

A Case for Adaptation to Enhance Usability and Accessibility of Library Resource Discovery Tools

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Abstract. Library resource discovery tools (RDTs) are the latest generation of library catalogs that enable searching across disparate databases and repositories from a single search box. Although such “Google-like” experience has been applauded as a benefit for library users, there still exist usability and accessibility problems related to the diversity of user goals, needs, and preferences. To better understand these problems, we conducted an extensive literature review and in this process, we initially grouped issues into three categories: interface, resource description, and navigation. Based on these categories, we propose adaptation as an alternative approach to enhance the usability and accessibility of RDTs. The adaptations could be conducted on three levels pertaining to categories of issues found, namely: interface, information, and navigation level. The goal of this paper is to suggest how the process of adaptation could be considered in order to mitigate usability and accessibility issues of RDT interfaces.

Keywords: Digital library accessibility · Usability · Web accessibility · Digital libraries · Universal access of information · Adaptation

1 Introduction

The advent of the digital technology has caused the proliferation of information resources in digital formats. As a result, we see libraries engaged in the presentation of digital content, management of institutional repositories and open access journals, production and management of educational movies, provision of access to online resources, and mass digitization of print resources [1]. Moreover, presentation of books in eBook, audiobook and braille versions and production of text in PDF, HTML, and EPUB alternatives are among the notable activities observed in digital library environments [1]. All those efforts contribute to libraries’ tradition of collecting and organizing information for supporting research, development, and other activities in their parent organizations.

As libraries continue to embrace technology, user’s interaction with libraries is also becoming increasingly reliant on library search tools. Driven by the apparent motive of improving the user experience, the tools have evolved from simple card catalogs to web-based catalogs, web-based catalogs augmented with recommenders, metasearch

tools, and eventually to web scale resource discovery tools (henceforth referred to as RDTs) [2].

RDTs are referred to as the “new generation library catalogs” which offer a single point of access to library resources as well as databases that libraries have subscribed to [3, 4]. They provide users with “simple, fast and easy “Google-like” search experience,” present librarians with statistics on the usage of their holdings, and offer content providers an alternative channel to increase usage of their resources [5, 6]. The “Google-like” experience is explained as the possibility of using a single search box to simultaneously search across in-house and remote databases in a manner suitable even to inexperienced users [6].

RDTs are available as commercial and as open source products [2]. Depending on their design, their interfaces could include advanced search options, options for filtering search results, results ranking, cloud of search terms, resource descriptions (resource overview), cover images or thumbnails of titles, icons, push technologies such as RSS feeds, recommenders and other features [7, 8]. Figure 1 provides an example of an RDT, which is currently being used by Norwegian academic and research libraries.

Apparently, developments in library search tools are fueled by the need to improve their usability. However, the demands of universal design and the subsequent need for reaching all users, make accessibility an important issue to consider along with usability.

The screenshot shows the Oria discovery tool interface. At the top, there is a header with the UiO logo and the text "Knowledge changes everything". Navigation links include "New Search", "Databases", "E-journals", "Can't find it?", and "Help". There are also links for "e-Shelf", "My Account", and "Sign in".

The search bar contains the text "the snowman" and has a "Search" button. Below the search bar, there are "Advanced Search" and "Browse Search" options. The search results are displayed in a list format, showing the following items:

- Snømannen** (Book): R.L. Stine 1943- Jukebox klubben 1996. Fulltext available. Click Get it to see which institutions that have a physical copy.
- Pass deg for snømannen** (Book): R.L. Stine 1943- 2000. Fulltext available. Click Get it to see which institutions that have a physical copy.
- The snowman.(Poetry and Medicine)(Poem)** (Article): Shectman, Robin. JAMA, The Journal of the American Medical Association, Dec 18, 2002, Vol.288(23), p.2936(1) [Peer Reviewed Journal]. Full text available.

On the left side, there are filters for "Personalize your results" (with an "Edit" button), "Expand My Results" (with options for "Include material your institution doesn't have access to" and "Show only"), and "Refine My Results" (with options for "Resource Type" such as "Articles (580)", "Reviews (232)", and "Newspaper Articles (144)").

On the right side, there are "Advanced search options" and a "Results list" label. A "View all" link is also present at the bottom right of the results list.

Fig. 1. The Oria discovery tool as implemented by the University of Oslo (UiO) library.

