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Accessibility and Diversity in LIS: Inclusive Information Architecture for Library Websites

Kyunghye Yoon, *St. Catherine University*
L. Hulscher
R. Dols

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Kyunghye Yoon, Laura Hulscher, and Rachel Dols

ABSTRACT

We incorporate the perspective of diversity in order to discuss accessibility problems in LIS. "Diversity" is defined as the ability to create and ensure inclusive information access and services for different user groups. We outline the results of our study on library website accessibility for screen-reader users. Based on our findings, we argue that the inaccessibility of library websites is primarily a problem of diversity rather than being merely a technical issue. The high-level implications of this problem indicate the need to adopt inclusive principles that require usability beyond accessibility for all user groups in library web design. To meet this goal, we propose an inclusive information architecture specifically focused on screen-reader access. Our intention is to present broader guidelines for information design by illustrating one way in which inclusive principles can be applied to library website design by expanding and customizing the information architecture to meet the individual needs of diverse user groups.

Access to information, an important principle in library and information science, is a fundamental human right necessary for equal opportunity and full participation in society. However, serving the information needs of a diverse public requires that libraries make efforts beyond simply distributing resources. It also requires ensuring that those resources are actually usable by everyone. Web accessibility in particular has become crucial for libraries. Because of the increasing pervasiveness of Internet technology in everyday life, library websites are now a critical public access point to valuable information resources.

Diversity has also been recognized in library and information science as a foundational principle that ensures intellectual freedom and equal access to information for all members of society. In this sense, there is a parallel between accessibility and diversity principles, both of which stress inclusion and equal access to information. To adhere to these principles, libraries

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must provide effective and functional access to information resources in order to meet the needs of the entire diverse range of individuals in the populations that they serve.

In this article, we address accessibility as a diversity issue and propose the concept of inclusive information architecture as a means of promoting both accessibility and diversity. As a case example of identifying an underserved group's needs for the purpose of extending information access based on the principle of inclusion, we investigated library websites' accessibility for persons with visual impairments. We use this investigation as an example of identifying an underserved group's needs for the purpose of extending information access based on the principle of inclusion. The study identified accessibility barriers common to library websites. For this article, we address accessibility barriers from a usability standpoint, and we interpret inaccessibility as the result of a lack of inclusive principles in web design. The purpose of this article is to provide an in-depth discussion of the conceptual implications of meaningful accessibility that meets the needs of diverse individuals at a higher level than mere technical compliance with standards. Moreover, this article aims to foster the inclusion of diverse user groups by expanding the concept of information architecture within the context of library websites.

In the following sections, we begin with a literature review and a brief description of our study and its findings, followed by a discussion of their conceptual implications. The discussion addresses how diversity issues contributing to inaccessible library websites might be remedied by incorporating inclusive principles. The inclusive information architecture proposed as a possible remedy is specifically illustrated and applied for visually impaired users as an example.

Background Concepts and Related Literature

Diversity

As the US population has become more diverse, historical concepts of diversity shaped by early civil rights movements have broadened from very general race- and gender-based categories to include a wider range of marginalized groups. Paul T. Jaeger and colleagues (2011) propose that for the LIS profession, diversity must include all groups that are "underrepresented, disadvantaged, or underserved in terms of information" (167). There is also a growing awareness of the fact that structural disadvantages for marginalized groups are created through cultural practices of exclusion. If this is the case, then achieving diversity requires not only fair laws, rules, and regulations but also cultural, social, and professional competencies that seek to limit exclusion (Lazar and Jaeger 2011). In this sense, we view diversity as a professional competency and adopt Raquel J. Gabriel's definition of diversity as "the ability of relating to, reflecting and adapting to different groups," emphasizing the cultural and social aspect "that includes more points of view" (2013, 573).

Professional devotion to diversity and equal access is reflected in a number of major American Library Association documents, including the Library Bill of Rights, which declares that the library serves "all members of the community" (ALA 1996), and the intellectual freedom

statement "Libraries: An American Value" (ALA 1999). The ALA also directs libraries to go beyond the goal of equal access by pursuing equity, in other words, to "commit resources in order to level the playing field" for disadvantaged groups (Kranich 2005). This is an important basis for our claim that librarians should consider expanding information architecture to include an additional layer for screen-reader users on library websites.

