of boiling an egg. The task analysis activity in this course consisted of four parts:

1. Describe how you access the weekly readings, engage with the readings and write reading responses. What does someone need to know to be able to do them? Draw a flowchart to show the steps involved.
2. Sketch out a design to teach future students how to access weekly readings, engage with the readings and write reading responses. Keep in mind the range of experience levels and interests: some students may be second language learners or have learning differences (e.g., dyslexia); some students are prospective doctoral students, who need the class as a prerequisite; most are current or prospective masters students with a strong interest in [this program], but not always with a strong interest in instructional design. Describe the learner needs.

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3. Describe how you would scaffold students to access the weekly readings, engage with the readings and write reading responses.
4. How would you assess learning?

Cohort 2 students completed two additional in-class activities related to ebooks. The learning theory activity directed students to articulate the theory of learning instantiated in various designs, including the ebook platforms they were using. By *instantiated*, we mean that any design for learning has a theory of learning designed into it, whether intentionally or not. Commonly, when a theory of learning is not deliberately designed into a technology, past educational experiences influence the designer, who reifies these as they design. Consider, for example, that when individuals are asked to design an online training, they may base the format on what they have experienced rather than on what research has to say about how people learn. The prototyping activity asked students to mock-up a new eplatform and describe how it would be used. They were challenged to consider “a perfect world, an ebook platform would be able to support my learning by (dream big here!)...”

## Interviews

As part of our usability study we asked all cohort 1 students to volunteer to be interviewed; four students volunteered. Given that it was toward the end of the semester, we were satisfied with a 33% response rate. We asked them to “think aloud” as they worked with three eplatforms, including two they had already encountered. We conjectured that because they had used ebooks for multiple weeks and across platforms, they would be familiar with tools and, when presented with a new platform, would seek these out. We asked them to describe how they used ebooks,



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what design features they liked and disliked, and frustration points. We documented student comments and actions through field notes.

Students in cohort 2 worked with one ebook platform for most of the semester and we anticipated this would lead them to identify what they liked and disliked about the platform. We interviewed all students about what their ideal ebook interface would include. We audio recorded and transcribed these interviews.

### *Data analysis*

To answer the first research question, which investigated what affordances and barriers students would note about ebooks and eplatforms, we analyzed the in-class activities, interviews, and reading responses in terms of the specific affordances and barriers of ebooks (Table 1). We sought to identify both frequent and unique ideas across students. While a student might comment on the importance of note taking tools for two or more different readings, we counted this as one affordance. This approach allowed use to compare across students who were more or less prolific in their commenting. We narrowed our focus to descriptions of ebook affordances after finding that student descriptions of print affordances and barriers were frequently juxtaposed with comments about electronic format.

Table 1. Coding scheme for specific ebook affordances and barriers

<b>Affordance Codes</b>	<b>Affordance = students mention the factor as something positive or beneficial Barrier = students mention the factor as something negative or harmful</b>
Online search	searching online for concepts and definitions is possible (Affordance only)
Syncing	syncing across devices is / is not supported.
Learning	ebooks can support their learning (Affordance only)
Convenient	ebooks are / are not convenient or portable
Green	ebooks are an environmentally sound choice (Affordance only)
Navigate	it is / is not easy to find, browse, or search text passages in an ebook
Offline	offline reading is / is not supported
Print/download	Printing or downloading is / is not easy or possible
Interface	the interface, i.e., the look and feel of the ebook, is / is not clear and easy to use
Access difficult	access process, e.g., logins, checking ebooks in/out was cumbersome (Barrier only)
Tiring	e reading is tiring or physically challenging (e.g., causes eyestrain) (Barrier only)
Uncomfortable	e reading is uncomfortable (Barrier only)
Error	error message was encountered (Barrier only)
Session timeout	session timed out (Barrier only)
<b>Tool-Specific Codes</b>	<b>Affordance = students found, noticed and/or appreciated the tool Barrier = students couldn't find or had difficulty using the desired tool</b>
Copy/Paste	select text passages from ebook and copy them in another document
Highlighting	overlay color on a text passage to emphasize it
Note-Taking	add comments to the text or margins
Searchable text	jump to each instance of a word or phrase
Text size	adjust the text size or font

To answer the second research question, whether their perceptions of affordances and barriers would change over time when they used multiple platforms or just one platform, we developed a coding scheme for the weekly reading responses inductively (Table 2). One study author prepared a scheme with categories defining affordances and barriers associated with print and electronic formats that were described by students. In addition, a category (Print Creative) was developed based on students' descriptions of strategies for printing parts of an ebook. Each author independently applied this coding scheme to score the 2015 data and then came together

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to review and discuss any areas of disagreement.<sup>73</sup> Through this process, we modified the coding scheme: one initial category relating to the relationship between the format and learning was abandoned after we experienced difficulty applying it consistently because it required too much inference. Instead, we refined the P-afford, P-barrier, E-afford, E-barrier categories to include a level for responses in which a student made a causal statement about a specific barrier or affordance. We also added a category (Device) to gain a clearer picture of the devices students used to access their weekly readings. We independently rescored all data with the final coding scheme (Table 1). Some students wrote multiple sentences, and in some weeks, evaluated more than one format. Therefore, each response could be assigned more than one code.

