Resource Discovery and Universal Access: Understanding Enablers and Barriers from the User Perspective

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Abstract. Resource discovery tools are keys to explore, find, and retrieve resources from multitudes of collections hosted by library and information systems. Modern resource discovery tools provide facet-rich interfaces that provide multiple alternatives to expose resources for their potential users and help them navigate to the resources they need. This paper examines one of those tools from the perspective of universal access, utilizing the experience of users with print disability. It aimed at exploring the way print disabled users use library search tools, the barriers they might face in the process, and what needs to be considered in order to implement discovery tools that incorporate the needs of users with print disability. Interviews that involved user testing were made with selected group of users. The data obtained in the process was analyzed and compared against the existing body of knowledge to forward design recommendations for future endeavors.

Keywords. Universal Design, inclusive design, library accessibility, resource discovery tools, digital library accessibility

1. Introduction

The right to seek receive and access information is enshrined as a human right by Article 19 of the Universal Declaration of Human rights[2] . Moreover, Article 9 of the United Nations (UN) Convention on the Rights of Persons with Disabilities[3] requires state parties to "*Promote appropriate forms of assistance and support to persons with disabilities to ensure their access to information*". Beside such international conventions and country specific anti-discrimination laws, the long-standing tradition of libraries and their commitment to equally serving their communities [1] provides them the rationale for incorporating the needs of people with disabilities in their day-to-day activities.

The goal of Universal Design, also called inclusive design, is to ultimately ensure that all content is designed to be accessible to all to the possible extent [2]. However, the reality in libraries is that they collect and organize resources in various formats targeting the needs of various groups of users. Resources may be accessible for some

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[2] http://www.un.org/en/universal-declaration-human-rights/
[3] http://www.un.org/disabilities/convention/conventionfull.shtml

but inaccessible for others. The discoverability of the right resource by the right person is determined by the quality of the discovery tools used.

This study aimed at identifying issues that need to be addressed for implementing inclusive resource discovery tools (RDTs) taking the case of Oria, a Primo-based discovery tool implemented in Norwegian academic and research libraries, and users with print disability. The term "print disability" is generally understood as the difficulty associated with effectively utilizing print text due to visual impairment, physical disabilities, and some forms of learning disabilities[4,5]. This paper considers universal design as *user sensitive* design [3] and attempts to present perspectives from real users. Therefore, it attempted answering the following main questions: how do people with print disability search library contents? What are the enabling and disabling factors they face in the process? How can their experience be taken to inform design of inclusive RDTs? To answer the questions, qualitative study that involved task-based interviews and observations with ten participants (four with low vision impairment and six with dyslexia) was conducted.

The rest of the paper is organized as follows: review of related works is presented next, followed by explanation of the research design and the methodology used. Then follow results and discussions of the findings. Finally, the paper closes with the conclusion section.

2. Literature Review

Since the introduction of online catalogs, there have been notable efforts to expose library materials to their potential users through provision of searching options by author, title, subject (topic) and other bibliographic information. Serendipitous features like "those who have read this also read…" incorporated on some library catalogs [4, 5] and features for faceted browsing [6, 7] have been some of the developments.

Libraries are increasingly adopting RDTs to provide single point of access to all materials in their holdings as well as digital archives, eBooks, and subscription databases [8]. Those RDTs are dubbed as the "new generation catalogs" libraries use to make their collections discoverable and accessible to the communities they serve [6, 7] with presumed advantage of richer, intuitive, and more improved user experience [9]. They simply can be understood as search engines of libraries though they may fail to cover all online resources, as they tend to rely on metadata taken from vendor-supplied databases [8]. RDTs have different components depending whether they are proprietary or built in-house. List of commonly known commercial tools include Primo from Ex Libris group, EBSCO Discovery Service from EBSCO Information Services, Summon ® from ProQuest and WorldCat ® Discovery Service from OCLC® [6]. These tools include features such as relevance-ranked keyword search results, facet metadata, tag cloud, and other features that help to enhance browsing, searching and filtering of search results [10]. The development of those tools is said to have leveraged best practices of successful websites such as Google and Amazon including user behaviors that are "assumed to have developed using those same sites", in order to provide better user experience than that can be offered by traditional web based library catalogs [9].

