Exploratory Usability Testing of User Interface Options in LibGuides 2

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Online research guides offer librarians a way to provide digital researchers with point-of-need support. If these guides are to support student learning well, it is critical that they provide an effective user experience. This article details the results of an exploratory comparison study that tested three key user interface options in LibGuides 2—number of columns, placement of the navigation menu, and visual integration with the library website—to understand their impact on guide usability. In addition to informing our own design choices, our findings can serve as the basis for further investigation into the connections between student learning and the usability of the LibGuides user interface.

Introduction

As library resources have moved online, web-based research guides have provided librarians with an avenue to meet students at the point of need, providing online support for research processes that now occur largely on the web. With the widespread adoption of research guides, the academic library community has begun to explore the connection between research guide usability and student learning, with the aim of designing guides in a way that increases their effectiveness as pedagogical tools.[1] A growing body of literature on the usability of LibGuides, a widely used platform for creating online research guides, identifies several common usability challenges within these guides—from use of library jargon to lack of visual focal point to extraneous content.[2] Such usability challenges can be an impediment to learning because they add to students' cognitive overload as they undertake the challenging work of academic research.[3]

While librarians creating LibGuides can draw on this existing research to identify best practices and common usability pitfalls for their own guides, there is a relative lack of research into design choices made at the system level rather than at the guide level. In particular, we know little about how the guide layout—the spatial distribution of guide components—affects the ways that students interact with the guides. These structural features of the user interface contribute to its cognitive effectiveness and efficiency, thereby impacting student learning.[4]

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In migrating from LibGuides 1 to LibGuides 2, librarians at our institution wanted to use the new platform's expanded design and customization options to optimize our sitewide layout for usability. To this end, we conducted an exploratory usability study of design prototypes representing three key layout choices—number of columns, navigation placement, and visual integration with the library website. This qualitative approach enabled us to observe how students interacted with each option and discuss their responses with them.

Literature Review

Web-based research guides have become a staple academic library service. Librarians invest considerable time in creating and maintaining these guides,[5] seeing their potential to meet students at their point of need and serve as an online "unmediated stand in" for librarians.[6] Since the launch of Springshare's LibGuides in 2007, this platform has come to occupy what Bowen, in an article on the efficacy of LibGuides as a pedagogical tool, describes as an "increasingly dominant but under-researched position…in the academic library world for delivering guides and tutorials."[7] Bowen's statement highlights the need for more research into how to design LibGuides to be more pedagogically effective.

Why Design Matters for Learning

There is a growing recognition, both in the library community and in the e-learning community more broadly, that user experience and student learning are intimately connected.[8] The question of how well students can independently navigate and use an online research guide cannot be neatly separated from the question of how much they are able to learn from it.[9] This is because the design of an e-learning interface structures the learning environment in ways that impact cognitive effectiveness and efficiency, shaping students' behaviors in that environment.[10] In an essay presenting design recommendations for LibGuide creators, Ahmed explains "the overarching goal is to use aesthetics to engage users and effectively support the pedagogical purpose of a guide."[11]

The need for careful attention to design is doubly important with LibGuides because they are intended to support students in the complex and demanding activity of conducting academic research. In particular, they are geared toward two of the research steps that students find most challenging, according to research conducted by Project Information Literacy: getting started with their research and finding appropriate sources.[12] As design expert Don Norman puts it, "Things intended to be used under stressful situations require a lot more care, with much more attention to detail."[13]

Research Guides and User Experience Design

One way for academic libraries to turn this careful attention to detail toward their research guides is by conducting usability testing. As Castro-Gessner, Chandler, and Wilcox have argued,[14] it is important for libraries using LibGuides to undertake such testing because, while Springshare has created a good user experience for guide *creators* (their customers), it is our job as librarians to be sure this translates into a good user experience for guide *users* (our patrons). While there is good reason for librarians to devote time to usability testing and to share their findings with each other, the body of research involving design and usability testing of LibGuides is small; most published studies of LibGuides instead focus on managing the implementation of LibGuides and ways of using LibGuides.[15]

Nevertheless, a review of the usability and design literature on LibGuides identifies several common usability impediments that have been found in multiple studies.

