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What Do Users Tell Us about FRBR-Based Catalogs?

YIN ZHANG and ATHENA SALABA
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FRBR user research has been the least addressed area in FRBR research and development. This article addresses the research gap in evaluating and designing catalogs based on FRBR user research. It draws from three user studies concerning FRBR-based catalogs: (1) user evaluation of three FRBR-based catalogs, (2) user participatory design of a prototype catalog based on the FRBR model, and (3) user evaluation of the resulting FRBR prototype catalog. The major findings from the user studies are highlighted and discussed for future development of FRBR-based catalogs that support various user tasks.

KEYWORDS FRBR (Functional Requirements for Bibliographic Records), library catalog, online catalog, OPAC (Online Public Access Catalog), user research, user tasks, FRBR implementation, system evaluation, system design

INTRODUCTION

Functional Requirements for Bibliographic Records (FRBR) offers great potential for libraries to develop catalogs that allow users to access bibliographic data in a more effective manner. Currently, there is still a lack of both guidance in FRBR implementation and FRBR user research in related developments. This article reports on a series of user studies conducted as part of an IMLS-funded project concerning the development and research of FRBR-based systems to effectively support user tasks and facilitate...
information seeking. Specifically, the article draws from the following three user studies conducted by the project team:

1. A user evaluation of three early FRBR-based catalogs (WorldCat, Fiction-Finder, and Library Labs of Libraries Australia);
2. A user participatory design and evaluation of a FRBR prototype catalog during its implementation process; and
3. A user evaluation of the resulting FRBR prototype catalog.

Since this article reports on three studies, it will focus on the following aspects concerning the studies: the rationale of each study, the method and design of each study, and what we learned from the studies that will help advance the design and implementation of user-friendly and effective FRBR-based catalogs.

LITERATURE REVIEW

Over the past decade, we have seen lively discussion, creative exploration, practical development, and active research related to FRBR, all of which seek to provide the opportunities that FRBR may offer for developing effective retrieval systems for users. This literature review will focus on the FRBR research and development efforts related to the library catalogs.

FRBR Implementation Efforts

With its emphasis on users and their information needs, FRBR offers great opportunities for creating retrieval systems that better support user information seeking. For online library catalogs, FRBR offers possible solutions for addressing some issues and problems in current catalogs, such as searching for materials with a known author and title, locating works scattered throughout multiple records in current catalogs, collocating at the work and expression level, and reducing the number of redundant searches required for current catalogs by providing effective displays and linking of related records.

Since FRBR is a conceptual model, it is open to a variety of interpretations and implementations. As a result, FRBR implementation efforts have been largely exploratory in nature and vary in many aspects regarding user interface and display, system features, FRBR model focus, collection, and other technical system implementation details. These differences in FRBR implementations are in part due to the various ways in which cataloging rules are interpreted and the various designs of the individual catalog systems.
Most FRBR implementation efforts have focused primarily on developing the system and adapting existing cataloging standards and practices to support user tasks as defined in FRBR. Very few projects have actually conducted or reported user studies pertaining to their developed FRBR systems. In addition, there has been a lack of evaluative comparisons of the FRBR prototype systems that have been developed.

Engaging Users in FRBR Research and Development

Understanding users’ needs and tasks has been a key element in the general process of designing effective online catalogs and retrieval systems. User involvement and user studies are essential to designing interfaces that can support the information search process, and this user participation is essential when it comes to making informed design decisions. In a Web information environment, user expectations on retrieval tools and their information-seeking behavior are constantly evolving and undergoing changes.