Libraries have been working to comply with accessibility requirements through the adoption of technical guidelines such as the Web Content Accessibility Guidelines (WCAG) [1]. Research shows that such activities have been largely limited to library websites and the studies have been mostly evaluative – examining to what extent the websites meet accessibility standards [1, 9]. However, research also shows instances where a website can be designed to pass the maximum AAA level accessibility test according to WCAG 2.0, but remain unusable to those it was intended for [10]. Therefore, researchers recommend to consider the adaptability approach, which builds on the guidelines-based approach, but emphasizes on matching resources with users' needs and preferences [11]. The fact that different types of users, with different goals and needs, use libraries would provide a justification for exploring this approach.

Therefore, this paper aims at exploring how usability and accessibility of RDTs could be improved through the adaptability approach. First, it discusses usability issues uncovered in different studies. Then, it presents accessibility issues as discussed in the literature, with a particular emphasis on a prior study that examined the accessibility of a library RDT from the user perspective. In relation to this, it discusses adaptability approaches from literature and attempts to show how they could be used to improve the accessibility and usability of library RDTs. Finally, the paper closes with conclusion and pointers for future work.

2 Usability of Library Discovery Tools

Usability studies on library RDTs have discussed advantages as well as weaknesses of the tools. For instance, Prommann and Zhang [12] evaluated Ex Libris® Primo¹ and said that the tool is suitable for groups of users with different goals and helps the users to conduct many tasks with a minimum amount of steps. They added that Primo allows filtering search results in different ways without the need of re-entering the search keywords. Moreover, they noted that Primo enables comparing search results via the *details* tabs found under each title, and offers “smooth transition” to external websites when needed [12]. A usability test made on EBSCO discovery service (EDS)² mentioned the ease of use and the possibility to narrow search results as its benefits [13].

RDT interfaces are rich with functionalities that offer alternative ways for searching and filtering. However, this could be a source of problem for some users. For instance, the study made on EDS found that the many features of the interface were found to be “overwhelming” or “confusing” for some users [13]. Studies hint that users might give little attention to end-user features other than the search box [14–16]. Users would also face confusion regarding the location of filters/facets (e.g., whether to look for “music” under *format* or *topic*) [13, 15]. Some would confuse resource types (e.g., eBooks with audio books) and face difficulty in choosing the right filter that helps to narrow the search down to the resource type they want [17]. Other problems include the ‘excessive’ number of clicks it takes to access electronic resources, irrelevant search results,

¹ <http://www.exlibrisgroup.com/category/PrimoOverview>.

² <https://www.ebscohost.com/discovery>.

difficulty in understanding jargons (for instance, mistaking “reviews” for peer-reviewed journals), and librarians’ limitations in providing an “understandable language” [12, 18]. Moreover, inconsistent metadata, inability to save search results, and RDT’s failure to distinguish eBooks from journal articles constitute a list of usability problems [12, 19].

Studies that noted the complexity involved in using library search tools quote Nielsen [20] suggesting that simple interfaces are the most effective ones [14]. Moreover, they showed that the selection and positioning of end-user features could affect the usability of resources behind the interfaces. For instance, Teague-Rector et al. [21] found that presenting search alternatives such as articles, books and journal titles with tabs instead of drop-down menus resulted in better exposure of resources stored in disparate silos. The experiment by Teague-Rector et al. [14] also showed that moving the search box from left to the center of the interface increased the number of searches conducted. Some attribute this to Google, which could have shaped users’ expectation to see the search box at the center [22, 23].

A solution raised in connection with simple search interfaces is the ‘progressive disclosure’ approach, where the interface is designed to show some of the most important features at startup and supply the more advanced ones later as required by the user [14, 24]. Differentiating less and more important features, however, would require considering different factors. First, users’ information needs, information seeking behavior, tasks and task models, goals and their experience of other search systems would need to be factored in [14, 22]. Paternò and Mancini [25] claimed that this could be tackled through the adaptation approach. Second, libraries require RDTs to expose resources to the right users and help to increase usage of library collections, in order to justify the cost of maintaining them [26]. Hence, the design of RDTs would require balancing the needs, preferences, and behaviors of users with the interest of the libraries. In addition to that, it could be important to note that libraries are increasingly adopting commercial discovery tools that won’t leave much room for customization [1]. This could limit their ability to influence the interface design.

In general, usability issues involving RDTs are related to interface level issues (e.g., simplicity vs comprehensibility), end-user features (e.g., search box, filters, results list presentation) and resource description and organization (e.g., language/jargon used to label features, metadata, and resource description). The next section compares these with accessibility issues explored mainly through a prior study made on a library RDT.