Web Accessibility: Legislation, Guidelines, and Standards

A great deal of the LIS literature on accessibility stresses its legal aspects—for example, the implications for libraries of Title II of the Americans with Disabilities Act (1990), Section 508 of the Rehabilitation Act of 1973, and various state laws (Vandenbark 2010; Fulton 2011; Lazar and Hochheiser 2013). The literature also demonstrates that in spite of legislative imperatives, most library websites are not truly accessible for people with disabilities (Lazar and Jaeger 2011; Southwell and Slater 2012; Comeaux and Schmetzke 2013). Jaeger, Bertot, and Subramaniam (2013) argue that improvements are especially crucial because technology itself can be responsible for constructing disability.

Another challenge lies in the ambiguity of technical guidelines for web accessibility and the lack of specific directives in applying them. Following the Web Accessibility Initiative's Web Content Accessibility Guidelines (WCAG) (W3C 1999, 2008), many resources provide recommendations and best practices for accessible web design (Thatcher et al. 2006; Riley-Huff 2012; Horton and Quesnebery 2014); however, a number of studies assert that guidelines such as WCAG 2.0, though broad in scope, are difficult for developers to interpret (Donnelly and Magennis 2003; Brophy and Craven 2007; Vandenbark 2010) and apply at the design stage (Fogli, Provenza, and Bernareggi 2014, 207). Dagfinn Rømen and Dag Svanæs (2012) also affirm that there is little to no correspondence between the priority levels of WCAG criteria and the actual severity of problems faced by real web users with disabilities. The issue is compounded by the fact that standards and guidelines become quickly out-of-date in the context of rapidly changing technology. For example, the guideline stating that all content must be accessible via keyboard is not clearly applicable to mobile devices with virtual keyboards or no keyboard at all (Abou-Zahra, Brewer, and Henry 2013).

A frequent approach to web accessibility is to have developers "adjust the code" to comply with guidelines after a site has been designed. This approach typically results in a product that is technically accessible but not usable for people with disabilities because their actual needs are not considered in the design process (Lazar and Jaeger 2011; Fogli, Provenza, and Bernareggi 2014). However, there are currently no guidelines to assist web developers in approaching website accessibility as a design problem as opposed to a technical compliance issue.

Usability, beyond Accessibility, and Universal Design

Studies have shown that compliance with technical accessibility guidelines does not guarantee meaningful information access, or usability, for people with disabilities (Rømen and Svanæs

2012; Hill 2013). Barbara Leporini and Fabio Paternò (2008) describe usability and accessibility as two intertwined aspects of the same thing. Brian Kelly and colleagues (2009) contend that prioritizing standards compliance over the context of usability may, in fact, limit accessibility. Jakob Nielsen (2005) urges developers to "adopt a usability perspective" when testing accessibility, which involves real users in conjunction with automated testing tools.

Universal design is a principle that prioritizes equality by "designing all products . . . to be usable by all people" (Mace, Hardie, and Place 1991, cited in Bjork 2009, 118). In terms of information resources, universal design aims to provide a barrier-free environment that allows all users to navigate and access information by means of a user-centered information architecture. Information architecture is a design process and outcome resulting in the structural design of an information space that supports the usability and findability (retrievability) of information (Morville and Rosenfeld 2006). By providing the proper combination of organization, labeling, searching, and navigation schemes, information architecture enables designers to create an information space that adheres to the principles of universal design.

Universal design should not, however, be confused with the "one-size-fits-all" approach. When an interface design is focused on a specific user group, it may not satisfy other users' needs. For example, integrating images and graphics as a text supplement is a common priority when designing websites to meet the needs of people with certain cognitive and learning disabilities (Friedman and Bryen 2007, 208), but an ideal website for users with visual impairments prioritizes text-based information over visual content. Following the idea of "flexibility of approach, delivery, and application" that allows universal design to be accessible to diverse audiences (Zeff 2007, 30), information architecture must emphasize the varying abilities and constraints of individuals in a diverse user population rather than seek a uniform solution (Winance 2014). To this end, we suggest an inclusive information architecture with multiple layers of interfaces that encompass the unique needs of different user groups through alternative information architectures but at the same time allow all groups to access the same underlying website, services, and content.