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[4] https://www.ahead.org/resources/e-text/position-statement
[5] http://printdisability.org/

There have been studies that looked into usability and related issues of these tools. A usability test done on Primo discovery system showed that the search interface posed challenges for new and inexperienced users [11]. New users would need time to get acquainted with the way resources are presented in the result list, the terminologies used to describe resource types, and the mechanisms put for filtering search results. Another study made on EBSCO Discovery Service [12] also identified some issues. One of the problems was the inconsistency in the use of icons which led participants to confuse material types. For instance, it was mentioned that participants mistook book reviews for books or periodicals for academic journals. The other problems mentioned were spelling errors, participants' failure to use spelling suggestions the system provides during and after search, and their unwillingness to go past the first page of the results. A study that explored challenges faced by libraries using RDT presented an array of problems including incomplete coverage of resources, difficulties in managing addition or removal of titles, reliance on metadata from external resources and the inconsistency observed in the metadata, non-standardized assignment of ISBN codes, etc. [8].

There have also been works aimed at augmenting library catalogs to suit the needs of people with disabilities. For instance, there has been a suggestion that users with visual impairment could be helped if the search results come along with more information [13]. For instance, a user with visual impairment would like to know whether an item is a book or an audio alternative, whether it is a tactile map or regular map, etc. Therefore, if a search tool could provide more information per hit such as summaries, target audience information, filters by format, genre, etc., that would help visually impaired users to know whether a material could be accessible or suitable for them [13]. It has been also noted that users with dyslexia would benefit if resources are described by their reading level or intended audience for that would help them to easily discover materials suitable for them [14]. Studies show that there are search goals which are met by search results without the need of clicking through them (positive abandonment), showing contents or snippets displayed with search results have the potential of addressing some of the information needs of the user [15]. A research that examined the searching experience of students with a print disability on three proprietary databases identified barriers such as erroneous formulation of Boolean search; inaccessible, untagged or image-based PDFs; unreadable links and too many links [16]. It was mentioned that those "rich" links were in fact impediments for the participants. A study that addressed the effect of dyslexia on information searching behavior on a university library catalog [17] showed that dyslexic users struggle if search tools are not error tolerant or don't include query building aids. The researchers recommended search systems to incorporate spelling suggestions, tolerate errors, provide feedback for queries that don't have match, allow users to replace difficult terms, and incorporate autocomplete feature.

In conclusion, the studies discussed so far show that designing inclusive library resource discovery tools presents a multifaceted challenge that requires addressing not only interface design issues, but also others including presentation of results, resource description and related matters. Our study aimed at building upon those previous works. The following section provides explanation of the methodology used in the study.

3. Methodology

The "crucial source of evidence" for the experience of people with impairments in relation to their participation in some activity is their views and opinions [18]. This research therefore aimed at offering the 'voice' of end-users a place in evaluating or shaping designs of information systems. Therefore, qualitative methodology that involved task-based interviews and observations was chosen for the study.

The study aimed at including as much user experience as possible. Therefore, effort was made to purposefully select participants who could have used different library systems and who would contribute much information. Therefore, the Norwegian Library of Braille and Talking Books (NLB) were contacted to help recruit some from their members. In addition to that, the cooperation was sought from university admission offices. Finally ten participants, four with low vision and seven with dyslexia, were included in the study. All but one of the participants were female. The age range was between 21 to 51. Seven of them were university students, one of them was a recent master's graduate and the rest two were employees at different institutions. The respondents were briefed about the intent of the research and all of them have given informed consent to participate in the study.

At first, the participants were asked more general questions on their disability, their use of technology, their use of library services and other relevant questions. Then they were asked to perform selected searching and browsing tasks on Oria and express their experiences in terms of what they liked, what was difficult for them, and what they would like to see changed to make the discovery tool more user friendly. The respondents used their own devices and they were contacted at their place of choosing, including their houses. The tasks were presented to them one by one and they were encouraged to think aloud in the process. They were being observed as they worked on the tasks and notes were being taken. The design of the interview guide was inspired by studies that utilized the International Classification of Functioning, Disability and health (ICF) as a framework for interpreting barriers and inclusion [18, 19]. The ICF links the biological and social conceptualizations of disability and offers vocabularies for people with disabilities to describe their lives in terms of participation and potential barriers for inclusion [18]. The interview questions before, during, and after the tasks were formulated using ICF as a framework and revolved around issues such as participant's use of library search tools, what frustrates them(barriers) and what would remove those barriers (enablers). The data collected in this manner was transcribed, coded, and analyzed to present answers to the research questions.

