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2020 LYRASIS Catalyst Fund Grant Report.
Preprint Accessibility

Is Early Access to Research Access for All?



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Project Abstract: Research focused on investigating the accessibility of preprint server platforms and files in order to identify accessibility issues and suggest possible remedies.

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1. The goal of your project – what did you hope to achieve?

This project sought to investigate the accessibility of preprint server platforms and the files they serve in order to identify accessibility issues and suggest possible remedies. The findings are foundational to considering how the LYRASIS community might advocate for accessibility when they do not have the ability to leverage a library licensing contract to do so. The project was designed as a one-time foundational investigation.

2. Your model or process – (a) what did you do; (b) what worked and what did not; and (c) what modifications did you make from the original proposal, or would you recommend others make if they want to adapt your model?

THE TEAM

Lisa Janicke Hinchliffe, Professor in the University Library at the University of Illinois at Urbana-Champaign, served as PI for the project. Sara Rasmussen and Mimosa Shah, graduate students in the School of Information Sciences, were hired as hourly graduate assistants. The team met and conducted its work virtually due to the pandemic and limitations on travel and gathering.

DEFINING PREPRINT SERVERS

Our first step in this project was to define our parameters for two key concepts: What is a preprint server? And what constitutes accessibility?

According to Kirkham et al., “a preprint is a non-peer reviewed scientific manuscript that authors can upload to a public preprint platform and make available almost immediately without formal external peer review.” In some cases, this is the author-accepted manuscript, or the last version before it undergoes publisher-based production processes.

A preprint server hosts preprints; servers may focus on a specific geographic region or scholarly domain. This server creates an open forum for the public to access emerging scholarly ideas, and authors to receive feedback on their ideas. We add that a preprint server must self-identify as such; by this criteria, institutional repositories are not preprint servers.

In selecting five preprint servers to study, we sought to identify a diverse group which also met the following criteria:

- The preprint server may restrict content to specific discipline(s) or require author vetting or submission approval but must not be closed to a specific community (such as institution-specific, funder-specific, or journal-specific). The preprint server is currently operational.
- The primary language of preprints posted to the server are in English.
- The sample of preprint servers constitutes a diversity of disciplinary representations, volume of preprints, institutional hosts, and server infrastructure.

This last component of server infrastructure was important due to the nature of accessibility testing: Our work would be somewhat duplicative if we audited multiple preprint servers hosted on the same technical infrastructure.

Using these criteria, we selected:

- OSF Preprints (Center for Open Science)
- SSRN (Elsevier)
- ArXiv (Cornell University Library)
- MedRxiv (Cold Spring Harbor Lab)
- APSA Preprints (Cambridge University Press)

ACCESSIBILITY CRITERIA

Disability is a diverse spectrum. In order to consider the accessibility of a website, one must consider the website's audience, who may be:

- People without perception of color
- People with limited vision and people without vision
- People without hearing
- People with limited manipulation and/or reach and strength
- People with Attention Deficit Hyperactivity Disorder
- People with learning difficulties and Dyslexia

These unique experiences require a range of accessibility solutions. The World Wide Web Consortium (W3C) has already laid the foundation in producing the Web Content Accessibility Guidelines (WCAG), an international standard for assessing whether web content meets four core expectations for accessibility across experiences: Perceivable, operable, understandable, and robust.

After researching the WCAG, we selected to test the preprint servers against WCAG 2.1 Level AA, which was last updated in June 2018. The W3C encourages using the most recent version to assess or develop web content.

We made a few modifications, excluding the following Success Criteria from our process:

- 1.3.4 Device Orientation, 2.5.1 Pointer Gestures, and 2.5.4 Motion Actuation because we did not test on mobile platforms.
- 2.1.4 Character Key Shortcuts because a developer must be consulted to make a determination.
- 1.4.11: Non-Text Contrast due to the complexity of testing.

METHODOLOGY: OVERVIEW

Drawing from the BTAA's definition of common user workflows, we focused our testing on webpages which support the core function of a preprint server: Navigating to the homepage, searching for a keyword, selecting a preprint article from the results, and downloading the PDF copy. From this, we defined six webpages to test:

- Homepage
- Search page
- Search results
- Three preprint articles and any associated downloadable files

Taking inspiration from the keyword that sent substantial traffic to preprint servers in the last year and a half, each preprint server was searched for “COVID-19.” In selecting manuscripts, we sought those which were representative of the site’s features, such as commenting, email and citation tools, PDF previewers. We further constrained the scope by ensuring the evaluation concerned only content accessible to the public, without the creation/authentication of a user account.