FRBR user research has been the least addressed facet of FRBR research and development. Only recently have some researchers started to conduct FRBR research that directly engages users in an attempt to fill the research gap. For example, Sadeh reported a usability study concerning a discovery and delivery system, which has a FRBR user interface design based on surveying users’ needs, preferences, behavior patterns, and evaluations of previous versions of the interface. The usability study involved eight academic library users, including faculty, graduate students, and undergraduate students from various disciplines. User interactions with the system were captured using a think-aloud protocol, unobtrusive observation, screen captures, eye-tracking, and post-search interviews and evaluations. The participants evaluated the FRBR-based interface very positively, finding it to be friendly, easy to learn, and easier to use compared to other systems. In another study, Carlyle and Becker pre-tested a survey instrument that was meant to examine the phenomenon of the known-item search by users of online catalogs. The purpose of the research was to evaluate the FRBR model as it pertains to describing entities that may help library users effectively search online catalogs. A total of 51 public and academic library users, who were looking for a specific book (known-item), participated in the study. The study found that for known-item searches, only 13% of the users indicated that they looked for a specific edition or book that had a particular publisher, 69% did not rely on edition or publisher for such searches, and 18% did not have a preference. When it comes to substitutability, the study found that the differences in manifestation (e.g., Web site vs. physical print versions; paperback vs. hardcover; regular print vs. large print; etc.) were as important as those in expressions (e.g., unabridged vs. abridged; languages). The findings of this study have practical implications for FRBR-based system design in
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differentiating FRBR entities such as expressions and manifestations and collocating related entities based on user-preferred attributes.

In a Delphi study of critical issues facing FRBR research and development, a panel of FRBR researchers and developers identified four critical issues or gaps facing FRBR user research:

- User studies pertaining to FRBR-based systems to ensure that implementations benefit end-users,
- User research concerning FRBR-based displays,
- Examination of end-user tasks with empirical research, and
- Development of semiotic frameworks and research to ensure effective communication between users and FRBR systems.

Research Gap

As a conceptual model, FRBR is subject to various interpretations and implementations. However, there has been a lack of both guidance in FRBR implementation and FRBR user research in related developments. Most FRBR development efforts have neither engaged users during the development process, nor have they been evaluated for the development outcome. With FRBR’s user focus, it is important to incorporate user input in FRBR implementations.

THREE USER STUDIES

The studies reported in this article were designed to address the research gap in FRBR user research and to identify FRBR implementation options that benefit users. The three studies were designed and conducted separately in sequence, with later studies building on the former. Study 1 is a user evaluation of existing FRBR-based catalogs; Study 2 is a user-involved design effort to build a FRBR prototype catalog based on the findings of Study 1 and direct user input; and Study 3 is a user evaluation of the resulting FRBR prototype catalog based on Study 2. The three studies shared a common theme of evaluating various implementations of FRBR in catalogs from a user perspective and identifying user-preferred implementation options for future development based on user research. This section highlights the research design and major findings of the three studies in sequence as they were conducted.

Study 1: User Evaluation of Three FRBR-Based Catalogs

This study aimed to examine and evaluate existing FRBR prototypes (as of 2007) from the end-user’s perspective. The major goals of this study were
to understand users’ experience with existing FRBR-based catalogs and to evaluate whether these systems support user tasks as defined in the FRBR model. The study also sought user input on which system features users find helpful when conducting searches in the catalogs and how the catalogs could be improved to facilitate user information seeking.

FRBR-Based Catalogs

The three FRBR-based catalogs selected for this study include OCLC FictionFinder (http://fictionfinder.oclc.org/), OCLC WorldCat.org (http://www.worldcat.org/), and Libraries Australia LibraryLabs FRBR prototype demonstration system (http://ll01.nla.gov.au/). All three catalogs contained some FRBR-like features and supported similar user tasks to be tested for comparison purposes within this study. The three catalogs, however, took different approaches for their specific implementations of user interfaces. For example, for displaying expressions and manifestations, FictionFinder adopted a table layout with filterable attributes and sortable column headers, LibraryLabs used a single page with a pre-defined linear, sequential order for displaying, while WorldCat relied on facets. The different implementation approaches offered an opportunity for users to explore various design and implementation options and to offer their input on the approaches based on their experience.

Participants

Participants in this study included 75 users from both the public (40 participants) and academic (35 participants) library settings, and were recruited from local libraries. Each catalog was evaluated by a roughly equal number of public and academic library users, with a total of 24–26 users for each system (see Table 1).