We calculated averages for each category. To calculate descriptive statistics, we normalized the scores to range from 0 to 1, which allowed us to compare categories that did not use the three-point range.

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Table 2. Coding scheme for analyzing reading responses

Code	Definition	Score = 1	Score = 2	Score = 3
Print	Prefers to read hard copy or printed copy, including book	Did not read in hardcopy or print anything	Did read hard copy and/or printed something out (may also have read something electronically)	NA
Print Creative	Resists reading electronic formats and describes strategies for getting materials to print	Did not print or only printed easy-to-print	Describes work-arounds / issues navigated to be able to print	NA
P-afford	Describes an affordance of print format	No specific affordance mentioned	A specific affordance is mentioned	A specific affordance is mentioned, and a causal statement is made about it.
P-barrier	Describes a barrier or challenge of print format	No specific barrier mentioned	A specific barrier is mentioned	A specific barrier is mentioned, and a causal statement is made about it.
E-afford	Describes an affordance of electronic format	No specific affordance mentioned	A specific affordance is mentioned	A specific affordance is mentioned, and a causal statement is made about it.
E-barrier	Describes a barrier or challenge of electronic format	No specific barrier mentioned	A specific barrier is mentioned	A specific barrier is mentioned, and a causal statement is made about it.
Device	Mentions factors (positive or negative) related to hardware	Nothing about hardware is mentioned	Hardware is mentioned, such as "desktop" "Iphone," "computer screen" etc., but not "screen"	A more complex statement about hardware, whether accurate or suppositional, is included

## Results and Discussion

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To address our first research question on what affordances and barriers students note about ebooks and eplatforms, we first present our analysis of affordances, and then of barriers. For each, we begin with our analysis of the reading responses, noting the number of students who mentioned each affordance or barrier across both cohorts. We triangulate these, providing examples from across our analysis of the reading responses, in-class activities, and interviews.

### *Affordances*

Interestingly, students mentioned few affordances. The most commonly noted affordances, features of the eplatform that users perceived positively, included readability (32% of students), portability (27%), and navigation (23%) (See Figure 2 for all affordances).

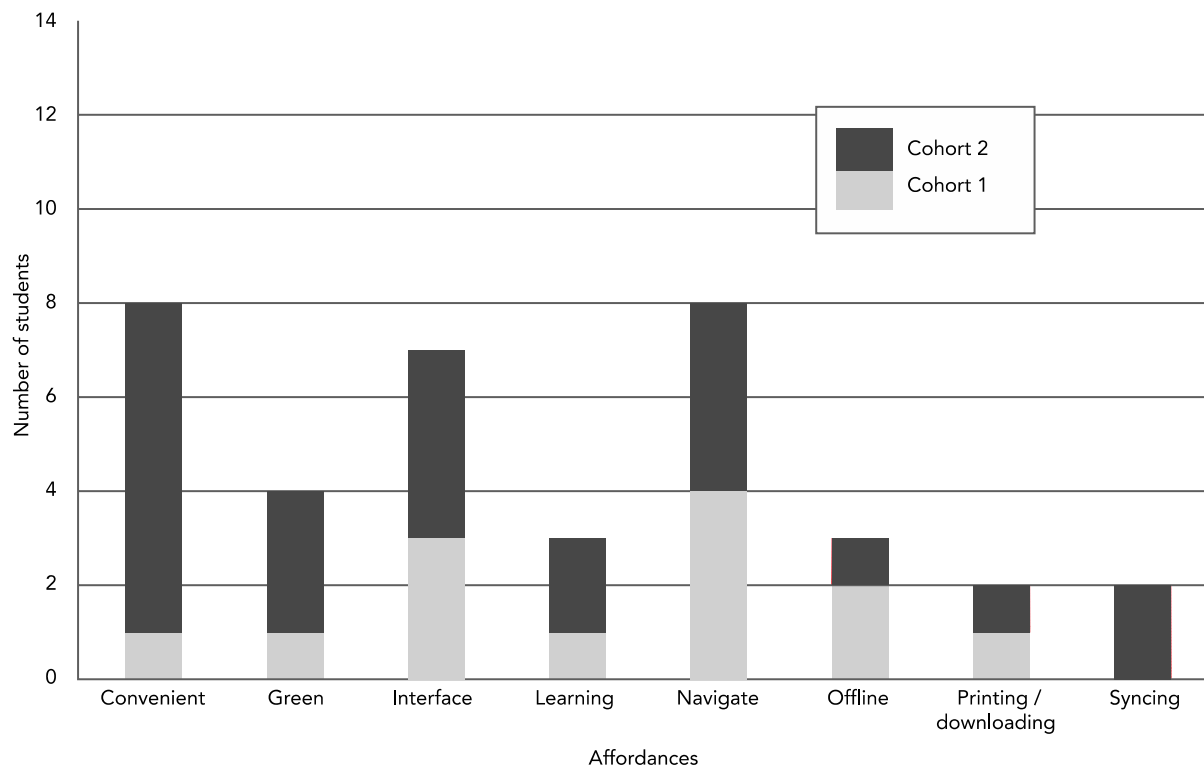


Figure 2. Affordances of ebooks noted by multiple students across both cohorts. Five students in cohort 1 and nine students in cohort 2 noted affordances.