The audit process included generating and analyzing automated accessibility tests, manually reviewing all content on each webpage and PDF sampled, and creating detailed notes documenting observations. Each audit resulted in a full WCAG 2.1 AA accessibility rubric for each preprint server. We then summarized these findings at a higher level in individual evaluation reports.

METHODOLOGY: TESTING INFRASTRUCTURE

To develop our findings, we used a combination of automated and manual testing methods. For our automated testing tools, we utilized:

- Adobe Acrobat Pro Accessibility Check: This built-in feature provides an exportable overview of key check-points in PDF accessibility, such as whether the document is tagged and bookmarked, whether images contain alternative text, whether the title and page language has been set, and whether tables appear to be correctly structured.
- University of Illinois at Urbana-Champaign's Functional Accessibility Evaluator: Available for free with account creation, the Functional Accessibility Evaluator (FAE) crawls up to 25 webpages each, on 5 websites, providing detailed findings for those WCAG 2.1 criterion which can be automatically assessed. Note: this tool is currently being re-evaluated for future sustainability by its maintainer.
- Google Chrome Dev Tools (Lighthouse): Free to use with Google Chrome Browser, this developer tool gives a lightweight overview of key accessibility issues, such as color contrast, alternative text, and WRI-ARIA implementation.

Our manual testing practice was informed by Deque University’s training, WCAG Conformance Testing Methodology. Each webpage and PDF in the sample was reviewed against WCAG 2.1 AA, using the techniques provided by Deque, with the Google Chrome web browser and NVDA screen reader.

We adopted NVDA for three reasons: NVDA is free and open source, making this testing process lower-cost to replicate. Deque University recommends it, and WebAim reports from a 2019 survey that NVDA holds nearly equal market share with JAWS. We considered also testing on mobile with Android’s TalkBack screen reader, but ultimately decided to focus on desktop use, as we found that there were enough overlaps in the testing process that this would yield unnecessary duplication of effort.

Before officially beginning testing, we ran a trial audit of Preprints.org, to calibrate our process and estimate the time required to complete a WCAG 2.1 AA audit.

We intended to have two people each complete separate audits to ensure thoroughness and reproducibility. Our primary modification to the plan was that ultimately only one person completed the audit.

METHODOLOGY: DETAILED PROCESS

Before beginning the test, we explored the selected sample webpages, using these prompts:

- Identify from a sighted perspective: what are the main landmarks? Where are there buttons, menus, forms, or other interactive elements?
- Make note of these elements, so that you remember to check each of these in the process that follows, especially with respect to 1. Keyboard Navigation, 2. Document Structure and Forms, and 3. Visual Presentation.

We reviewed the following key areas for accessibility, adopting the testing methodology laid out by Deque University, and adjusting it slightly for the specific focus of this project. Each area mapped to the results from our automated testing tool, FAE, and the WCAG guidelines.

Step	Accessibility Evaluation	FAE Rule Group	WCAG Success Criterion & Deque Guide Links <i>* Some manual checks required</i>
1	Keyboard Navigation	2.1 Keyboard accessible	2.1.1 Keyboard* 2.1.2 No Keyboard Trap
		2.2 Enough time	2.2.1 Timing Adjustable 2.2.2 Pause, Stop, Hide*
		2.4 Navigable	2.4.1 Bypass Blocks* 2.4.2 Page Titled 2.4.3 Focus Order* 2.4.4 Link Purpose (in context)* 2.4.5 Multiple Ways* 2.4.6 Headings and Labels* 2.4.7 Focus Visible*
		3.2 Predictable	3.2.1 On Focus* 3.2.2 On Input 3.2.3 Consistent Navigation 3.2.4 Consistent Identification
2	Document Structure and Forms	1.3 Adaptable	1.3.1 Info & Relationships 1.3.2 Meaningful Sequence 1.3.3 Sensory Characteristics 1.3.5 Identify Input Purpose
		3.3 Input assistance	3.3.1 Error Identification* 3.3.2 Labels or Instructions 3.3.3 Error Suggestion*