4. Results

Participants were asked to perform searching and browsing tasks on Oria and explain features they liked and features that made their tasks difficult. As shown in Fig. 1, Oria incorporates different features including the search box, search refining /filtering options in the left pane, and the area to display search results. For each title in the search result, information on the resource such as title, author, material type (presented with icons or thumbnails with labels describing the material type), availability (online or in the physical library) etc. is available. Moreover, links to read online and/or to locate in a physical library are included.

Most (six) of the respondents were from the University of Oslo. Therefore, the activities were carried out via the university's library website.
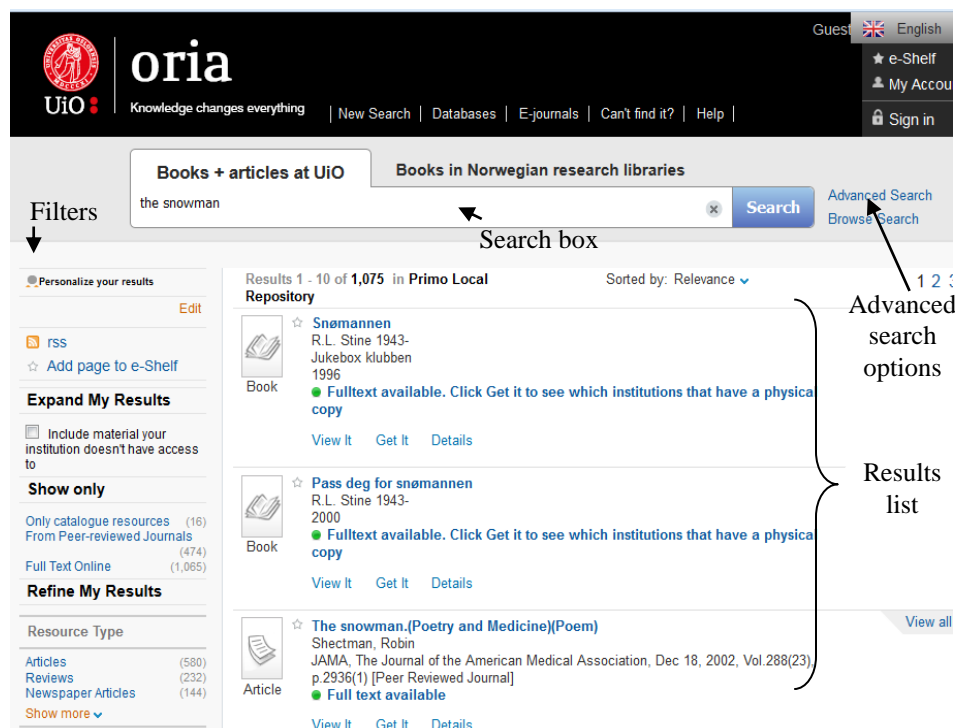

Figure 1. The Oria discovery tool as implemented by University of Oslo library

The primary purpose of the exercise was to give the participants a chance to explore the search tool so that they can speak about enabling or disabling elements of the discovery tool and secondly, to observe some of the difficulties they face. Literature on library search tools show that users primarily perform searching and browsing tasks: the searching tasks involving searching for specific resources by author or by title while browsing conducted with keywords or subject headings [20, 21]. Therefore, four tasks that involve searching and browsing tasks were presented to the participants.

Table 1. Searching and browsing tasks

Task 1. Check if the library has the book The Snowman written by Jo Nesbø. See if there are Norwegian and English versions
Task 2. Search for an ebook on business ethics. Try to open one of them for reading
Task 3. Is there any audio book for a book "The Count of Monte Cristo"?
Task 4. Find some recent journal article on universal design of ICT

All of the users were able to perform the first task though users with JAWS had difficulty at the beginning to find the search box because, at the beginning, they were using the library homepage where there were two search boxes. The one at the top is

for searching within the website while the other down around the middle was for searching in the library. Seven of the respondents typed the title "the snow man" with some of them typing it in Norwegian "Snømannen". In either of the cases, the search result presented both the English and Norwegian titles related to the work. One of the respondents chose to search by author's name saying that would be the fastest way to find versions of works by the same author. Two other respondents typed the author name and the book title together in the search box. In all of the cases, the respondents navigated from the search box to the first page of the results list to decide whether the item is present or not. One of the JAWS users used the voice over functionality to have the results read out for her while the other one asked the researcher to read out the results for him.