3 Accessibility of Resource Discovery Tools

Accessibility is a concept often discussed along with disability. It can have different meanings based on the model of disability used. For instance, the medical model interprets disability as a mental or physical limitation of an individual, whereas the social model treats it as a failure of the environment to accommodate the needs of people with disability [27]. This paper adopts the conceptualization as presented by the International Classification of Functionality, Disability and Health (ICF) model, which interprets disability as a result of medical and/or contextual (personal and environmental) factors [28]. Therefore, accessibility could be seen as a way of identifying and

dealing with sources of impediments, either personal or environmental, in human computer interaction.

Most studies conducted regarding the accessibility of digital library services were related to library websites [29, 30]. Many of them used automatic testing tools to check conformance of library websites to WCAG guidelines [9, 29]. Though studies related to library RDTs are few, some of them identified the needs people with disabilities could have during their interaction with library search tools. For instance, Berget and Sandnes [31] stated that people with dyslexia are prone to making spelling errors while typing search terms. Therefore, they recommended search tools to be error tolerant and support autocomplete features in order to reduce the effects of dyslexia. Another study by Berget and Sandnes [32] found that users with dyslexia formulate more queries and spend much time while searching on databases which lack query support features. Therefore, they claimed that such tools are not accessible for users with dyslexia. Similarly, Habib et al. [33] found that users with dyslexia shun search functions of virtual learning environments which do not tolerate typographical or spelling mistakes.

A study conducted by Beyene [17] on Oria, a library RDT used in Norwegian research and academic libraries (as shown in Fig. 1), confirmed the findings of the studies mentioned above. However, it also provided a glimpse into the challenge associated with diversity in needs and preferences. For instance, two participants with dyslexia had different reactions regarding the colors highlighting the search terms in the results list: one of them saying that the highlights are distracting, while the other saying they are helpful (see Fig. 2). A user with low vision impairment liked the autofill suggestions, while another participant with the same impairment said the suggestions are annoying if cannot be read correctly by his screen reader software. Participants with dyslexia generally liked the use of icons among resource descriptions, while some users with low-vision impairment did not find them helpful. Such examples were many, but in general, the accessibility issues explored in this study could be broadly classified as interface level issues, search results presentation, and navigation related. Next, we compare issues discussed in Sect. 2 with accessibility problems explored mainly in Beyene [17], to recommend an approach that could be used to address the combined concerns of usability and accessibility.

3.1 Interface

A typical interface design issue that causes usability problems for users is the tendency of “overpopulating” the interface with different features [13]. This is also identified as an accessibility problem that could cause strain to users with dyslexia and visual impairments who might use various assistive technologies [17]. In addition to that, the suitability of background and foreground colors; font type, size and intensity have been among accessibility issues identified by participants in the aforementioned study. Moreover, the blurring or disappearance of text and icons when the interface is changed to high contrast was a problem for some users with low vision impairment [17].

Libraries using the same discovery product could follow different styles regarding background and foreground colors of the interface. For example, libraries at University of Oslo and Oslo and Akershus University College use Oria, a discovery tool built

upon Ex Libris® Primo. However, CSS-related differences are quite noticeable on their respective search interfaces. This shows that some accessibility problems could emanate not only from the product, but also from the implementation of the product.

3.2 Search Results Presentation

RDTs typically present search results supported with metaphors and visual cues. For example, in Oria, each resource title is complemented with an icon or cover image to show whether the material is an eBook, article, audio book or any other type of resource. Visual cues are also used to indicate the availability of a material in the library system; green for availability and yellow for unavailability.

The “details” link included with each title leads to detailed information, such as the publisher, date of publication, series, and other descriptions about the resource. Usability studies regard these as important for comparing search results, but they mention metadata inconsistency as a problem [22]. On the other hand, these could be “too much information” for users with cognitive and other forms of print disability [17].