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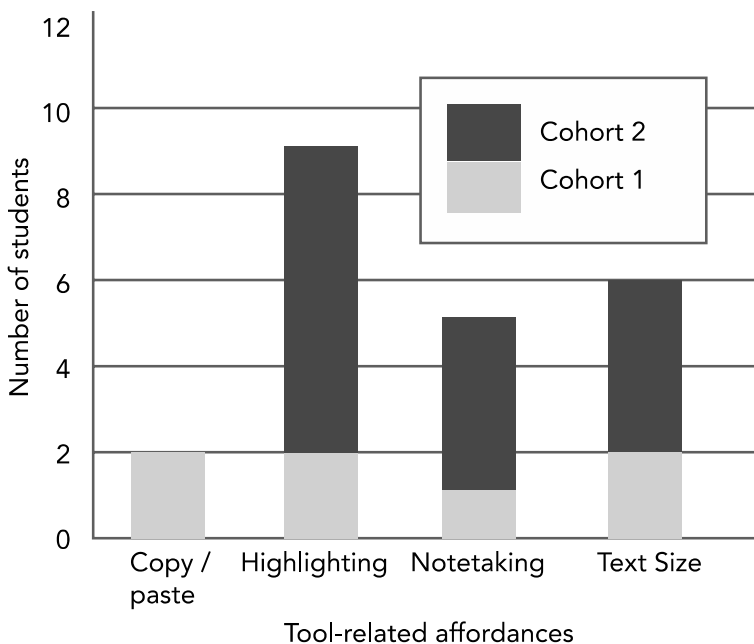
For instance, one student explained that he liked the interface, linking it to his ability to use the tools he wanted, “I read the eBook on my iPad within the Kindle app. It’s easy and convenience [sic] to read on my iPad and make highlight and underline with notes.” Another student expressed a more lukewarm appreciation of the interface, “CourseSmart reader is pretty good, once you get used to it.” This comment highlights that it takes time for students to learn the tools. Students appreciated having a clear navigation structure, as noted by a cohort 1 student, “I really like that the page numbers are always visible in the table of contents because when I cite or something I don’t have to scroll up to the top of the page or down to the top of the next page.” Likewise, on the task analysis activity, students spoke to ease of use with navigation. As pointed out by Hernon et. al<sup>74</sup> and others, ebook users often struggle when navigating new interfaces and appreciate when navigation structures support rather than hinder their aims. Students often tied portability to a particular device. For example, a cohort 2 student wrote, “I do like the ability to have this book and many others on my iPad. (Much lighter weight).” On the learning theory activity, students who used the PDF Kindle platform mentioned more affordances than those who used other platforms.

Another affordance identified by students was the idea of ebooks as an environmentally responsible choice. For instance, a cohort 2 student explained, “I felt slightly victorious after printing the first two chapters and then decided to spare a tree and read the final chapter (13) on my phone.” These affordances are consistent with perceived benefits of ebooks identified by other studies.<sup>75</sup>

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Even students who expressed appreciation for ebooks were pleased when printing and downloading were supported and easy to achieve. This may reflect a preference for reading academic texts in print as found by Mizrachi.<sup>76</sup> Some affordances were only mentioned by a single student. These included reading offline, synchronizing ebooks across devices, and links to external sources for more information.

In terms of the specific tool affordances, students appreciated being able to highlight (41%) and take notes (27%) (Figure 3). The most popular tool-related affordances cited by students were highlighting, note taking, manipulating text size, copying text, and the ability to search the text. In the task analysis activity, most students (76%) across both studies mentioned highlighting as a step in their process of engaging with readings. A cohort 1 student detailed this, “As I read, I can easily highlight/comment on ANYTHING in chapter.” Likewise, students noted highlighting and taking notes in their learning theory activity and prototyping activity. One student discovered and appreciated a tool that generated a formatted citation.



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Figure 3. Tool-related affordances noted by multiple students across both cohorts. Three students in cohort 1 and nine students in cohort 2 noted tool-related affordances.

Only one student mentioned the dictionary tool in the reading responses, but many, prompted by the instructions, mentioned this on the prototyping activity, suggesting they had not noticed this tool. These features are consistent with findings from other studies,<sup>77</sup> though the emphasis on manipulating text size may be more pronounced among this group of students, some of whom also mentioned their age or eyesight issues when noting the importance of text size manipulation.

## *Barriers*

Overall, students noted more barriers than affordances. This would both include challenges they encountered with the platform and interface, and also features that actually were included in the platform or interface but that they failed to discover. These included that navigation was difficult (45% of students), that printing or downloading was difficult (36%), that the interface was challenging (32%) (Figure 4) and a number of other barriers encountered in their weekly work with ebooks.