Tasks

The user tasks for this study were designed around the four general user task categories that are defined by FRBR (find, identify, select, and obtain).

<table>
<thead>
<tr>
<th>Catalog</th>
<th>Academic Library</th>
<th>Public Library</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>FictionFinder</td>
<td>10</td>
<td>14</td>
<td>24</td>
</tr>
<tr>
<td>LibraryLabs</td>
<td>13</td>
<td>13</td>
<td>26</td>
</tr>
<tr>
<td>WorldCat.org</td>
<td>12</td>
<td>13</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>40</td>
<td>75</td>
</tr>
</tbody>
</table>
regarding a specific entity such as work, expression, manifestation, or item. For comparison purposes, the tasks were designed in a way that could be performed by users in any of the three FRBR-based catalogs included in this study. The specific tasks that participants performed on the three online catalogs are as follows:

1. Find a set of works (e.g., find Harry Potter materials);
2. Find a work (e.g., find *Harry Potter and the Prisoner of Azkaban*);
3. Find an expression (e.g., find *Harry Potter and the Prisoner of Azkaban* in Spanish);
4. Find a manifestation (e.g., find *Harry Potter and the Prisoner of Azkaban* published by Arthur A. Levine Books in 1999);
5. Identify a work (e.g., identify *Harry Potter and the Prisoner of Azkaban*);
6. Identify a manifestation (e.g., identify the most recent publication of *Harry Potter and the Prisoner of Azkaban*);
7. Select a manifestation (e.g., select the most recent publication of *Harry Potter and the Prisoner of Azkaban*); and
8. Obtain an item (e.g., obtain a copy of *Harry Potter and the Prisoner of Azkaban*).

Data Collection Methods

Data about user interactions with the FRBR-based catalogs were gathered through a multi-method approach, including screen captures, pre- and post-search interviews and surveys, and eye movement tracking. In addition, we conducted two follow-up focus groups consisting of a total of 15 library users: one focus group for academic library users and one for public library users.

Findings

By examining how individual user tasks were supported by the three FRBR-based catalogs, there were noted differences in user success. For example:

- “Find a work” tended to have the highest success rate among all tasks across all systems;
- “Find a set of works” tended to be completed successfully;
- “Find an expression” appeared to be challenging, particularly in WorldCat.org;
- “Find a manifestation” was difficult, particularly in FictionFinder;
- “Identify a manifestation” based on a publisher was very difficult in all evaluated catalogs; and
• “Obtain an item” tended to have the lowest success rate, with those participants using FictionFinder having the least success, followed by those using LibraryLabs.

In terms of user perceptions about the tasks and catalogs, users had no difficulty finding sets of works or a specific work. Finding an expression tended to require more effort because language information was not always available and the option to sort results by language was not always intuitive. Identifying and selecting a specific manifestation by publisher and/or date was considered challenging. Additionally, information on how to obtain/acquire an item was problematic and confusing, especially in FictionFinder, where the “find edition” label led to libraries containing the item and the “libraries” label actually measured popularity of the item in library collections. This confused most of the participants, who assumed the “libraries” label would lead to library holding information.

Interestingly, when comparing the FRBR-based catalogs with a typical local library catalog for supporting the same task chosen by participants, the participants were almost equally successful in completing the tasks (95% and 94% for their respective success rate). Participants did find some FRBR-based catalog features and design options very helpful in completing the tasks. Table 2 summarizes the top 10 catalog features and design options that were helpful in completing the tasks.