These include the following:

- inconsistent design from page to page and from guide to guide[16]
- confusing terminology/reliance on library jargon[17]
- cluttered pages lacking a focal point[18]
- too much content, not appropriately scoped to the task at hand[19]
- hard-to-recognize navigation[20]
- excessive tabs in the navigation menu[21]

In a review of the literature on user experience design and online research guides (which is not limited to LibGuides), Little draws a connection between usability challenges such as those listed above and students' cognitive load when using research guides.[22] She frames this review by differentiating between intrinsic, extraneous, and germane cognitive load. The intrinsic load is the cognition that is required to conduct academic research and learn about a topic. A poorly designed user experience causes extraneous cognitive load, taxing cognition by forcing students to focus on decisions that are not directly relevant to the learning task. Germane cognitive load occurs as students integrate what they're learning in the research process into their knowledge base. In order for research guides to serve as effective instructional experiences, she argues, "librarians must try to manage intrinsic load, minimize extraneous load, and promote germane load."[23] Little concludes with an extensive list of recommendations for guide creators based on her review of the literature. Her tips include building guides at the course level rather than the subject or discipline level, limiting the amount of text and breaking it into small chunks, and providing clear, targeted descriptions for each resource listed.

Guide Structure, Usability, and Cognition

Little's list of recommendations, like much of the LibGuides usability and design literature, is targeted toward actions that can be taken by individual guide editors. There is very little usability research on how structural design decisions made at the system level impact usability, save for a 2009 study of LibGuides at the University of Washington Libraries. This study found that some of the default system structures built in to LibGuides—in particular the layout and navigation placement—caused confusion for their end users (although it does not go into much detail as to how and why these structures were confusing).[24]

Like the content decisions of individual guide editors, these structural design decisions can impact students' cognitive load. Structural features of the user interface, such as page layout and navigation, shape the learning environment and direct students' attention. Kirsh argues that attention to the usability of these structures can increase the effectiveness and efficiency of not just cognition but also metacognition in e-learning environments such as LibGuides.[25]

One reason these questions of structure and layout in LibGuides are underresearched is that much of the existing usability research was conducted using LibGuides 1, which did not offer much flexibility in terms of guide layout—there is no sense in doing extensive usability testing of interface features over which you have no control. Version 2 of LibGuides, however, provides flexible templating and style options that allow for extensive customization of your LibGuides platform.

Our research fits into this gap in the literature. Because of the potential impact of user interface structures on student learning and the new layout options afforded by LibGuides 2, we decided to run a usability study comparing some of these options before migrating to the new platform. We selected the following three user interface options to focus on, all of which are straightforward to implement in LibGuides 2:

Navigation placement. Navigation is a critical piece of the user experience puzzle, as the ease with which users are able to navigate a website strongly correlates with

their likelihood of returning to that site.[26] The default navigation placement in Lib-Guides 1—horizontal tabs running across the top of the page—has been tested by several libraries, but the results of these studies vary. While some studies found that the tabbed layout rendered the navigation invisible to users,[27] others found that users recognized and liked the tabbed navigation.[28] What is clear in the literature, however, is that design changes to this default navigation such as reducing the number of tabs[29] or changing their visual design[30] can increase usage of the navigation menu (and thus of the guide's subpages). LibGuides 2 makes it possible not just to tweak the design of the menu, but to change its placement. The new platform offers left-hand navigation in addition to the horizontal tabs as a built-in option, while custom template, HTML, CSS, and JavaScript options allow for other local configurations.

Layout. The column-based layout of pages within LibGuides is another critical usability consideration. The usability of the widely used default three-column layout has been questioned in the library blogosphere[31] and on the Code4Lib listserv,[32] but we did not find any published studies focused specifically on this topic. There are, however, two key findings in the literature that we suspect could be related to the column-based layout. First, because inconsistent layouts are a source of confusion to students,[33] allowing individual guide editors to select the number and width of columns for each page poses usability challenges. Second, several usability studies of research guides have found that students are overwhelmed by cluttered layouts and struggle to find a focal point.[34] While the number of columns is certainly not the only source of clutter, it is reasonable to consider it a potential factor.

Visual integration with library website. By allowing for custom HTML, CSS, and JavaScript in the sitewide header and footer and in guide templates, LibGuides 2 makes it possible to visually integrate the research guides with the overall look and feel of the library or institutional website. To the best of our knowledge, there is no literature addressing the pros and cons of treating research guides as visually integrated with the library website rather than as a distinct platform.

Methodology

To investigate how these layout decisions impacted usability, we conducted an exploratory comparison test. Exploratory usability testing is a method for evaluating preliminary design ideas.[35] Exploratory tests are typically conducted one-on-one, with the goal of collecting qualitative data that can provide insight into how participants respond to the design under consideration. (This approach is also sometimes called formative usability testing, as it is meant to guide design decisions, as opposed to summative usability testing, meant to evaluate designs post-implementation.)[36] We combined this exploratory approach with comparison testing, which tests multiple design alternatives and records performance and preference data for each.[37] We chose this methodological approach for two reasons: First, it was an appropriate choice for our purposes because we were in the design phase of our migration to LibGuides 2. Second, due to the lack of research into how the layout of research guides impacts usability, we saw a need for an exploratory approach that would provide the larger library community with some insight into these questions.