The second task required participants to search an eBook and try opening it for reading. Six of them typed the keyword and begun to inspect the results list. They took the link "full text available" as a hint for the material being an eBook and clicked on it, which, in some cases, took them to the publishers' site. It was noted that some respondents confused ebooks and articles. One JAWS user tried to use advanced search options to limit the result list to eBooks but JAWS couldn't show her the advanced search boxes. She said such inconsistency is usual with JAWS as, at times, it fails to recognize some parts of a page. She had to quit the task. The other participant using the same screen reader also quit the task saying, *"This is not designed for me".* He said he was usually assisted by librarians when he searches for materials and this task was too complicated for him. Three of the respondents used the filters to narrow the results to ebooks, and then clicked the "full text available" link which took them to publishers' websites. One of them was assisted to locate the filters.

There were some reactions from the participants in relation to the second activity. Three of the participants with dyslexia said there is too much information included under each search result and too many links to reach to the publishers' site. One of them clicked the *Details* tab and said of the information there*, "I don't need all this information to read this book".* One of them spoke of the navigation and said it makes her unsure as the number of navigations increases. She said, *"too many steps make me unsure, and take a lot of time. I don't often have that much time."* Three of the respondents (two low vision, one dyslexia) said the text is too small to read. One respondent said she expected a pdf to show up underneath the "fulltext available" link, not to navigate to somewhere else. Two of the visually impaired participants using JAWS didn't complete the task. Three respondents said they expected to find the filters underneath the search box, as it is with other library catalogs they are familiar with.

For the third task, six participants used filters to narrow search results for the audio versions related to the title but most of them required assistance in locating the audio filter option. Oria shows some of the filters while hiding the others under the "show more" link. Two participants tried full text search typing "Count of Monte Cristo audio" and the system was able provide audio books at the top of search results. It was noted that the expression "audio file" was added among titles presented at the top. One of the JAWS users tried to navigate using link lists generated by the software but was not able to complete the task. JAWS generated numerous link lists and some of them were labeled as 1,2, 3, without proper link labels. She was able to see a link labeled "material type" but couldn't locate the one for filtering audio. She saw multiple links labeled as "view more" and asked, *"View more of what?"* The problem with JAWS as she said is that it picks every link on the page and every link is taken out of its context. Her comment was "*you have to be stubborn to use it, I rather ask someone because*

that is a more effective way to find the material". The other respondent using this tool didn't perform this task at all. Some participants were observed confusing audio books for ebooks and audio books for text-to-speech enabled PDF documents.

For the last task that required users to browse recent journal articles, two of them typed "universal design of ICT" and used the date and the material type filters for narrowing the search result to articles. Two of them typed "universal design of ICT, article", four others used the filter to narrow the result to articles and inspect the list for the dates to see which one might be recent. Participants with JAWS didn't perform this task. One of them made an effort navigate to advanced search options, which at this time JAWS was able to recognize. At this point, she asked the difference between filters and advanced search options. She was later frustrated by the number of search boxes presented for advanced search and quit the task. It was noted that the participants were gradually getting more familiarized with the system as they work on the tasks.

After the completion of the search tasks, the participants were asked to express their experience to regarding what they liked, what frustrated them, and what they think should be done so that the tool can incorporate their needs. As shown below, features liked by respondents have been presented as enablers while those posed challenges have been presented as barriers.

4.1. Users Opinion

4.1.1. Enablers

The first question respondents were asked after completing the tasks was on what they liked of the system. The respondents with dyslexia mentioned the thumbnails and icons which are shown among titles in the result list. Icons and thumbnails are used in Oria to show the material type of a title. Moreover, Icons are used to show availability of resources either online or in the physical library with green color showing availability and yellow showing unavailability. Experienced users can combine the icons to quickly check whether a material is available for access. However two of the respondents with dyslexia commented that there is inconsistency in the use those images as some titles come up with thumbnails of cover pages while others come up with gray icons. Three of them mentioned other libraries they browse (two of them citing NLB) and said those libraries set a good example on consistent use of icons. The other feature favored by the respondents was the possibility offered for performing searches by author, title, keyword, or full text using a single search box.