Studies on Users with Visual Impairments

It is estimated that 6.64 million people in the United States have visual impairments (Cornell University 2012). Library websites are an especially important resource for members of this group because of their increased demand for access to materials such as Braille books, audiobooks, transcripts of image-based texts, and search tools (Phillips 2006; Southwell and Slater 2012). However, web users with visual impairments often "fell far short of what active participation in society requires" when it comes to being able to interact with websites (Van der Geest 2014, 161).

Web design principles developed to make the most of the graphical user interface (GUI) privilege users who perceive information visually (Leuthold, Bargas-Avila, and Opwis 2008). Studies investigating the information-processing behaviors of persons with visual impairments

suggest that in order to provide equal access, websites need to be designed differently to support the needs of this group (Given et al. 2007; Sahib, Tombros, and Stockman 2012). Stefan Leuthold and colleagues (2008) argue that the browsing and navigation behavior of screen-reader users is based on aural processing, which is inherently distinct from the information processing of sighted users. To enhance aural processing, Yi-Fan Yang, Sheue-Ling Hwang, and Bo Schenkman (2012) created a search engine that gives blind users more control over the display of results to enhance their searches. These studies suggest that many current website designs do not function well for people who are visually impaired and that it is necessary to design websites with these users in mind to ensure accessibility.

Leporini and Paternò (2008) developed a set of "usability criteria" based on the two major challenges for screen-reader users: (*a*) difficulty of inferring context while navigating aurally and (*b*) information overload from having to navigate content sequentially. These challenges are consistent with the main findings of the current authors' study on accessibility, in which all of the major usability barriers of the tested websites for visually impaired users fell into one of these two categories.

Brian Wentz and Jonathan Lazar (2011) employed usability testing as a way of comparing the accessibility of two versions of a website: the desktop and mobile versions of Facebook. They found that the mobile version was the more accessible and usable version for persons using screen readers. However, many study participants noted their displeasure with the fact that Facebook Mobile does not offer all of the same features as the desktop version. Thus, the authors warn against the discriminatory practice of creating separate versions of websites that are more accessible but lack the full functionality of the main site (Wentz and Lazar 2011).

Jonathan Lazar, Abiodun Olalere, and Brian Wentz (2012) conducted a usability test with the aim of identifying the main accessibility and usability barriers for screen-reader users on job-application sites. This study is similar to our own in that both illuminate the accessibility barriers of websites for users with visual impairments in the context of specific tasks and provide recommendations to web designers.

Description of the Study and the Findings

Objectives and Procedures

In this section, we employ findings from our study of library website accessibility to discuss diversity issues related to accessibility in web design.[1] The primary goal of the study was to uncover ways in which libraries could adapt their online services by identifying some of the main sources of inaccessibility on their websites. However, the researchers also took the

1. The study was funded by a grant from the Friends of the Library Development and Services Research Fund Endowment established by the former Minnesota Department of Education, Friends of the Library, Library Development and Services.

opportunity to explore the specific web use and browsing needs of people with visual impairments.

In the study, a usability-accessibility test was conducted with six blind participants,[2] who were asked to navigate three different library websites (two academic and one public) and two nonlibrary websites while the researchers observed their navigation patterns through think-aloud protocols. Participants used their own laptops and screen readers. Their level of experience with screen-reader technology ranged between 15 and 33 years.

Each data-gathering session consisted of a preinterview, the actual testing of the website, and an exit interview. The preinterview explored participants' everyday web use with questions about frequently used websites and some of the challenges they experience as screen-reader users. The testing portion consisted of an open-ended exploration of the home page followed by two to three basic, predetermined task scenarios for each of the four sites. The task scenarios for the library websites included catalog searching, making a research help appointment in an academic library, and signing up for a public library e-book workshop. The nonlibrary website tasks included searching for an information item, placing an order, and finding directions to the physical location of a business. The testing employed researchers' intervention and redirection when accessibility barriers prevented tasks from being carried out. This was done in order to get data on as many aspects of the websites' accessibility as possible. The exit interview was conducted to gain participants' retrospective thoughts on what had happened, what had been their expectations, and what had made the tasks difficult or easy.

Findings

Our test results were consistent with other studies' conclusions that most library websites are not truly accessible (Oud 2012; Southwell and Slater 2012). In fact, even with frequent intervention by the researchers, no single participant was able to complete all of the library website tasks successfully. Normally, usability criteria ask how easily participants are able to complete a task or how many tasks are completed easily. Yet our study revealed that visually impaired users are not able to navigate or explore typical library websites independently. The question for our study therefore became how many tasks the participants were able to complete with some intervention.