Each of the top three system features and design options were considered helpful by nearly half of the participants:

1. About half of the participants (49%) appreciated the friendly, easy to use, and appealing user interfaces. Evidently, user interface design was the most important aspect when it came to user experience with the catalogs.

| TABLE 2 Top Ten System Features and Design Options |
|----------------------------------|-----------------|-----------------|
| Features/Design Options           | Number of Users | Percentage       |
| 1. User friendly, easy to use, and appealing user interfaces | 37               | 49               |
| 2. Related items links in descriptions for collocations | 36               | 47               |
| 3. Refining options               | 35               | 46               |
| 4. Additional information not available in traditional catalogs | 21               | 28               |
| 4. Sorting options (e.g., by date, format, language, etc.) | 21               | 28               |
| 6. Availability/holdings information | 20               | 26               |
| 7. Single search box              | 19               | 25               |
| 8. Clear and easy to understand terminology and labeling | 14               | 18               |
| 9. Clear organization and presentation of results page and description | 11               | 14               |
| 10. FRBR display (by format, language, editions) in LibraryLabs | 9                | 12               |
2. Second, links to related items in descriptions for collocating by author, subject, and similar entries were preferred by 47% of the participants.
3. As a close third, various refining options provided by the catalogs were liked by 46% of the participants.

Other helpful features users named included additional information (such as ratings, reviews, and price) that was not available in traditional catalogs; unique and flexible sorting options (e.g., by date, format, and language); availability and holdings information for items; the single search box; clear and easy-to-understand terminology and labeling; clear organization and presentation of the results page and description; and finally, the FRBR display of results by format, language, and editions offered in LibraryLabs.

The participants of the study were asked to offer suggestions on how the catalogs could be improved to make their tasks easier. The top ten suggestions are summarized in Table 3. Proposed by 51% of the participants, the leading suggested improvement was to add more links to related works for collocations. The possible links could be via “more like this,” hyperlinked subjects, hyperlinked authors, series links, linked keywords, linked cited works, or linking other formats from a desired work. This suggested improvement was a common concern across all three catalogs.

Second on the improvements list (suggested by 45% of the participants) was the need for grouping and displaying information on the results page

<table>
<thead>
<tr>
<th>Suggestions</th>
<th># of Users</th>
<th>Percentage</th>
<th>By Catalog</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Add more links to related works for collocations</td>
<td>39</td>
<td>51%</td>
<td>12</td>
</tr>
<tr>
<td>2. Group and display information in categories and in order</td>
<td>34</td>
<td>45%</td>
<td>7</td>
</tr>
<tr>
<td>3. Add sorting options</td>
<td>34</td>
<td>45%</td>
<td>11</td>
</tr>
<tr>
<td>4. Improve interfaces to display results</td>
<td>25</td>
<td>33%</td>
<td>7</td>
</tr>
<tr>
<td>5. Use clear labeling and terminology</td>
<td>24</td>
<td>32%</td>
<td>13</td>
</tr>
<tr>
<td>6. Allow advanced search option at the initial page</td>
<td>20</td>
<td>26%</td>
<td>5</td>
</tr>
<tr>
<td>7. Provide availability and library holdings information</td>
<td>19</td>
<td>25%</td>
<td>5</td>
</tr>
<tr>
<td>8. Add more search options</td>
<td>17</td>
<td>22%</td>
<td>7</td>
</tr>
<tr>
<td>9. Include additional information in descriptions</td>
<td>15</td>
<td>20%</td>
<td>4</td>
</tr>
<tr>
<td>10. Place buttons/certain information logically</td>
<td>14</td>
<td>18%</td>
<td>8</td>
</tr>
</tbody>
</table>
in categories arranged by language, date, author, and title depending on the type of search (e.g., alphabetical order by author for author searches). This was an area that would need to be addressed particularly in LibraryLabs. Tied for second place on the improvements list was the need for sorting options. For example, participants believed that the catalogs should provide users with multiple sorting options and allow users to sort by age groups, date, language, and relevance in the three catalogs.

About one third of the participants suggested improving two interface display areas:

- The first area dealt with the overall interface look and feel. For example, it was suggested that the interface displays be less cluttered, with larger font styles and color to signal the difference between sorting and refining options. Other suggestions included the possibility of using column display and highlighted searched terms in the results pages as well as within resource summaries. The LibraryLabs interfaces received the most suggestions for improvement in this area.
- The second area for interface improvements dealt with clear labeling and terminology. For example, change “find editions” to “find libraries” in FictionFinder, and clarify “language” choices for site interface and the material/resource language in WorldCat.org. FictionFinder received the most suggestions for improvement in this second area.