## Undesirable Difficulties

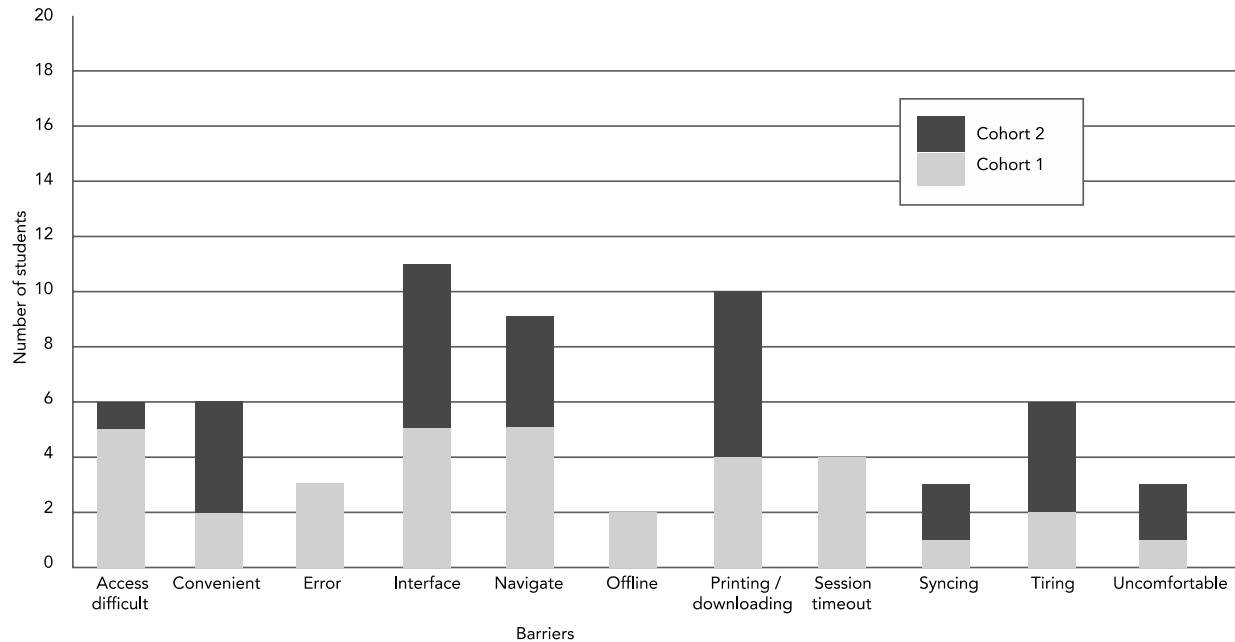


Figure 4. Barriers noted by multiple students across cohorts. Ten students in cohort 1 and ten students in cohort 2 noted barriers.

Students characterized the platform as complex to use. As one student pointed out: “Design is not intuitive to first time users.” Almost all mentioned that the design assumed prior knowledge of the format. One student summarized this well:

“Seems like the designers either thought users had pre-requisite knowledge for certain features or certain features were meant ONLY for power users. Maybe designer thought reading is enough for learning. Maybe the designer did NOT predict that ebooks would be used for education & would be mostly for leisure reading.”

The idea that eplatform design is not intuitive has been noted in previous studies.<sup>78</sup> As part of this, navigation issues were noted by a student from cohort 1: “I have no idea how to mark how to navigate back to the page I want with this next and previous stuff. At least with the other readings we had page numbers.”

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The complexity of accessing and working with ebooks was particularly visible in the diagrams students produced in their task analysis. These flowcharts often involved 20 or more steps. One student included in the flowchart a decision point about how one could seek help if encountering problems with downloading texts. Another student, whose response is captured below (Figure 5), illustrated several pain points with accessing ebooks in the flowchart. Although this response was unique in calling out these problems, the barriers mentioned here—being forced to create an account or getting logged out of readings—were also noted by students across both classes within their individual weekly reading responses.