In our study, about half of the library tasks were completed successfully. Among the successfully completed tasks, only half were completed without intervention from facilitators. A task scenario that required finding an item from a library catalog was completed by only

2. Five is the widely accepted number of participants required for usability testing (Nielsen 2012), as the research purpose is to uncover usability problems with the design rather than to understand the user population. The participant group consisted of two women and four men between the ages of 19 and 58. Three were postgraduate students or professionals, and one was a college undergraduate student.

one participant without intervention, taking 7 minutes. Another task that required finding a subject resource was completed only once without intervention, taking 5 minutes. Finally, a task that involved signing up for a workshop was completed by two participants in a relatively short amount of time without intervention but was extremely difficult for all other participants. Overall, the library websites were more difficult than the nonlibrary websites for participants to navigate, even with assistance. For example, even with effort, very few participants had success finding the library catalog search interface on their own.

The most common barrier to task completion on the library websites was difficulty with navigation. This problem was most often inherent to the websites' information architecture rather than technical barriers. Participants were often unable to locate themselves within a site's structure (i.e., determining which page they were on or which process they were involved in). In some cases, basic orienting information was not properly available. Examples included the fact that a "home" button was not shown on the catalog page, which caused users to rely on back buttons or to try editing the page URL, or the fact that the full name of a university was not available as text (only the acronym was used in the alternate text for the image), although it was visible to sighted users via a subtitle on the logo image.

Library sites often provide multiple entry points for searching items; for example, "databases," "journals," "nonfiction," and "new collections." This is not inherently bad design, but it may confuse screen-reader users because they don't have the benefit of visual cues and are more attuned to semantics. Just finding a library catalog was not an easy task for the study participants because of multiple points to access scattered among other busy content. In other cases, the volume and variety of information on each page also contributed to this problem.[3] When participants tried to read pages containing a large amount of text or diverse types of information, they were often unable to make sense of the pages' context, especially if the information was not coded in a hierarchical structure that allowed them to get an overview of the page or skip to the desired content, or if the pages relied too heavily on visual cues for navigational context.

Our observations of participants revealed that they were not frequent library website users, despite their desire and need to access and use information on the web, which was consistent with other study findings (Lewis 2013). Most participants used the Internet regularly for purposes such as e-mail communication, social networking on sites such as Facebook and Twitter, shopping, job searches, music, and reading. Many also indicated that they prefer to use familiar sites as much as possible rather than face the learning curve of new sites. Overall, the library websites in our study seemed extremely difficult for participants to navigate and use

3. The assessment that library web pages contain excessive information for the purposes of a screen-reader interface was based on respondents' frequent comments that the sites were "too busy," indicating that the number of links, menu options, or different elements on the page was too great to process at one time.

unless assistance was provided. Without an adequate understanding of the library site structures or a sense of the value of the library resources to them, many participants expressed that they would not have the motivation to commit on their own to the steep learning curve necessary for blind web users. This shows considerable inequity in meeting the needs of this particular user group and calls for attention to the conceptual implications of the problem for the broader LIS field. In this article we will argue that technical validation with accessibility guidelines and evaluation tools does not necessarily provide a conceptual framework that can guide accessible web design for screen-reader users at a high level. Without high-level accessibility, users may be discouraged from using unfamiliar or complex websites that they might otherwise find useful. This is especially true for library sites, whose complexity and tendency to include a high volume of information on each page is difficult for screen readers to manage and poses a significant barrier for users who depend on the linear transmission of written text into audio.

Even when technical compliance with accessibility standards was met, usability issues remained a steep barrier for study participants, which confirms the assertion by Christopher Power and colleagues (2012) that for mutually shared usability problems, people using screen readers experience barriers of significantly higher severity than people who are able to browse visually. Their study on the relationship between accessibility standards and usability barriers for screen-reader users concludes that usability must be adopted as a success criterion if web accessibility standards are to be effective in meeting the information needs of real people.

Our study results therefore suggest that screen-reader users are effectively excluded from the target audience for library services in the sense that their needs are not considered in the design of those services. We interpret this inaccessibility of library websites to be a fundamental diversity issue; in other words, users with visual impairments are not included in the working definition of "users" by website design criteria.