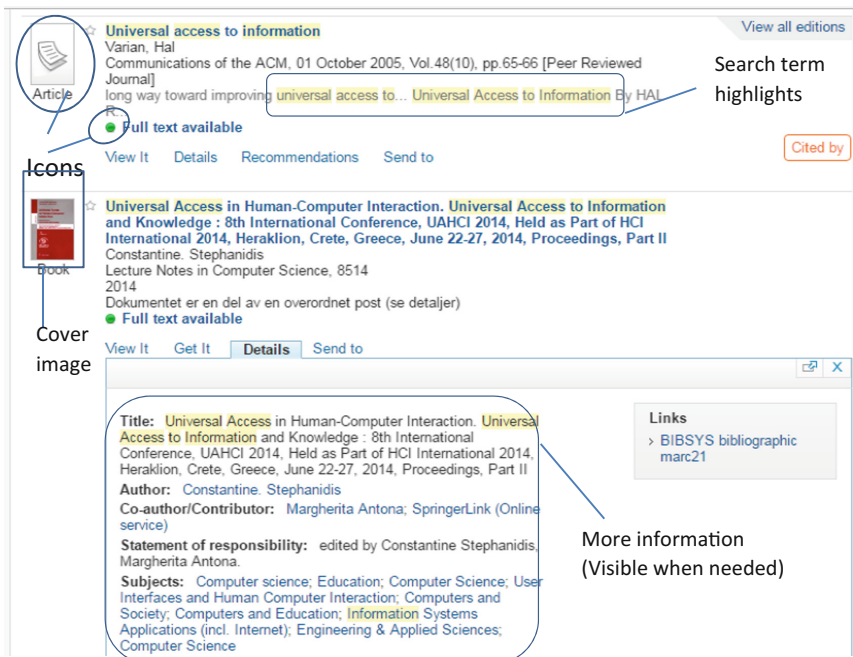


Fig. 2. A snippet of search result list for “universal access to information.” (Color figure online)

Beyene [17] also emphasized the importance of technical metadata (also called as accessibility metadata) that could provide important information for users with disabilities (e.g., whether a resource is accessible by text-to-speech tools, whether it is

behind a paywall). A study made on selected libraries showed that the use of accessibility metadata is not yet well explored [1].

3.3 Navigation

Accessing electronic journals or eBooks is a lengthy process that requires clicking multiple links, which at times takes the user out of the library interface. The possibility of “smooth navigation to other web pages” has been mentioned as an important usability trait of library RDTs [12]. However, this type of navigation could discourage users with a disability from using a library RDT [17]. Related to this, a problem pertaining to navigation of websites is the poor or inaccurate labeling of links [34]. This could pose a problem for users of screen reader technologies, such as JAWS, which generates a list of links to facilitate the navigation [17].

The examples discussed so far show the diversity in needs and preferences even among users with similar disabilities. As discussed by Kelly et al. [11] and Paternò and Mancini [25], adaptation seems a viable alternative to improve accessibility and usability. Next, we attempt to explain how this could be applied to library RDTs.

4 Adaptation: Addressing Accessibility and Usability

Adaptation has been discussed in terms of facilitating ease of interaction, quick discovery of information [35], adjusting web-based systems to accommodate user diversity [25, 35] and ‘individualization’ of solutions as opposed to the “one-size-fits-all” approach [36]. A study by Knutov et al. [37] classified the works on adaptation as *content*, *presentation* and *navigation* adaptation. Valencia et al. [38] claim that works on the adaptation of websites have largely been restricted to transcoding functionality and focused on “a single group” such as elderly people, people with limited mobility, and blind people. They sought to adapt web pages through the annotation approach based on WAI-ARIA³. Using similar approach, Ferati and Sulejmani [34] introduced techniques that can automatically increase website accessibility through a link, image, and navigation enrichment.

Literature shows two types of adaptation techniques: *adaptable* and *adaptive* [36, 39]. The *adaptable* approach allows users to control the behavior of the system by specifying their needs and preferences. The *adaptive* approach is an automatic process where the system learns user’s behavior from his/her interaction history and adapts the interface automatically [40]. As explained by Peißner [36], the adaptable systems give the user total control to change the appearance of the interfaces from his/her perspective. However, it would be taxing to users to spend time doing the modifications. On the other hand, the adaptive approach would let the system do the modifications on user’s behalf. However, those automatic changes could confuse some users [25].

The pros and cons of both approaches in library environments could be weighed at least from two different perspectives. First, the tradition of libraries where privacy is

³ <https://www.w3.org/TR/wai-aria-1.1/>.

sacrosanct would discourage collecting any type of information from the user. That goes to the extent of deleting log files and loan history [41]. Second, as it can be learned from the discussion made so far, it could be impractical to profile people by their disabilities as people with similar disability could have different accessibility-related needs. This would, therefore, entail empowering users to choose the mode of interaction that better suits their needs, which makes the adaptable approach a better way to start the adaptation of RDTs.