Research Questions

We identified the following three research questions:
- Does the number of columns (one, two, or three) affect students' ability to quickly grasp the content and purpose of the guide?
- Which navigation menu placement is more visible: horizontal navigation at the top of the page or vertical navigation on the left?

- How will wrapping the guides with the persistent content from the library website affect students' perception of the platform? Will they prefer this illusion that LibGuides are part of the library website, or is it preferable to keep this separate platform visually distinct?

Participants

We recruited undergraduate and graduate students at our institution to participate in the study through a campuswide e-mail announcement and by marketing the study at the campus library. Students were accepted to participate in the study on a first-come, first-serve basis. Each participant signed up for a thirty-minute individual testing session. The convenience sample (N = 30) represented a wide variance in demographic factors like year in school, field of study, residential/commuter student status, gender, and race.

Materials

- **LibGuides.** We created static versions of three different LibGuides (one for each component tested) using content from guides our research librarians had created.
- **Desktop computer.**[38] All participants used the same desktop computer (a PC running Windows 7), and all testing was conducted using the Chrome web browser.
- **Screen capture.** We used screen capture software to capture participants' cursor movements during the testing sessions. This allowed for accurate timing of certain tasks and served as a proxy for eye movement.
- **Audio recording.** We used audio recording to capture participants' comments and questions during the testing sessions. This allowed for accurate documentation and coding of qualitative, open-ended responses.
- **Script.** Test sessions were administered using a prewritten script with instructions for each test component and questions to ask at the completion of each task.
- **Notes.** Two researchers took written notes on participants' responses and preferences during each test.

Procedures

Participants took part in individual test sessions in a quiet campus computer space. All participants were provided with an informed consent document upon their arrival and given the opportunity to ask questions before and after the test session. Each participant completed all three of the following tests, conducted successively:

Columns

We tested three different layouts: LibGuide's default three-column layout, a two-column layout, and a one-column layout. Our goal was to observe how students interacted with the content in each of these layouts, paying particular attention to how readily they could digest the information and identify critical content.

We built prototypes of three different pages ("Finding Articles," "Finding Books," "Getting Started") from the same guide in each of the three layouts (see figure 1), for a total of nine pages. We tested three different versions of three different pages for two reasons: First, had we tested only one page, we would know only which number of columns worked best for the content of that page—testing multiple pages made it possible for us to explore the usability of a particular layout across changing content. Second, to avoid repeating testing material—which might bias our results because participants could learn the content as they proceeded through the test—each participant

FIGURE 1
One-, Two-, and Three-Column Versions of the Page "Getting Started"

One-Column   Two-Column   Three-Column

tested three pages without repeating content or layout (for example: a three-column version of the "Finding Articles" page, a two-column version of the "Finding Books" page, and a one-column version of the "Getting Started" page). Because participants could learn features of the system and of the testing protocol as they proceeded through the test, we also randomized the order in which we presented the pages.

For each page, participants completed the following exercises:

Five-second test. After showing participants the page for five seconds, we first asked them to describe their understanding of the overall purpose of the page. Next, we asked participants to list everything they remembered seeing on the page.

Think-aloud test. For each of the three pages, we asked participants to complete a task that reflected the sort of activity for which they would use that guide page during a class research assignment, prompting them to share their thought processes with us as they completed the task.

Goldilocks test. We asked participants whether the amount of information on each page was too little, just right, or too much.

Layout preference. At the conclusion of these exercises, we asked participants which of the three page structures they saw had the clearest layout. Participants had the opportunity to return back to their three pages as they responded.

Navigation

We tested two different navigation menu placements: LibGuide's default tabbed horizontal navigation menu at the top of the page and a vertical navigation menu on the left-hand side. The goal of this portion of the test was to observe participants' interactions with each of these menus, paying particular attention to the visibility of the navigation menu.