About a quarter of the participants suggested adding an advanced search option to the initial page (26%). A similar number of participants suggested providing availability and library holdings information. They also suggested that these aspects should be easier to find, made more prominent, written in a larger font, accessed through a hyperlink, or made sortable (25%). Additional suggestions for improvements included:

- Providing more search options such as audience, age group, date, publisher, format (22%);
- Including additional information in descriptions such as reviews, summaries, cover art, citations, and sample pages (20%); and
- Positioning buttons in the interface correctly or making sure certain information can be found in a more prominent location or near related information (18%).

Study 2: User Participatory Design of a Prototype Catalog Based on the FRBR Model

This study was conducted during the design process of a FRBR prototype catalog by the project team. Based on the results of the user evaluation
of previous FRBR-based catalogs (Study 1) and the project’s FRBRization outcome of the MARC (Machine Readable Cataloging) records from the Library of Congress collection, the project team designed some layouts and illustrations for search and display interfaces within the prototype catalog. The purpose of this second study was to seek user input and feedback on some important interface design issues for the FRBR entities, such as work, expression, and manifestation. Specifically, the project team sought user input on the FRBR-based features, for example, whether the hierarchical display approach of work, expression, and manifestation is understood by users and how to improve the display to make it easier to be understood and used. The results of this study helped the project team finalize the design of the FRBR prototype catalog.

Participants
Twenty-five participants were recruited from those who visited a local academic library. Out of the 25 participants, 2 (8%) were graduate students and 23 (92%) were undergraduates; 10 (40%) were male and 15 (60%) were female.

Data Collection Methods
For this study we conducted a structured survey interview. The participants were asked a series of questions regarding the library catalog design prompted by FRBR search and display layouts as well as illustrations on paper. The interview process was audio-recorded and each interview took about an hour.

Findings
The findings and suggestions from Study 1 were used as a basis for prototyping a FRBR catalog. During the design process, twenty-five participants were invited to offer suggestions regarding the interface design decisions for the following interfaces:

1. The display of works from an author search;
2. The display of works from a subject search;
3. The display of works from a title search;
4. The display of expressions, first by language and then by form;
5. The display of expressions, first by form and then by language; and
6. The display of manifestations.

Some of the major findings of the user study follow in the next sections.
What Do Users Tell Us about FRBR-Based Catalogs?

USER IMPRESSION OF THIS PROTOTYPE CATALOG IN DISPLAYING RESULTS

Overall, 72% (18 out of 25) of the participants had a positive impression of the results displayed in the prototype catalog. Statements such as “efficient,” “organized,” and “easy to understand” were commonly used by the participants to describe their overall impressions. Meanwhile, 28% (7 out of 28) of the participants felt that the prototype catalog needed improvement in displaying results. But the suggested improvements were not necessarily related to the FRBR implementations specifically. For example, one participant felt that, although the catalog was very structured, it needed more color and that the first few displays were “blah.” Another participant felt that the displays were “cluttered.”

HELPFULNESS OF THE PROTOTYPE CATALOG

Overall, 88% (22 out of 25) of the participants felt that a catalog designed this way would be more helpful to users than other catalogs they had encountered. One participant felt that it may or may not be helpful to others, depending on what the person was searching for. One participant felt it was neither more nor less helpful than other library catalogs; it was just a different way of showing the same information. One participant was not sure if it would be more or less helpful.

NAVIGATION BETWEEN WORK, EXPRESSION, AND MANIFESTATION

Overall, 84% (21 out of 25) of the participants found the prototype catalog easy to navigate with a hierarchical approach between work, expression, and manifestation, while 16% (4 out of 25) found it somewhat difficult to navigate. Participants suggested that more hyperlinks would improve the overall navigation experience.