4.1 Adaptation of Library Resource Discovery Tools

Paternò and Mancini [25] presented levels of adaptation that can be considered for helping users in an information space: *Presentation*, *Information*, and *Navigation* levels. This type of categorization seems well aligned to the categorization of accessibility and usability problems presented in Sect. 3. We have not come across works that attempted this approach for improving accessibility and usability of library RDTs at these three levels. However, there are some examples that could be discussed here in order to suggest adaptation at the three levels.

Interface/Presentation Level Adaptation. Needs related to the interface elements such as the search box, filters, results list, background and foreground color, and font type and size, could be considered as elements of *presentation* level adaptation. There are some examples of presentation/interface level adaptation available, though not related to libraries. For instance, the Cloud4All home page⁴ shows how a web page can be adapted to the needs of those who prefer to use it in high contrast mode and/or to those who do not like images and prefer big fonts. The other option that can be mentioned here is to imitate the Gmail interface by providing *standard* and *basic/html* views, as suggested by a user with low vision impairment [17]. The standard view is supposed to be used by a standard user and the basic/html view is to be used by people who want to have a simplified view. Another example that could be related to interface level adaptation is *Accessibility Toolbar*⁵, an open source toolbar that can be installed on web browsers to help users customize the way they view and interact with web pages [42]. Considerations could be made to enable users to change the interface characteristics from their profiles or to have an external toolbar to change elements on the interface.

Information Level Adaptation. The information provided regarding the search results including titles, icons and other visual cues, list of alternative formats (audio, video or textual alternatives such as PDF, HTML and EPUB), and resource description/metadata (e.g., title, subject, format, abstract/review, accessibility to text-to-speech tools, etc.), can be considered for an information level adaptation. A closely related work that can be mentioned here is a case presented by researchers from the eLearning community⁶. The search interface of the education media library

⁴ <http://www.cloud4all.info/>.

⁵ <https://www.atbar.org/>.

⁶ <http://www.a11ymetadata.org/accessibility-metadata-in-action-at-teachers-domain/>.

showcases the use of accessibility metadata for faceted search – to filter resources by their accessibility attributes. For example, a person with hearing impairment can use filters to display only videos with subtitles. The user can also set his needs and preferences in his profile to see the search results coming up with kind of information he/she needs. For instance, if a hearing-impaired person wants videos with captions to appear in search results, he can log in his profile and set his accessibility preference, indicating he prefers videos with captions. The next time he searches, the result list displays a list of videos with additional information: videos with captions come up with a label “accessible” whereas those without caption display the label “inaccessible”.

Not all users would need or want icons or other pictorial representations and not all of them would require information on the accessibility of the resources [17]. Therefore, it would be important to enable turning them on and off, depending on the user’s needs.

Navigation Level Adaptation. The different methods of navigation users require in an information space could be treated as an issue of *Navigation* level adaptation. The study by Ferati and Sulejmani [34] showed that poor link descriptions cause navigational problems. The solution they provided for automatic enrichment of links could be suggested for RDT interfaces.

Experiments and further research would be required to weigh the applicability of those examples to design adaptable RDTs. The best of the three examples given above could also be combined to experiment adaptation of RDTs at different levels.

5 Conclusion and Future Work

Library discovery tools have evolved to a web scale search tools that offer users a one-point access to multiple repositories and databases. However, the usability and accessibility issues explored in this paper suggest the need for simplifying knowledge discovery and access to all users. Users are diverse in terms of needs, goals, preferences and disabilities. Library search interfaces are rich with different features, which aid resource discovery and access. However, they could also present a scene of complication for some users, especially for those with different types of disabilities.

The primary goal of this paper was to build a case for the adaptation of library RDTs based on a literature review and empirical findings, and then to provide examples that could be followed. The overall discussion shows that adaptation can be done at interface/presentation, information, and navigation levels to entertain the accessibility and usability needs of diverse users. The study focused on providing suggestions on how to empower users to make their own choices regarding their interaction with library search tools. Therefore, examples that conform to the adaptable approach were presented to suggest their applicability for adaptation of RDTs at presentation, information, and navigation levels. As future steps, we initially intend to develop a prototype informed by best practices as discussed in the above section. Using this prototype, we will then conduct experiments to compare several designs, which would result in design recommendations that could inform future endeavors related to RDTs.

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