FIGURE 2
Top and Left Navigation Placement

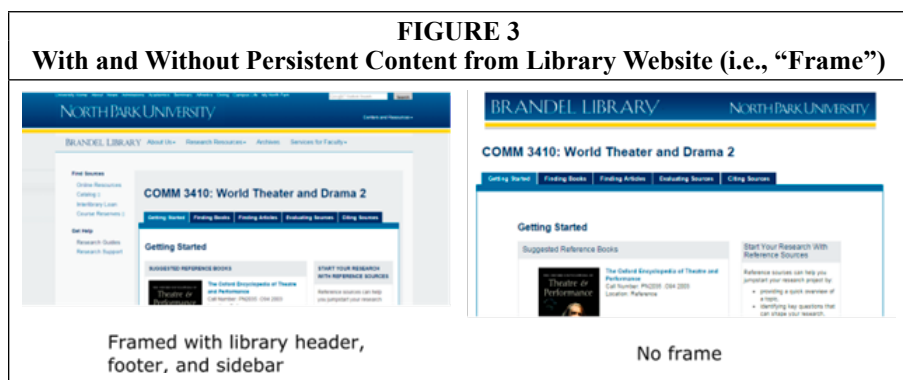Top, Horizontal Navigation   Left, Vertical Navigation
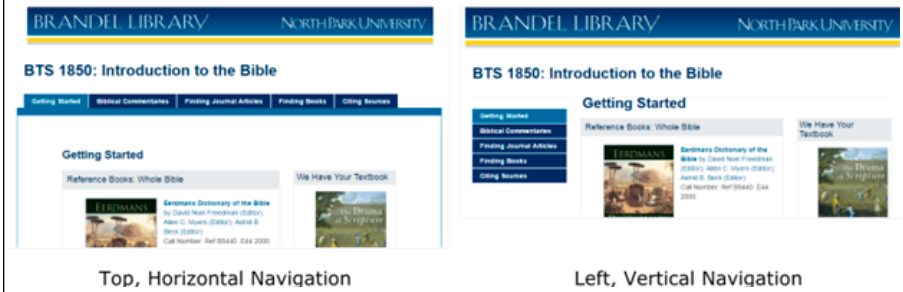
We built two prototypes of the same guide, one with top navigation and one with left. We used a split testing method to compare navigation placement, with each participant testing one of the two prototypes (see figure 2). Participants completed the following exercises:

Five-second test. After showing participants the page for five seconds, we asked them to recall the pages available on the site.

Think-aloud test. We instructed participants to use the guide to find an article, a task that would require them to use the "Finding Articles" tab in the navigation menu, and asked them to share their thought processes with us while completing this task.

Framing/Integration
We compared two prototypes of the same LibGuide: one with the default LibGuide layout ("unframed") and one that framed the LibGuide with the persistent header, footer, and sidebar content from our library website ("framed"[39]) (see figure 3). This portion of the test was designed to offer insight into our final research question: should we visually integrate LibGuides with the main library website? Participants completed the following exercise:

FIGURE 3
With and Without Persistent Content from Library Website (i.e., "Frame")

Framed with library header, footer, and sidebar   No frame

Paired comparison. We added links to the two prototypes to a local copy of the "Research Guides" page from the library website. Each participant was instructed to navigate from that page to each prototype. We asked them to share their thoughts with us as they compared the framed and unframed versions and then to select which interface they preferred and discuss their reasoning.

Data Analysis
We used a system of codes (explained in more detail below) to categorize the responses and open-ended comments made by participants. This coding process provided us with descriptive statistics that summarize our data. To limit subjectivity, each researcher coded the data separately.

Results
Columns
The results of this portion of the test suggest that the two-column layout had a slight edge in usability for the students we tested, and that the three-column layout was least usable. The two-column layout fared slightly better than the others in most performance measures and was strongly preferred by the majority of participants. In the sections below we summarize the results for each portion of this test:

	TABLE 1								
	Level of Understanding of Page Purpose by Number of Columns (N=30)								
	1 Column			**2 Column**			**3 Column**		
	Precise	*Vague*	*Inaccurate*	*Precise*	*Vague*	*Inaccurate*	*Precise*	*Vague*	*Inaccurate*
Articles	0	8	2	1	6	3	3	4	3
Books	1	8	1	2	6	1	2	5	3
Getting Started	2	6	2	2	7	1	1	5	4
Overall	**3**	**22**	**5**	**5**	**19**	**5**	**6**	**14**	**10**

Note: Each participant tested three pages out of the nine represented in this table without repeating content or layout (for instance, a three-column version of the "Finding Articles" page, a two-column version of the "Finding Books" page, and a one-column version of the "Getting Started" page).

Five-second test. In the five-second test, we showed participants each page for five seconds and asked them to tell us its purpose. We coded their responses as either *precise*, *vague*, or *inaccurate*, based on the extent to which their response correctly identified the page's purpose of serving as a guide to library research for a specific class. The frequencies of each response are presented in table 1.

The key takeaway is that the majority of the participants were unable to identify the purpose of the page, regardless of number of columns. It is also worth noting that, for the three-column version, ten participants (33%) inaccurately identified the purpose, while only five participants were unable to identify the purpose for the one- and two-column versions. These results suggest that, while none of these versions of the page communicated its purpose in a quickly absorbable way, the three-column version was especially challenging.