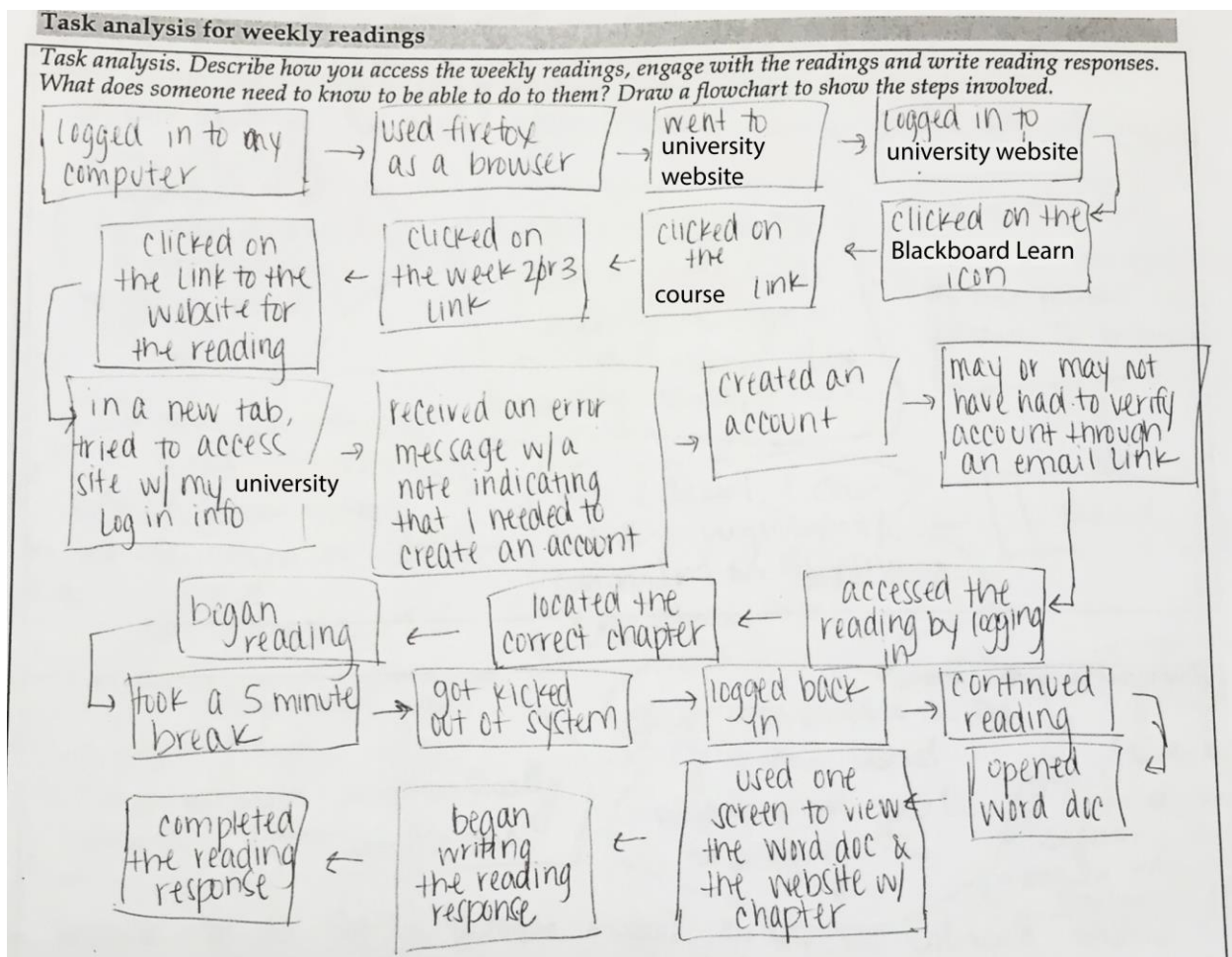


Figure 5: Task Analysis for Weekly Readings

## Undesirable Difficulties

Students experienced difficulties with access, including requirements to log in or to check out materials, which confused them: "I read the chapter on my Mac through the University Library system. I had no problem accessing the information, but was asked to rent the book after approximately 20 minutes of reading. I am not sure what this means since I was simply asked to click one of two options." These same issues showed up in the flowcharts on the task analysis. Three students across both cohorts mentioned the need to remember login credentials within their flowcharts. Two students specifically mentioned access barriers.

Students across both cohorts described challenges with reading online due to a lack of connectivity to networking or power. In some cases, this was articulated as a temporary constraint connected to travel as described by a student from cohort 2: "I was traveling and had a very difficult time finding a hotspot that would support me [sic] reading assignment. When I finally got to the hotel and Wifi, my computer was dead. I needed to charge my surface pro, get on the Wifi and start my reading. I really needed to be able to read this offline. I was on a plane and traveling a lot, access was an issue." In other cases, the problems persisted across multiple weeks. One student in cohort 1 mentioned problems with wifi over three different weeks and three students experienced problems with session timeouts. Research conducted in other countries has surfaced similar connectivity concerns.<sup>79</sup>

Students often wanted to print or download and expressed frustration when this was not readily achieved or if the resulting product was subpar: "I decided to print this chapter but it printed with the edges of the text cut off so I reverted to reading this chapter in eFormat as well."

Five students commented specifically on physical challenges with reading electronic formats. In most cases, this concerned eyestrain or fatigue, for example: "Likewise because I already spend a

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large amount of time using computers at work my eyes tend to get fatigued from computer screens." The influence of eformats on eyestrain has been expressed in other studies.<sup>80</sup> On the learning theory assignment, many mentioned the inability to adjust the font size and eyestrain. One student explained, "Hard to read—felt like I was going cross-eyed during the reading. Probably missed something important—a little distracting." One student included a loop in her task analysis flowchart to illustrate her need to re-read electronic text in order to remember it, something she said was not necessary when reading print. These comments suggest that students were metacognitive in monitoring their comprehension. However, there is also evidence that students did not always know what might support their learning. Three students, all in cohort 2, expressed that reading in eformat was not comfortable, in some cases because of the device, and in other cases because of a desire to be "more cozy." We argue that some of the ways students wanted to read—particularly reading in bed—may not be supportive of concentrated engagement with any text, whether print or etext.<sup>81</sup>

Students also found many tools to be difficult to use (Figure 6). For instance, they particularly noted difficulties with highlighting (32%) and changing the font size (23%). They were disappointed if they experienced difficulty finding or using a particular tool.