4.1.2. Barriers

Participants were asked to reflect on the difficulties they faced while working on the tasks. Their responses were mostly repetitions of their reactions during the activities. Their responses are categorized and presented in the following manner.

Interface Design: Five of the respondents said there is too much on the interface. One of them said the links are too compact which creates a possibility of jumping lines and clicking wrong links. All but two participants commented that fonts are too small and difficult to read. A participant with low-vision impairment who cannot read unless in high contrast said the fonts have weak intensity which makes them harder for her to read. The two JAWS users were at first confused because there were two search boxes at the home page of the library search interface. The one at the top was for searching within the website while the second one was for searching within the library.

There is a lengthy list of filtering options on the left side. Though some in each category are hidden with "view more" links, one participant said the need of scrolling down to look at more options discourages her from using that part of the interface. The other problem noted with filters is that they don't allow selection of multiple filtering options on the first page. Two respondents noted the difficulty posed to "unfilter" the search results. Once a filter is performed, Oria takes that out of the filters list and puts it at the top of the results list with a label "refined by:". The x button there must be clicked to unfilter the results and see the filter back at its normal place. The respondents said that is not convenient.

The other complaint was on the number of clicks it takes to get an electronic resource, which makes some of them uncertain and feel that they are wasting time. A respondent said she expected a PDF to show up underneath the "full text available" link, not another link to navigate to somewhere else. Poor or faulty link descriptions are also mentioned as problems affecting those depend on JAWS for navigation.

When the interface is viewed in high contrast, the upper part of the page containing menus and logo of the discovery tool turns to white. A respondent with visual impairment and who can not read unless in high contrast said "it *painful for me. I cannot change it. It is very uncomfortable for me because it is like the sun on my face. I don't know how to avoid it. I just prefer just to go to Google again because everything can be black there"*. The same respondent said she cannot see the book icons because they will become unrecognizable in high contrast. She added, though, the presence of alternative text for the icons helps to recognize what they stand for. Two respondents with dyslexia noted the color similarity between the titles, their links, and their status descriptors which might confuse some users. They suggested the color of the titles to be different from others details of the title.

Search Results Presentation. Most of the respondents said there is too much information per title. However one respondent hinted lack of "important" information. She said she uses kindle books and there, there are descriptions on whether a book is text-to-speech enabled. She said she missed that information on Oria. She added that that could have helped her to save her time from trying inaccessible PDFs. There were two incidents where participants clicked the "Full text available" links but the resources were not available. There have been comments regarding the yellow highlights seen in the in the results list. A participant with dyslexia said she does not like those highlights because they distract her. Another participant with the same impairment said she likes the yellow highlights because they help her to quickly see whether what she is looking for is available.

Lack of Spell-check and search suggestions: the other problem mentioned the by majority of the respondents, especially by the dyslectic respondents, was the lack of those functionalities on Oria. A respondent with visual impairment explained her experience on other library catalogs and said, *"Whenever I am not sure of what I want, I type the first two or three letters in the search box and see if something interesting comes along the drop down suggestions"*. However, another respondent with the same impairment said the search suggestions would be annoying if they cannot be read correctly by screen reader software.

Users' perception: The interviews and the experiments show that one of the factors excluding users with print disability is their own perception of library search tools. While working on task 1 mentioned in table 1 above, one of the respondents thought of using advanced search because she was *"not confident enough on this system to write author and title together"* in the search box. A respondent with visual

impairment tried to solve the same problem by typing the title of the book and then check the search results. When he was asked what he normally does, he went to Google and typed both author name and title of the book together.

User devices: The difficulties faced by the two JAWS users indicate that problems could be related to the technologies used by users. One of them explained that there are times JAWS fail to work properly. That was noted during the user testing session. She said that she uses the combination of assistive devices including JAWS, braille display, speech synthesis, and screen magnifier and guessed perhaps that mix makes the system busy.