As a follow-up question in the five-second test, we asked participants to list everything they recalled seeing on the page. We coded their responses based on the elements of the page they represented. This open-coding method left us with the following categories:

- headings (coded hierarchically by HTML elements h1, h2, and h3)
- main content (like the links to databases on the "Finding Articles" page)
- layout (any mention of the way the page was structured)
- images
- navigation menu
- branding (any mention of branding elements such as our logo or color palette)

The recall frequencies of each category are summarized in table 2.

Overall, the two-column versions of the pages had the advantage in the most categories: heading 1, heading 2, main content, navigation menu, and branding. The first four of these categories are the most important in terms of users' ability to navigate a page. Additionally,

TABLE 2			
Frequency of Page Content Category Recall by Number of Columns (N=30)			
	1 Column	**2 Column**	**3 Column**
Heading 1	10	14	9
Heading 2	4	7	4
Heading 3	8	4	5
Images	14	15	21
Layout	4	3	10
Main	5	7	5
Navigation Menu	3	4	1
Branding	0	3	1

several participants commented that the two-column layout made it clear what page content was primary and what content was secondary. Both of these factors make the page more scannable, which is a key component to usability because students are more likely to skim a page than to read it closely.[40] While the three-column version had a strong advantage in two categories (images and layout), these categories both reflect an aesthetic rather than a content-based impression of the page.

Think-aloud test. We found no differences in students' ability to complete the assigned tasks, or in the pathways they took to doing so, based on the number of columns in the version of the page they were testing. Their comments, questions, and missteps in completing the tasks were based on page features not related to the number of columns. Thus the task completion test did not provide us with data that would help answer our research question. However, it is worth noting that students were basing their answers to the Goldilocks test and the preference question on experience using the pages to complete research-related tasks.

TABLE 3 Goldilocks Rating for Each Page by Number of Columns (N=29)									
	1 Column			**2 Column**			**3 Column**		
	Too Little	Just Right	Too Much	Too Little	Just Right	Too Much	Too Little	Just Right	Too Much
Articles	2	7	1	1	7	2	2	7	0
Books	1	7	2	1	8	0	1	8	1
Getting Started	4	5	0	0	10	0	4	6	0
Overall	**7**	**19**	**3**	**2**	**25**	**2**	**7**	**21**	**1**

Note: Total number is 29 rather than 30 because one test participant did not answer this question; each participant tested three pages out of the nine represented in this table without repeating content or layout (for instance, a three-column version of the "Finding Articles" page, a two-column version of the "Finding Books" page, and a one-column version of the "Getting Started" page).

Goldilocks test. In the Goldilocks test, we asked participants whether the amount of information on each page was too much, too little, or just right. (Note that the content of the pages was the same, with only the number of columns changing). Table 3 summarizes their responses.

The two-column pages had a slight advantage here. Across the board very few students thought there was too much information on any page. However, for both the one-column and three-column versions, 24 percent (7/29) of students thought the page had too little information. We included this question because we were curious whether the layout might contribute to information overload, so we were surprised that the answers skewed toward "too little" rather than "too much." It's worth noting, though, that many students shared our concern about information overload, commenting that they liked a more minimalist approach to content because it kept them from feeling "overwhelmed" or "overloaded."

Layout preference. For our final question in this section, we asked students which of the three layouts they had used presented the information most clearly. Although we specifically asked for preferences based on page layout and not on content, several participants did base their decision on the content of the page. Table 4 shows how many

	1 Column			2 Column			3 Column		
	Total	*Content Based*	*Adjusted Total*	*Total*	*Content Based*	*Adjusted Total*	*Total*	*Content Based*	*Adjusted Total*
Articles	1.5	—	1.5	4	—	4	3	1	2
Books	5	2	3	6.5	1	5.5	2	1	1
Getting Started	2	1	1	5	—	5	0	—	0
Overall	**8.5**	**4**	**4.5**	**15.5**	**1**	**14.5**	**5**	**3**	**2**

TABLE 4
Preferred Layout Based on Number of Columns (N=29)

Note: Adjusted Total reflects the number of preferences based on layout by subtracting those preferences based on content from the total; in cases where a participant couldn't decide which of two layouts he or she preferred we added 0.5 points to each; total number is 29 rather than 30 because one participant declined to answer this question; each participant tested three pages out of the nine represented in this table without repeating content or layout (e.g. a three-column version of the "Finding Articles" page, a two-column version of the "Finding Books" page, and a one-column version of the "Getting Started" page).

participants selected each layout as their preferred layout. In cases where participants could not decide between two of the three layouts, we assigned a half point to each. We have also noted instances where their stated preference was based on the content of the page, not the layout, and provided an adjusted total.