Discussion of Proposed Information Architecture with Inclusive Principles

Given this interpretation, this article will focus on providing a high-level recommendation for library web design. Our intention is to address the fundamental issues of equal accessibility as a diversity issue and not just a technical one. We propose the principle of inclusive information architecture as a conceptual framework that incorporates inclusiveness principles to guide website design from the very beginning of the process, in contrast to conventional accessibility testing, which is usually done after the site is completed. The proposed information architecture considers the individual contexts of diverse groups by expanding the notion of universal design to include multiple modes of presenting the same content in order to meaningfully support their unique needs.

The inclusive information architecture suggested is multilayered, with each layer employing a user-centered design to cater to different user groups with different disabilities or other

unique contexts of use. We focus specifically on the design of one layer, which is based on the understanding gained through our study of the nature of visually impaired users' information processing through screen readers. In this section, we describe how the proposed inclusive information architecture will be screen-reader-friendly and will reduce the accessibility barriers that we found in our study with the following four guiding principles.

1. Screen readers assume that information is presented linearly.
2. Screen reader users process information aurally.
3. In aural processing, cognition is limited by the amount of information.
4. Screen-reader users have the same information needs as any other users.

Screen Readers Assume That Information Is Presented Linearly. Support Linearization of Information with Hierarchical Structure

The inclusive information architecture proposed in this discussion assumes that users with visual impairments are the main target audience in order to prioritize and address their specific needs, information-seeking strategies, and interests. This group relies on screen readers and uses the keyboard exclusively instead of the typical mouse-keyboard combination preferred by sighted users. Screen-reader users do not have a critical advantage that sighted users have: the ability to glance across the entire page at once and know which area contains the desired information. Therefore, screen-reader-friendly information architecture should enhance usability for the linear presentation of information so that users can navigate websites according to their own unique strategies for browsing, searching, and locating information when linearized. It should be based on text-oriented content with a well-embedded hierarchical structure and should not rely on visual cues.

Effective linearization of information is fully enhanced by a clear hierarchical navigation system and a careful reorganization of information that is appropriate and available for screen readers. With linear content presentation, it is essential to provide top-level navigation so that users can effectively skip to the information they want and bypass unnecessary sections. The hierarchical structure should allow the content to be logically divided into broad categories first and then further divided into subcategories, as needed.

The architecture that supports linearization can be viewed as analogous to the idea of responsive web design: mobile sites are an effort to rearrange the desktop site's information in a way that is compatible with small, narrow screens. In mobile web design, the small screen size means that the most effective architecture for user experiences involves removing multicolumn layouts and turning them into single-column layouts, among other adaptations. Incidentally, users with visual impairments often seem to rely on the mobile version of a website if available because mobile sites tend to be more accessible in general (Wentz and Lazar 2011). This is most

likely because the single-column design common in mobile sites forces web developers to linearize the site's content into a logical order and provide a clear set of navigational headings that can be understood without extra text or visual cues.

Screen-Reader Users Process Information Aurally. Information Is Available Only through Text Reading. Prioritize Information Content That Can Be Read as Text-only and Is Suitable for Aural Processing Rather than Visual

With effort, hierarchical navigation can and should be implemented reasonably well, even within a visually oriented website; however, a screen-reader-friendly information architecture would differ in prioritizing and calling attention to information and resources that are actually available and accessible via screen readers. The catalog, for example, should allow for searches of collections that would be of interest to visually impaired users by virtue of being in a readable and accessible format, such as audiobooks, e-books, Braille books, and other machine-readable content. Given that one of the most important features of a library website is catalog searching, the search interface should be augmented with additional filters to help users find these items.

In our study, library catalogs presented multiple barriers for screen-reader users. Simply locating the search interface for materials was almost always a struggle on the public library website. Searching was not an easy task for most participants because filters were not easily perceivable in a linearized environment. Another source of difficulty was that the catalog searches often brought up long lists of results that were difficult for the participants to scan. Results should be presented manageably for the screen-reader user's browsing; for example, titles should be formatted as links or headings to facilitate skipping from title to title. The presentation of catalog search results is one of the areas in which improved navigational hierarchy is needed for screen-reader users to bypass unwanted items and to go directly to the desired one.