## Undesirable Difficulties

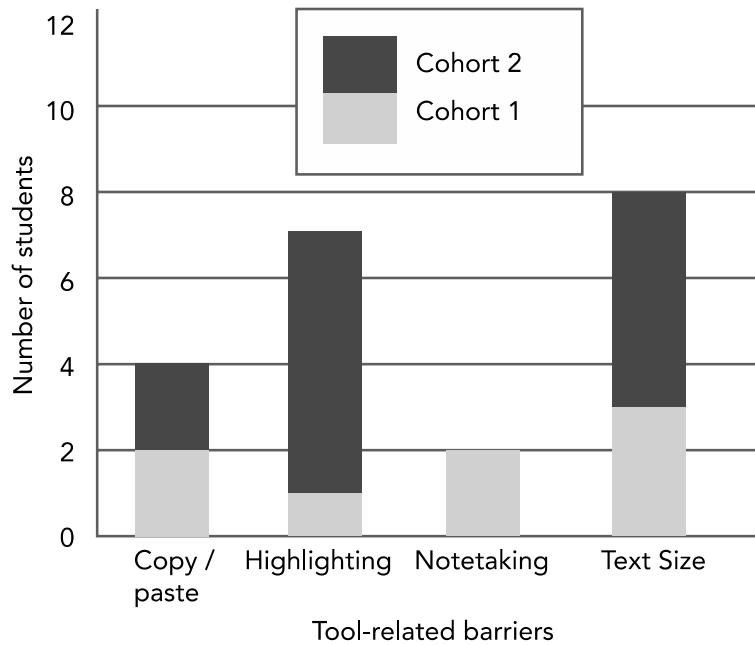


Figure 6. Tool-related barriers noted by multiple students across cohorts. Six students in cohort 1 and six students in cohort 2 noted tool-related barriers.

Highlighting was the tool students most wanted to access and was the most commonly-noted when students could not find the capability or figure out how to use it: "I was unable to highlight, make comments, or highlight citations that I want to look up." Students also expressed concern when they could not easily manipulate text size as indicated by this student from cohort 1: "Some of the options made little sense – like the small, medium, and large text sizes. Despite using LARGE, I STILL had to use (control+) to zoom to the level I wanted to read at." Other tools students wanted to use, but could not always find or take advantage of were copy/paste and note-taking as is cited by this student from cohort 2: "But one of the two articles doesn't allow me to highlight or take notes, so it took me some time to play around the tools." These comments

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are interesting in that students indicated they had to use skills they already possessed, such as keyboard shortcuts (Control +) or "playing around" in order to make use of tools.

On the task analysis activity, nine students specifically mentioned the need for learners to know about tools and mentioned specific features including text highlighting, text size adjustment, and dictionary look-up. Interestingly, dictionaries did not come up frequently in weekly reading responses. The other features mentioned previously did, but students were not consistently able to find and use them, and then ended up citing them as barriers. These barriers are similar to those found by Muir and Hawes.<sup>82</sup>

Students consistently saw the need to provide some type of support prior to tool use: "It's important to show the affordances so you can jump right in using the platform to your advantage, highlighter (auto collecting all your highlights), dictionary, ability to make flash cards, that would make me excited to use the Kindle ebook." This comment echoes findings in past research that students benefit from having tools modeled for them.<sup>83</sup>

In our second research question, we sought to understand how students' perceptions of the affordances and barriers of ebooks changed over time and across platforms. In cohort 1, students were asked to engage with three platforms. In their weekly reading responses, students consistently cited fewer barriers with platform 2 as the semester progressed (Figure 7).

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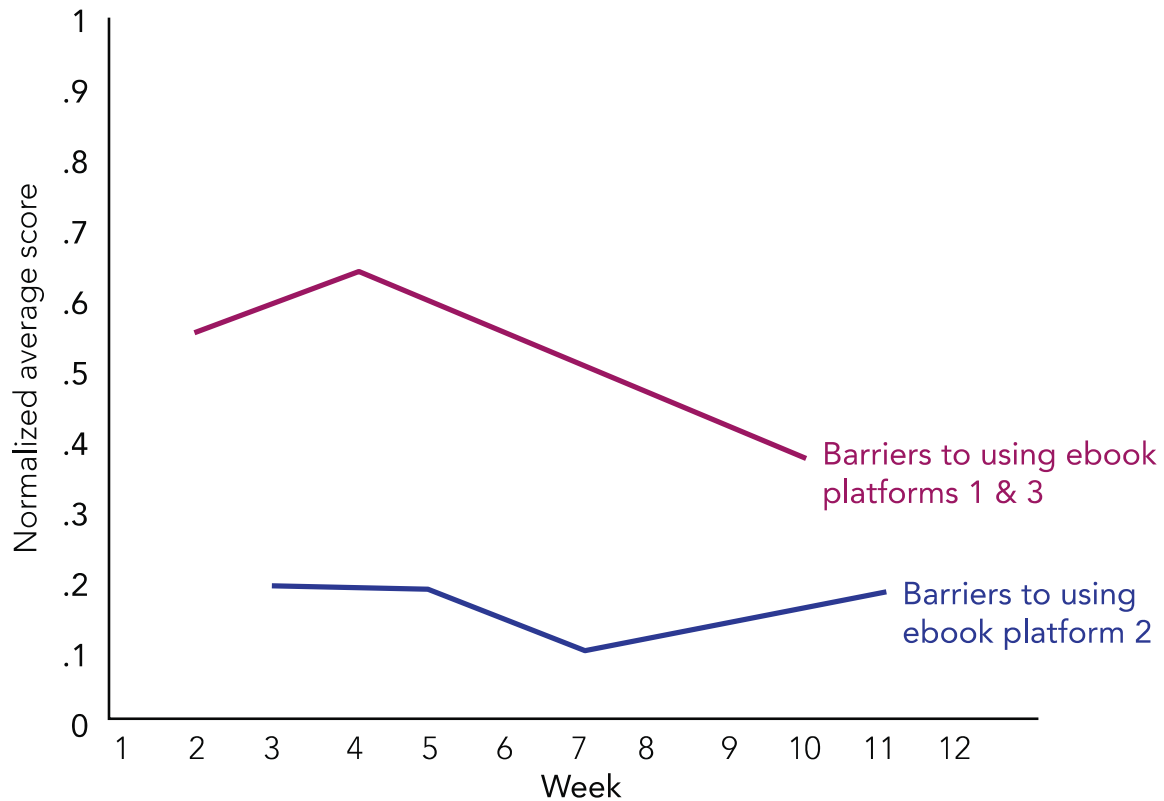