A majority of the twenty-nine participants[41] preferred the two-column version. This result is stronger after adjusting for the eight participants whose comments about their preferences were based on the content rather than the layout of the page. Of the twenty-one participants who commented on the layout of the page in answering this question, 69 percent (14.5/21) preferred the two-column version, 21 percent (4.5/21) preferred one column, and 10 percent (2/21) preferred three columns. In discussing why they preferred the two-column layout, many participants commented positively on the division of the page into a main content area with a sidebar section, with several noting that this layout made the page easier to navigate.

Moreover, while we did not ask participants which layouts they disliked, many volunteered that information: three people (10%) expressed dislike for the one-column layout, and eight people (27%) expressed dislike for the three-column layout, but no one expressed dislike for the two-column layout. All three participants who disliked the one-column layout said they did not want to have to scroll. Negative commenters on the three-column layout found this structure overwhelming. According to one participant, having three columns made it "hard to know which side to read." Another complained, "It just hurts my eyes, 'cause I'm trying to focus on one thing and everything's right there." While, in general, users' preferences do not necessarily align with what is most usable, it is worth noting that, in this case, participants' explanations of why they preferred or disliked a particular page spoke to the usability of the layout, with many commenting on whether or not a particular layout succeeded in quickly conveying the structure and hierarchy of the page content.

Navigation Placement
The results of this portion of the test suggest that placing the navigation menu on the left side of the page rather than on the top made it more visible to our test participants.

TABLE 5 Top vs. Left Navigation Menu Placement (N=30)						
	Top Navigation (n=15)			**Left Navigation (n=15)**		
Five-Second Test						
number of participants recalling the navigation menu	0			6		
Think-Aloud Test						
number of participants finding the navigation menu	*Immediately*	*Eventually*	*Never*	*Immediately*	*Eventually*	*Never*
	10	3	2	12	3	0

Five-second test. In the five-second test, we showed each participant a prototype with either a top, tabbed navigation menu or a left, vertical navigation menu for five seconds, then asked them to recall what pages were available on the site. We split participants into two groups, so each navigation style was tested by fifteen users. The top row of table 5 shows how many participants successfully recalled the menu for each prototype.

None of the fifteen participants who tested the version with a horizontal navigation menu placed on top recalled the navigation menu when prompted, while six (37.5 percent) of the participants who tested the left-hand, vertical navigation placement recalled noticing the menu.

Think-aloud test. We instructed participants to complete a task that would require them to navigate to the "Find Articles" button in the navigation menu. We coded this activity based on how quickly students used the navigation menu: either *immediately,* *eventually* (that is, they either scrolled through the page or clicked on other links before going to the navigation menu), or *never.* The bottom row of table 5 summarizes the results of this test.

The majority of participants immediately located the navigation menu in both the top menu and left-hand menu. However, while all participants testing the left-hand menu version were able to complete the task, two students testing the top menu version were unable to complete the task—they never located the menu and eventually gave up on the task of finding an article.

Framing/Integration

This portion of the test was a paired comparison of two prototypes of the same Lib-Guide: one with the default LibGuide layout ("unframed") and one that framed the LibGuide with the persistent header, footer, and sidebar content from our library website ("framed").

In comparing these two options, almost all participants noted that there was a tradeoff between the cleaner, more spacious layout of the unframed version and the additional options provided by the framed version. Ultimately, 65 percent of participants concluded that they preferred the framed version. However, many of them mentioned that, while aesthetically they preferred the unframed version, they felt the access to the menus from the library's website and the consistency between the library website and the guides were worth the tradeoff of a slightly busier layout. In the words of one participant, the framed version was preferable "because I can get back to other places. I feel stuck on the other one. I'm not allowed to go anywhere." Another student appreciated that the framed version provided her with "tiers of where to go from here."

The 35 percent of participants who preferred the unframed version largely commented on its wider, less cluttered layout. As one participant said, "I feel kind of overwhelmed when things are squinted in and squeezed together."

An unexpected finding was that the frame influenced participants' recognition of the top navigation menu. Nine participants either explicitly commented that the tabs were in the framed version but not in the unframed version or immediately interacted with the tabs in the framed version but not in the unframed version. We suspect that this effect is due to "banner blindness"—the tendency of web users to look past header content.[42] By framing the LibGuide with the library's persistent header and menu, we bumped the guide navigation below the header and into the main content area, thus making it more visible to users.