A brief tutorial of how to use the catalog's basic and advanced search tools would be a useful feature in the inclusive architecture, as many of the advanced search tools on the test websites proved difficult for the study participants to use. Difficulties with search interfaces can be attributed not only to poor linearization but also to a lack of familiarity with library catalog searching. Some websites create tutorials specifically for screen readers, and these tutorials are invisible to anyone who does not access the site with a screen reader. In the case of libraries, though, a basic tutorial on advanced searching would be equally beneficial for many sighted users who are less familiar with catalog searching, so it might be helpful to make the tutorial available to everyone. However, the tutorial in this layer can be further tailored for the screen-reader users' characteristics of information searching.

For screen-reader-friendly information architecture, it is also important to provide a meaningful description for those who rely on textual description for the missing content provided by

visual cues and context. The screen-reader-friendly architecture must include these strategies, which depend on a thorough implementation of web accessibility best practices. When library websites contained links requiring visual placement or contextual cues to be fully understood, the text-only presentation of such links confused the participants. We observed that such confusion often resulted in "rabbit holes" from which the participant could not escape because the appropriateness of a link could not be evaluated through the destination page without the visual context.

Another consideration to be taken into account is that users with visual impairments are generally more interested in getting direct access to information content and less in taking time to listen to summaries of decorative elements or background images that do not contribute to the substance of the information on the page. Therefore, we suggest separating decorative images from content images, providing meaningful alternative text for content images and blank alternative text (alt="") for decorative images, which is recommended by the WCAG.

Links browsing is most effective when the site follows the guidelines for accessible link labeling. Many screen-reader users rely heavily on links lists for navigation, which means that they do not always have the context of the rest of the paragraph to help them make sense of a link's text. For that reason, it is important to make sure that the link text is descriptive enough to be understood out of context without being overly wordy. Links browsing is also facilitated when redundant links are removed and the number of links is lessened.

In Aural Processing, Cognition Is Limited by the Amount of Information. Help Reduce Cognitive Overload to Improve Information Processing

An accessibility barrier found numerous times in our study was the presence of too much information. The participants often complained that library sites were "too busy," especially when on library home pages, indicating that there was too much information to process efficiently. Many of the issues stemming from this problem can be resolved not only by a hierarchical structure for top-down navigation but also by eliminating redundant points of access to the same content. Multiple access points can be useful for visual browsing but almost always seem to hinder screen-reader users.

Many library websites appear to use the home page to appeal to every possible user and use of the library's web resources. This practice results in an unmanageable volume of text for screen-reader users to parse and also creates the additional barrier of too many links. As screen-reader users often browse links lists for more efficient access, an excessive number of links, particularly when redundant and/or not clearly labeled, substantially increases the time needed to browse websites and places a large burden on a user's short-term memory. We suggest minimizing the amount of redundant content so as to reduce the cognitive load on users.

By cutting out repetitive occurrences of content and paring down the volume of information on the home page, screen-reader-friendly architecture will also avoid accessibility bar-

riers generated by dynamic web elements, such as tab panels and drop-down menus in the navigation bar. We use the term *dynamic* to mean any web element that shows or hides content based on a user's action, typically mouse hovering and clicks. Such elements can be difficult or even impossible to use for people who rely on a keyboard instead of a mouse. Many of the websites in our study contained dynamic elements in order to save visual space, especially on the home page, which, as discussed earlier, already had a great deal of content. For sighted users, drop-down menus are an appealing design factor because they make the page appear less cluttered, but for screen-reader users, they are not only hard to interpret but are often difficult or even impossible to use as intended without the help of a mouse.

Although the Web Accessibility Initiative's Accessible Rich Internet Applications (W3C 2014) provides ways to describe dynamic and interactive elements in coding, many dynamic elements are used mainly to enhance visual appeal and are often unnecessary in screen-reader-friendly information architecture. The clutter will have already been reduced if the home page is organized with a hierarchical navigation menu and if the content is pared down to remove excessive or repetitive occurrences of information. If the page contents are streamlined and excess information is reduced, then there is no need for dynamic elements whose purpose is to save space and reduce the appearance of clutter.

Cognitive load can also be reduced by reorganizing information so that the content is linearized in a logical sequence. Even if a page is hierarchical, we observed that it does not linearize logically, which can limit the users' ability to find what they need. One specific example of a problem that the study participants encountered was a search button that was located directly above the associated search filter menus. A sighted user would have no trouble associating the filters with the search button because of their visual proximity, but one of the participants had difficulty because of the order of linearization. The search button, being on top, was the first thing that the screen reader read, which means that the participant heard the presence of the button and stopped reading because he thought he had found everything he needed. An improved design would place the search button after the last filter so that the button would be read after all of the filtering options.