Figure 7. Cohort 1 students' perceptions of barriers over time

Interviews with cohort 1 students provided an opportunity to observe how students navigated familiar and unfamiliar eplatforms, with the conjecture that because they had been exposed to several different eplatforms, this would translate to being able to navigate an unfamiliar eplatform. We did not find evidence for this conjecture. This may be in part to the lack of standardization guiding eplatform design.

Past research has shown that students' evaluation of ebooks can be platform-dependent and based on the degree to which the particular eplatform affords specific actions.<sup>84</sup> Platform 2 appeared to offer functions that students in cohort 1 desired. Thus, we chose to primarily use that platform with cohort 2, hypothesizing that if students became very familiar with this more well-received platform, they might seek similar affordances when exposed to a new platform.

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We hoped that by using a more desirable platform we could engender favorable attitudes towards ebooks, which could then serve as a foundation for future use of other platforms, given that attitudes seems to predict future perceptions<sup>85</sup> and openness to future ebook usage.<sup>86</sup>

As a result of removing/reducing eplatforms 1 and 3, we added additional PDF readings, which enabled us to draw a comparison between a specific eplatform and PDF format. We compared students' evaluations of their experiences with eplatform 2 and PDFs, finding that while students gained confidence using PDFs, they noted more barriers in the ebook platforms over time (Figure 8). We found that while students perceived fewer barriers over time when using PDFs, they identified more barriers the more they used eplatform 2. This means that as students became more familiar with the eplatform, they found more to dislike about it. This extends findings elsewhere that continued usage of a variety of platforms does not reduce frustration.<sup>87</sup> Our work suggests that even a single, familiar platform may not reduce frustration. It seems that as the novelty wore off, and as students worked to use the text for complex course assignments, they increasingly noticed challenges; this aligns to findings that students prefer print for complex tasks.<sup>88</sup>



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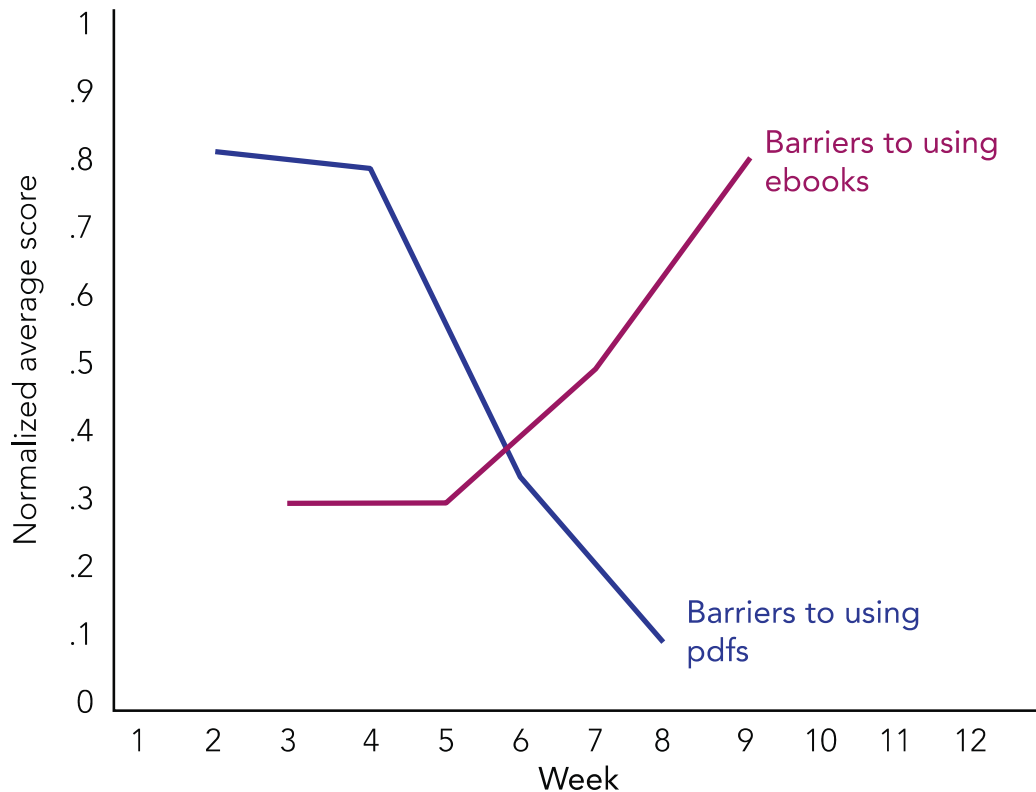


Figure 8: Cohort 2 students' perceptions of barriers over time and by format

### Conclusions and Implications

We investigated extended use of ebooks with two cohorts in a semester-long instructional design course. We found that students noted many more barriers than affordances. Common barriers included difficulties navigating and printing/downloading. Based on findings from cohort 1 that a particular platform was more desirable than others, we investigated sustained use of that platform with cohort 2, finding that increasing familiarity brought increased frustrations, as illustrated in figure 8. We expand on our findings and discuss implications below.