Navigation Follow-Up

Given our discovery that visually framing guides with the persistent content from our library website affected navigation menu visibility, we employed an iterative design and testing strategy, following up our original usability test with a small-scale test of three possible menu placements. This test repeated the navigation testing method discussed above; however, whereas in the original test we used out-of-the-box LibGuides to test left vs. top navigation placement, for this test we created the following three new mockups, all of which included the persistent header and footer from our library website (see figure 4):

FIGURE 4
Top vs. Left Navigation Placement with Framed Version of Guide

Top navigation with persistent sidebar   Left navigation with breadcrumbs   Top navigation with breadcrumbs

- top horizontal navigation with persistent sidebar from library website
- left vertical navigation, with breadcrumb navigation replacing the persistent sidebar from the library website
- top horizontal navigation, with breadcrumb navigation replacing the persistent sidebar from the library website

To test these three mockups we used guerrilla usability testing, an effective strategy for testing a prototype without the significant commitment of time and funds involved in a large-scale formal usability test.[43] Our test participants were students we encountered in the library lobby who agreed to participate in a three-minute usability study (N = 24). We repeated the five-second test and the think-aloud test (as described in the Methods section under "Navigation") for each of the three mockups, testing eight students per mockup. The top row of table 6 shows how many participants successfully recalled the menu for each prototype in the five-second test; the bottom row shows the ease with which students found the navigation menu when given the task of finding an article.

This round of testing added weight to our earlier finding that framing the site in the context of the library's website made top-level LibGuide navigation more visible. When we tested left vs. top navigation menu in the unframed, out-of-the-box version of LibGuides, no students recalled the menu during the five-second test, and two students were unable to complete the task of finding an article because they never found the navigation menu; but, when we did the follow-up test with the framed versions, some students did recall the top navigation in the five-second test, and all students were able to complete the task of finding an article.

TABLE 6
Top vs. Left Navigation Menu Placement for Framed Libguides (N=24)

	Top Navigation with Main Website's Left Sidebar (n=8)			Left Navigation with Breadcrumbs (n=8)			Top Navigation with Breadcrumbs (n=8)		
	Immediately	*Eventually*	*Never*	*Immediately*	*Eventually*	*Never*	*Immediately*	*Eventually*	*Never*
Five-Second Test									
number of participants recalling the navigation menu	1			3			2		
Think-Aloud Test									
number of participants finding the navigation menu	4	4	0	4	4	0	5	3	0

Discussion

What is most striking about the results of our study is that, for every structural feature of the page layout we tested—number of columns, navigation menu placement, and visual integration with the library website—we found that the most usable option for our test participants was something other than the widely used default settings from LibGuides 1: Instead of the standard three columns, we found the two-column guide to be most usable. Instead of top, tabbed navigation placement, we found left-hand navigation placement to be most usable. Instead of treating LibGuides as a separate, standalone platform, we found that our test participants preferred viewing guides that were visually integrated into the library website and provided them with access to its persistent menu options.

These findings matter because we know that the structural features of an e-learning user interface can impact cognition and student learning. Page layout and navigation placement contribute to the structure of an online learning environment in ways that affect student behavior in that environment; the amount of mental resources they have to expend on navigating it; their awareness of the information available in that environment; and their metacognition, or reflective awareness of their own learning processes.[44] While the library literature has recognized the connection between usability, cognition, metacognition, and student learning within LibGuides,[45] research to-date has been largely focused on issues related to the content of the guide rather than its overall structure. Our exploratory research into the following structural factors suggests that they too may impact usability and cognitive load.

Columns

The two-column layout performed slightly better than the one- and three-column versions in most of our measures of performance and was the strong favorite when we measured user preference. Moreover, several participants expressed a strong dislike for the three-column layout.

Many of the participants' open-ended comments during this portion of the test speak to the connection between layout and cognition. One participant, in explaining why he preferred the two-column version, said that it "immedi-

ately shows where to go"; another commented similarly, "It allows me to be able to navigate it." Some participants even identified how the two-column structure functioned pedagogically, commenting on how they liked having a main content area with examples and tips on the side. Students who disliked the three-column layout told us that it was "overwhelming," making it "hard to know where to go." As one student summarized: "It just hurts my eyes, 'cause I'm trying to focus on one thing and everything's right there." These comments highlight how the layout of a research guide can impact its effectiveness in communicating the structure of the learning task, which in turn influences the guide's cognitive efficiency and effectiveness.