			<u>3.3.4</u> Error Prevention*
3	Visual Presentation	1.4 Distinguishable	<u>1.4.1</u> Use of Color <u>1.4.2</u> Audio Control <u>1.4.3</u> Contrast (Minimum) <u>1.4.4</u> Resize Text <u>1.4.5</u> Images of Text <u>1.4.10</u> Reflow <u>1.4.12</u> Text Spacing <u>1.4.13</u> Content on Hover or Focus
		2.3 Seizures	<u>2.3.1</u> Three Flashes or Below
		3.1 Readable	<u>3.1.1</u> Language of Page <u>3.1.2</u> Language of Parts
4	Alternative Text	1.1 Text alternatives	<u>1.1.1</u> Non-text content
5	Audio and Video	1.2 Time-based media	<u>1.2.1</u> Audio or Video Only <u>1.2.2</u> Captions <u>1.2.3</u> Audio description or media alt <u>1.2.4</u> Live Captions <u>1.2.5</u> Audio description
6	Dynamic Content and Widgets	4.1, 2.5 Compatible	<u>4.1.1</u> Parsing <u>4.1.2</u> Name, Role, Value <u>4.1.3</u> Status Messages <u>2.5.2</u> Pointer cancellation <u>2.5.3</u> Label in name

For PDFs, we recorded our findings as follows:

Report section	PDF Accessibility Check sections
"Document structure"	Tagging Logical Reading Order Titles Tables Headings
"Visual presentation"	Primary Language
"Alternative text"	Alternative Text

RECOMMENDATIONS

After completing this research, we present the following recommendations to others who may wish to adopt our methods.

- **Budget enough time:** We found that conducting the accessibility audits took roughly 50% more time than we initially estimated (took 15 hours instead of 10 hours). This is no doubt due to investing in training our own auditors; once up to speed, we estimate we could keep doing audits of this scope in 10 hours or fewer.
- **Iterate your process:** WCAG auditing can feel quite repetitive. For example, a Level A criterion may test for whether a certain feature is present, while a separate Level AA criterion tests the quality of that feature. We adjusted the order in which we tested the WCAG guidelines, to create efficiencies. The automated tests provide some insight into where the manual test needs focus. More tightly integrating our review of automated test results together with the manual test sped up the process overall.
- **Looking at PDF accessibility?** Consider integrating PDF/UA guidelines into your audit. While Deque University provides some overlapping guidance, WCAG is optimized for websites, e.g., interactivity and forms.

3. Your accomplishments – what did you achieve?

We identified a range of specific accessibility barriers on each preprint server, particularly with respect to the PDFs downloaded from the sites.

We found implementations of the latest web accessibility techniques, content with "room for improvement," and inaccessible features. In some cases where we identified a problem, we were unsure of its cause and therefore unable to specify remedies, as the architecture of accessibility is far more technical than anticipated.

We intend to share these with the site administrators in hope that it will directly encourage remediation.

FINDINGS

Every preprint server analyzed was close to meeting the WCAG 2.1, Conformance Level AA, standard of accessibility. All of the sites were even closer to meeting Conformance Level A. This suggests some awareness of accessibility best practices. The findings show that all users would be able to load the homepage, navigate most of the search tools tested, select a preprint result, and navigate its individual landing page.

A primary area of concern, however, is what happens after a user downloads a PDF. Many PDFs were wholly inaccessible, some were readable (excluding images) and none were fully accessible. In the case of the readable PDFs, found on OSF Preprints and MedRxiv, we would need to sample more PDFs to understand whether this was simply coincidence, or an indication of an accessibility check happening as part of the server's publishing workflow.

Within webpages specifically, several themes emerged across the sites: issues most commonly arose with search tools (such as unlabeled filtering or faceting buttons), modal dialogs (hard-to-use contact forms and feedback forms), inaccessible error messages, and content only available on-hover. We also found that low color contrast was frequently an issue, despite being easy to test and solve.

Images are not central to preprint servers; most servers featured minimally descriptive alternative text, if any, although APSA Preprints, featured exemplary alternative text. However, in preprint PDFs, images are common and entirely without alt text.

Through our audits, we found examples of accessible content: APSA Preprints had implemented WAI-ARIA specifications, particularly in providing contextualized accessible names for interactive elements, which enhances the web browsing experience of screen reader users. SSRN had accessible error handling, so that if something went wrong in completing a form, it would be clear to the user what happened and how to fix it.

Although this is not measured by the WCAG audit, MedRxiv provided access to preprint content directly on the website, without requiring PDF download. As Polka et al. note, "HTML or XML full text preprints provide a better reading experience, including more flexible, responsive, accessible, and mobile-friendly display formats." While this bypasses any concerns about PDF accessibility, ensuring all users can read the manuscripts they host, the current implementation has weaknesses. The inline content contained images of data tables, without sufficient alternative text, rather than actual tabular data provided in the PDF.

Three of five preprint servers acknowledged accessibility, in three different ways. Arxiv provided a mechanism for contacting the site's accessibility team. SSRN provided a Section 508 link. APSA Preprints linked to its accessibility policy, plus accessibility team contact information.