Tailoring the layout and contents of the page to reduce the cognitive load in some ways parallels current practices in web design meant to attract audiences of different cultural groups to enhance usability for different cultural audiences and to target each particular local group (McCool 2006).

Screen-Reader Users Have the Same Information Needs as Any Other Type of Users. Create an Additional but Not Separate Architecture

It is important to note that the proposed architecture is not intended to be a separate website but should be additionally available according to users' requests. It is often the case that when

a website maintains a completely separate "accessible" version, that version is not updated as frequently as the standard one, with a resulting disparity in information access between disabled and nondisabled users (Hazard 2008; Wentz and Lazar 2011). In our proposed architecture, a screen-reader user would have the option to select a link and go to the screen-reader page if desired but could also stay on the main page instead. Screen-reader-accessible architecture can be added as a "Skip to" link in the HTML at the top of the main site's navigation, and the link can be styled to be hidden from sighted users' view while still being available to screen readers. Similarly, "Skip to" links can be employed in other major navigational aids. For example, a "Skip to Results" link can be added to the catalog searches, thus saving time and making search interfaces more usable.

Adding inclusive information architecture for screen readers would allow the existing visually oriented information architecture to fully leverage current trends in the visual and dynamic features that help sighted users optimally organize information. Such techniques can actually enhance communication and support for users with disabilities, such as dyslexia or other cognitive/mental disabilities (Friedman and Bryen 2007). By creating an inclusive information architecture for screen-reader users, developers would be able to address the needs of multiple disability groups: one architecture would provide visuals to assist users with learning disabilities and cognitive impairments, and the other would provide screen-reader users with the linear, focused, text-based content that best meets their needs. The information architecture for linearized content should be considered not as an add-on but as a built-in part of the initial website design populated with the same content as visually oriented architecture, allowing screen-reader users to interact with it in the same way as sighted users.

If a library already has a mobile version of its website, the mobile site may be a good starting point to augment for the screen-reader-friendly architecture because it is already linearized in a meaningful way. Quite a few other features of mobile-specific architecture are also optimal for screen-reader users, such as the fact that mobile sites have fewer redundant repetitions of links and content than desktop sites and the content relies on hierarchical navigation and linear order rather than on visual context to make sense.

Conclusion

Through our accessibility study, we discovered some of the barriers impeding the usability of library websites for users with visual impairments who rely on screen readers, and we propose a practical design solution to make library websites more usable and accessible for screen-reader users by employing inclusive principles of universal design. These principles could be applied to the design of library services to meet the needs of any underserved group. The LIS profession has always been committed to equal information access for all, and it is time for librarians to prove their relevance by showing that the profession is prepared to serve an in-

creasingly diverse population. We can achieve this by ensuring that information on library websites is equally accessible to all users and by designing library services to meet the needs of diverse groups from the ground up. Our proposed screen-reader-optimized information architecture is one example of the direction that such an approach might take.

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Kyunghye Yoon: assistant professor, MLIS program, St. Catherine University, St. Paul, Minnesota. Yoon received her PhD in information transfer from the School of Information Studies at Syracuse University. She teaches web usability and accessibility, user experience design, digital libraries, and information seeking and retrieval. Her research interests include user-based information retrieval and information access in digital environments, with a special focus on human-information interaction. E-mail (corresponding author): kyoon@stkate.edu.

Laura Hulscher: independent researcher, Minneapolis. Hulscher recently graduated from the MLIS program at St. Catherine University with a specialization in digital libraries. As a student, she participated in the web accessibility and usability course that led to the research discussed in this paper. Her research interest is the usability and accessibility of information systems, particularly in relation to information architecture and information presentation. E-mail: lh.hulscher@gmail.com.

Rachel Dols: accessibility Independence, St. Paul, Minnesota. Dols graduated in 2014 from the MLIS program at St. Catherine University. She was a student in the web accessibility and usability course from which this paper developed. Since then she has helped found and conduct research for

Accessibility Independence, a startup nonprofit organization whose focus is assistive technologies for people with visual and hearing impairments. Her specific research interest is display technology for converting digital and print images to tactile representations for people with visual impairments. E-mail: racheldols2@gmail.com.