While we did not find any other research specifically comparing the number of columns used in LibGuides (or in research guides more broadly), we did find some echoes of the comments from our students in other qualitative usability studies. Much like our students' comments on how it was hard to "focus on one thing" and navigate in a three-column layout, Hungerford and colleagues found that several students commented on how the guides lacked a focal point.[46] Although it is not clear from their article how many columns were in the guides they were testing, at the end they recommend using a two-column layout. Quintel similarly suggests a need to reconsider the three-column layout, though her research is instead focused on navigation.[47] The findings from our comparison testing of one-, two-, and three-column guides round out these suggestions from previous researchers, providing data that paint a picture of how the number of columns might affect both the usability and the cognitive effectiveness of a research guide.

Navigation

In our test of out-of-the-box LibGuides, the left-hand navigation placement outperformed the top navigation placement in both the five-second test and the think-aloud test.

Navigation menus are a critical cue in an online learning environment, structuring the environment, signaling the scope of the content,[48] and guiding students through the available options.[49] Because navigation menus are such an important piece of the usability puzzle, it concerns us that two of the fifteen students testing the top, tabbed navigation placement did not find the menu and were unable to complete the assigned task of finding an article. While this is a small number, it is a substantial usability problem because it would prevent students from doing the research that the guide is designed to support.

Our finding that the top, tabbed navigation was less visible is consistent with usability principles. This tendency of web users to overlook the page header has been termed "banner blindness."[50] Indeed, when we conducted a follow-up test using guide prototypes that were framed with the persistent header from the library website—thus bumping the LibGuide's navigation down below the "banner" area—the tabbed navigation became more visible to users.

In the library literature there are mixed findings on the visibility of top, tabbed navigation: while some studies have found that it rendered the navigation invisible to users,[51] others found that users recognized and liked the tabbed navigation.[52] Several studies consider how design changes can make this tabbed navigation more visible, but our study is the first we know of that studies the effect of placing the menu elsewhere in the interface. Our findings suggest that there might be better alternatives for menu location: on the left side of the page, or lower on the page so that it is not in the invisible "banner" section at the top.

Framing/Integration

While most participants preferred having the LibGuides visually integrated with the library website, they did note that there was a tradeoff—framing the guides with

the persistent header, footer, and sidebar menu from the library's website provided more navigation options and maintained a consistent experience, but it also made for a more cluttered layout. (Participants who preferred the unframed guide mentioned the same tradeoff.) Our results here highlight one of the beauties of using comparison testing during exploratory research: the goal is not necessarily to identify the "winning" design but to encourage participants to talk about what they like and dislike about each option.[53] Having that insight before implementing a design allows you to consider additional options and create additional mockups that combine the positive features of both designs. In this case, it was clear that participants liked having visual consistency and access to the navigation from our library website, but did not like clutter. Thus, in implementing LibGuides, instead of choosing one option or the other, we found a way to balance those concerns.

Suggestions for Future Research

Our research into how page layout impacts guide usability suggests that LibGuides 1's standard three-column guide with tabbed navigation may not be the most usable option. Fortunately, LibGuides 2 offers subscribing libraries ample customization options: more built-in options for menu placement and number of columns, the ability to create custom templates, and mechanisms for adding custom CSS and JavaScript. Given that our findings ran counter to the default behavior of LibGuides 1, we would suggest to other libraries that it is worthwhile to explore the different layouts afforded by these customization options and conduct their own usability testing (even though this is more work than simply carrying over LibGuides 1 layouts to LibGuides 2).

It is important to note that our study design was exploratory and qualitative, not experimental—our data are not generalizable to other institutions. Rather, what our research contributes to the broader library community is insight into how system-level guide layout choices—the number of columns and navigation menu—can impact usability in LibGuides; our data also add to our understanding of the connection between layout and cognition. There is a need for more qualitative research that would help us learn more about how students interact with LibGuides in these different layouts and could deepen our understanding of how these interactions structure cognition and learning. There is also a need for quantitative, experimental research that would provide generalizable results. For example, based on our findings, one might hypothesize that two-column guides are more usable than three-column guides—or that navigation menus are more visible on the left of the guide than at the top of the guide—and test that hypothesis using web analytic data or A/B testing.

Conclusion

LibGuides provide librarians with a powerful means of providing remote, asynchronous research assistance and instruction. But poor design choices can impinge on the guides' effectiveness as pedagogical tools, adding extraneous weight to students' cognitive load as they are undertaking the challenging work of academic research. In our exploratory comparison study of key layout features in LibGuides, we found that a two-column layout was most usable and was strongly preferred by participants in our test and that many students actively disliked three-column layouts; we also found that the navigation menu was more visible on the left side of the page than at the top. Both of these findings run counter to prevailing practice in LibGuides, highlighting the need for further research into the question of how layout choices structure the learning experience in LibGuides.

Notes

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