Our findings expand most previous research by investigating students' perceptions of ebooks in an authentic learning environment for a long duration. This study adds to the existing literature in finding that ebooks continue to frustrate and disappoint students, and that continued use of

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ebooks seems to reinforce the disappointment rather than mitigate it. Whether they were ebook enthusiasts or ebook averse, all students in this study experienced and expressed frustration with the ebooks they encountered.

### *Implications for Librarians*

Since libraries have invested heavily in ebooks as a means of supplying academic content, librarians hold much responsibility for improving the ebook experience. This can happen through purchasing decisions, vendor communication, and ongoing user engagement. Purchasing is a critical indicator of the utility and value of an ebook platform. Although ebooks today offer more options and fewer restrictions than their forerunners, it is necessary to continue advocacy for better ebooks/eplatforms that facilitate the types of teaching and research tasks in which users are engaged. Thomas and Chilton note that academic libraries are the principal buyers of academic content and “have a duty to advocate for what users need”,<sup>89</sup> which also means that libraries should *not* purchase or sustain contracts with ebook vendors who persist in providing a product that is difficult to access and use. Feedback from students in this study contributed to the library’s decision to cancel one ebook package that requires users to create a separate account and provide an email address, which is subsequently used to push announcements of new material. Students—even those who considered themselves ebook enthusiasts—critiqued such business practices.

Such information can also be communicated to vendors, helping them understand how ebooks are used on your campus. This can strengthen even effective platforms by helping vendors understand the need for unlimited use and perpetual access rights for needed texts.

### *Implications for Instructors and Learning*

## Undesirable Difficulties

Effective advocacy necessitates an understanding of *how* users want to use ebooks. Within the teaching context, it is critical to know if instructors are assigning ebooks as primary or supplemental texts and if students should read cover-to-cover or parts. This information can promote better decision-making when considering an ebook platform that may restrict printing or downloading or limit simultaneous use. One student in this study told the authors that she was a “little concerned” about not having a print text which she could easily highlight and annotate, but felt increasingly comfortable once she understood that she would not need to memorize and reproduce specific information. Understanding instructors’ intentions can help librarians and instructors alike in determining whether a specific format or even a method of access (library supplied versus student purchased or leased) will support pedagogical goals. Given the high costs of academic material and sustained concerns with textbook affordability, these questions must play a central role in purchasing decisions.

When choosing books for their course—and attending to the high cost of textbooks—faculty might choose an ebook over other formats, not realizing the impact this might have. A key role for librarians at this time is to consider the information faculty might benefit from, such as using annotations to encourage interactive use with the ebook.<sup>90</sup> From our own experience, it is important to demo the interface(s) the students will experience, as the faculty member is likely working with a different platform provided by the publisher as a desk copy.

Based on our analysis of students’ experiences, we see a clear need for better scaffolding of tools in eplatforms. Although some students may experiment and find affordances of ebooks, others won’t without scaffolding. Designing such scaffolds can be done by librarians, vendors, and instructors. Without stronger built-in support from vendors, users are unlikely to realize the affordances ebooks offer. However, learning to use tools in one platform does not appear to

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transfer to other platforms. Resources developed in-house could showcase eplatform tools and guide users through activities to learn how tools function across platforms. Instructors could reinforce ebook tool use by helping students develop strategies for learning with ebooks and including assignments that support the development of such strategies. Instructors can also share with students their rationale for using ebooks and model ways to use eplatform tools effectively. Again, because instructors may be accessing their ebook with a different platform, collaboration with librarians may be key.

## Limitations & Future Directions

Our study was conducted in a unique setting—an academic program housed in a library at a Hispanic-serving research university. Our findings may not replicate to other settings directly, though our approach of extended engagement with students enhances transferability.

The interviews with cohort 1 students were conducted with a small subset of students and were not audio-recorded. This limited our ability to draw strong inferences about the whole class, although the insights from the interviews did reinforce our concerns about using multiple eplatforms in one course.

It is possible that more experienced or technically facile users will be even more dissatisfied given the relative ease of use they experience with other technologies and hope to enjoy with ebooks. As students of instructional design, participants in this study were instead struck by the features that ebooks did not offer, such as easy customization of text display, the ability to highlight and annotate, or interactive features such as embedded media content.

Future studies could investigate the impact of embedding resources into ebook platforms and providing instructional materials for instructors to use in their courses. More research is needed

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to understand the kinds of resources that could be beneficial, given the variety of ways instructors envision students using ebooks. Such studies should investigate whether use of such resources in authentic learning situations leads students to continue using tools that they see affordances in, and whether these contribute to increased satisfaction with and learning from ebooks.

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