4. Lessons learned – what insights did your organization gain while implementing the project? These could be insights into such areas as the community served, your own organization, or issues your project sought to address. Lessons learned are often unexpected.

Looking specifically at whether open access translates to accessibility, this project asked, “Can the library recommend a preprint over the version of record?” With respect to accessibility specifically, this research initially suggests, yes: cautiously and with a plan to assist users with accessibility issues that may arise.

This project demonstrated that quality of accessibility will vary widely. For example, simply *having* alternative text for an image is not the same as having effective alternative text: both brief and descriptive. Librarians with limited time and resources will find themselves asking, how much is “accessible enough”?

Likewise, accessibility solutions are not one-size-fits-all. Although low vision and blind users face the most barriers in accessing web content, accessibility concerns a much broader range of needs and accommodations. At times, these may even conflict. Ultimately, this requires web developers to make design choices which have trade-offs. Related, “automated” accessibility tools are sources of information, but they only identify about 30% of accessibility issues (Deque University). They still require a trained person to interpret their results and apply the recommended improvements to a website.

As technology changes and norms around user experience evolve, there will always be new ways to improve accessibility as part of the holistic user experience.

However, the onus of accessibility is not always clear. U.S. legal precedent may put this on the individual, in cases where institutions determine that providing accessible services creates an “undue burden” for that institution (<https://www.ada.gov/effective-comm.htm>).

Is it the responsibility of a scholar to ensure their manuscript is accessible before uploading it? Is it the duty of the preprint server hosting the document? Or should libraries and their patrons find their own technologies or methods for rendering content accessible?

A preprint server may see itself solely responsible for its infrastructure (the website), not its content (the PDFs). Indeed, many of the PDFs we sampled in this project were inaccessible. However, there are software workarounds: Adobe Acrobat will try to auto-tag a document, rendering it at least partially accessible, if it knows that a screen reader is available. Is that “accessible enough”? In the absence of already-accessible preprints, the library may step in not only to facilitate access, but to help users improve their own experience.

Complicating this is the varying amount of work required to meet accessibility requirements. While creating document semantics is almost as easy as clicking a button with Adobe Acrobat, developing useful alternative text for flowcharts, substituting images of tables with actual tables, and writing effective descriptions of dense statistical charts is far more challenging. It points to the reality that accessibility is not one actor’s responsibility, but many.

In examining these questions, it became apparent that accessibility requires expertise. WCAG audits are detailed, complex, technical, and iterative: This is why accessibility auditing, a specialized task, is outsourced. However, having a general understanding of web accessibility can benefit librarians, first as a tool for supporting users, and second as a tool for advocacy.

Finally, although this study specifically excluded them from its scope, we anticipate that Institutional Repositories may face these same accessibility issues.

5. What's next – where do you go from here? How do you plan to sustain and/or expand upon your accomplishments both for your organization and the community? Is there a way that LYRASIL can support your efforts in continuing the work, or play a role in developing the project further?

There may be an opportunity for a “shared service” that can be tapped by multiple libraries, perhaps offered by a consortium or organization such as LYRASIL, that focuses on web services that are freely available. This would complement efforts elsewhere in the field that focus on subscription resources.

The project also revealed a number of potential follow-on projects:

- A study of how different testers reach consensus on what to look for when testing for accessibility.
- A project to develop recommendations for preprints servers on how to get to the accessibility that they are committed to.
- A project to develop guidance for preprint servers on how to receive, review, and process inaccessible submissions.
- Studies that extend this investigation to additional preprint servers as well as institutional repositories, library publishing platforms, etc.

6. How can others find out more? Provide URLs for project materials, websites, software repositories and other publicly available content produced during your project.

Project presentations have been deposited in IDEALS, the Institutional Repository of the University of Illinois at Urbana-Champaign.

- Presentation for LYRASIL Staff: <https://www.ideals.illinois.edu/items/123809>
- Presentation at the 2021 Charleston Library Conference: <https://www.ideals.illinois.edu/items/119675>

A Zotero group for related citations is also available:

https://www.zotero.org/groups/2794006/preprint_accessibility_project

7. Are there any examples of PR, presentations, recognition, or marketing materials that were produced during the course of the project?

Project presentations have been deposited in IDEALS, the Institutional Repository of the University of Illinois at Urbana-Champaign.

- Presentation for LYRASIS Staff: <https://www.ideals.illinois.edu/items/123809>
- Presentation at the 2021 Charleston Library Conference: <https://www.ideals.illinois.edu/items/119675>

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