4.1.3. Recommendations

The last question the respondents were asked was on what they think would make Oria appealing for users with print disabilities. Some of the comments were directed at the search interface. A respondent with visual impairment suggested Oria would be accessible and usable to all if it emulates Gmail by providing standard and basic html views saying, "*The standard view will be good for you, the html view will be suitable for me*". He also recommended voice input technology to be added to aid search. The other respondent commented the filters can emulate finn.no. to make them collapsible and expandable and also enable selection of multiple filtering options. There were also recommendations regarding presentation of search results. Two of the respondents described the need for a filtering option by file types (PDF, HTML, etc.) or presenting alternative formats available for each resource. Gutenberg Digital Library and JSTOR were mentioned as possible inspirations on how to present search results in that manner. There was also a suggestion to present search results sorted by material type.

5. Discussion

This study aimed at identifying issues that need to be addressed while implementing RDTs which could be inclusive of the needs of people with disabilities. It took the case of Oria and the experience of people with print disability and asked: how do people with print disability search library contents? What are the enabling and disabling factors they face in the process? How can their experience be taken to inform design of inclusive RDTs? The overall analysis shows that users with print disability use author, title or keywords like anyone else while searching for a resource. However, they have needs that RDTs have to accommodate in order to enhance their experience. That can be done by focusing on the following themes that stood out in the course of the study.

5.1. Simplicity and Minimal Effort

The overall study shows that users with print disability prefer if RDTs offer them the simplicity to get what they want with minimal effort. It was observed that participants prefer if their activities are limited between the search box and the results list. In sessions that involved searching resources by material type (audio, article, etc.), The pattern observed among the participants with dyslexia was that, after they typed in their queries, they quickly go to the results list and check for the thumbnail(icon) of the media type they were asked to look for. Then they check the titles. They were mostly reluctant to use filters.

The participants showed their preference if each title in the result list includes information on availability of alternative content (PDF, HTML, etc.). That would help them to know whether that title is available in formats suitable for them.

It was possible to observe full text search formulations incorporating descriptions of material types. That can be seen as the users' desire to get materials quickly without the need of using the filter options. As explained in the above section, there were occasions where titles incorporating labels such as 'audio file', 'brief article', etc. coming at the top of the results list, depending on the formulation of the query. However, the results (number of hits) were different when done using the search filters. That would lead to say that, if annotation by material type is done consistently to all of the resources, that could enable users to perform faceted search as they type in the search box. The study also confirmed that automatic search and spelling suggestions could provide the simplicity users want while searching for a resource.

There is a hint for the need of accessibility-related information, for instance, on whether an ebook/pdf file is accessible for text-to-speech tools. The overall essence is to make search interfaces more informative and to save time of users. This confirms previous studies that indicated search tools could help to address some information needs without the need for clicking through. However, it is also noted that "too much information" would frustrate some users.

The studies reviewed in this paper as well as this study have highlighted the importance of icons in simplifying information search if used properly. Studies have shown that inconsistent use of icons would confuse users and lead them to confuse material types. This study also confirmed that if used consistently, icons could help in simplifying resource discovery and access.

The type of problem faced by JAWS users demonstrates the difficulty posed by poor or faulty link descriptions. Links need labels that describe their function. It was however possible to note that too much links per page increase navigational strain for people using screen reader software. Addressing this and other issues mentioned above would contribute to offering users the simplicity they desire.

5.2. Needs and Preferences

The study showed that it might perhaps be unproductive to profile users by their disabilities. Two users with similar impairment would have opposing preferences on the same thing. Some users like icons, the others see them as clutters. There are different color, font, etc. preferences. This shows that RDTs need to have features that capture user needs and preferences and provide adaptations in terms of display and content presentation.

6. Conclusion

Library discovery tools are gateways to the wealth of content hosted by libraries for their diverse groups of users. As noted in related works and as confirmed in this study, their implementation should be sensitive to the needs of users with disabilities. This paper attempted to present users' perspective on barriers people with print disability might face while using library discovery tools. The findings from this study show that RDTs need to be designed emphasizing simplicity and flexibility for addressing the needs of various groups of users. The paper discussed issues related to searching,

search results presentation, resource description, use of icons, fonts, etc. to raise points that could be important to inform better design of RDTs to suit the needs of people with disabilities. As part of further work, investigating features of commercial or in-house developed RDTs and their potentials in managing user needs and preferences would be an area worth exploring.

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