USER UNDERSTANDING AND INPUT REGARDING INDIVIDUAL DISPLAYS

Most participants were able to understand and interpret the FRBR results presented in the display interfaces we initially designed based on previous FRBR user research. The detailed user comments on individual displays yielded very valuable and specific suggestions to make the user interfaces more understandable and easier to use. The FRBR displays were refined accordingly based on the user input when the design team finalized the implementation of the FRBR prototype catalog. For example:

1. The displays of works in the search results for author, subject, and title searches were improved with visual clues, clearly aligned groups, clearer labels, and more hyperlinks.
2. The display of expressions by language/form was improved with visual clues, clearly aligned groups, clearer labels, and more hyperlinks. Also, the user study clearly revealed that grouping results first by language and then by form is more preferable to users than by form/language. Additionally, in the initial design, uniform titles were listed above their corresponding regular titles. Because some uniform titles contain genre and language elements, users found them confusing with the expression attributes in the FRBR display. Repositioning uniform titles below the regular titles proved to be helpful to provide additional collocating information while avoiding confusion.

3. The display of expressions by form/language was improved with visual clues, clearly aligned groups, clearer labels, and more hyperlinks. Additionally, uniform title was repositioned for the same reason explained previously.

4. The display of manifestation was improved with visual clues, clearly aligned multiple values for the same attribute, clearer labels, and more hyperlinks.

Study 3: User Evaluation of the FRBR Prototype Catalog

This final study in the sequence allowed the research team to conduct a user evaluation of the newly developed FRBR prototype catalog. The results will further provide insight on user understanding of the FRBR-based displays and provide system designers with informed guidelines for FRBR implementation options. The study adopted a comparative approach. That is, for each task, participants were asked to use both the FRBR prototype catalog and a regular catalog built in Koha for a live, interactive search. For comparison purposes, both catalogs contained the exact same records.

Participants

The participants of this study consisted of 34 students who were recruited in a local academic library. The participants consisted of 4 (12%) graduate students and 30 (88%) undergraduates; 15 (44%) were male and 19 (56%) were female.

Tasks

The study was designed to consist of two parts with different purposes and tasks.

Part 1 involved user evaluations of interfaces for displaying search results from common search options: title, author, and subject searches. The purpose of this part of the study was to seek user input on how they interpret and evaluate the search result displays and system features. In this part,
the participants were directed to conduct a specific type of search for each task so that all participants could reach the same results and comment on the same display interfaces. There were three types of tasks for this part:

1. Display works from a title search
   A title search for *Intermediate Algebra*
   A title search for *Algebra*
2. Display works from a subject search
   A subject search for algebra
3. Display works from an author search
   An author search for Darwin

The aforementioned tasks were chosen because they could generate an adequate number of results for FRBR displays and comparisons between the prototype and Koha catalogs. For example, we chose “algebra” in both the title search and the subject search because the search results presented totally different groupings for works, expressions, and manifestations for the two search options in the FRBR prototype while the Koha system displayed the search results from the two searches very similarly without any groupings.

Part 2 involved users performing tasks for finding/identifying/selecting a work, an expression, and a manifestation. In this part, the participants were not directed to conduct a search within specific parameters. The participants were freely choosing the search option they preferred for each task. The tasks for this part were selected to effectively illustrate the differences between the prototype and the Koha catalogs. Also, the tasks were tested for possible different options users may choose to perform the tasks. Part 2 included three tasks:

1. Work task
   Search for *Messiah* by George Frideric Handel
2. Expression task
   Search for *Red Badge of Courage* by Stephen Crane. Specifically, look for an English non-musical sound recording such as an audio book.
3. Manifestation task
   Search for *The Very Hungry Caterpillar* by Eric Carle. Specifically, look for an English book that was published by Philomel Books in 1983.

Data Collection Methods

This study collected two sources of data: (1) computer screen captures of user interactions with the systems when they were performing various tasks, capturing both audio and screen video, and (2) structured survey interviews with questions asked after each task regarding user experiences with the two systems as well as questions on general reflections, asked at the end
of Part 2, about both systems based on user interactions with the systems. The interviews were recorded and transcribed for data analysis. The screen captures were recorded and analyzed using Morae software.

Findings

This last user study in the sequence was a user evaluation of the developed FRBR prototype catalog. The major findings are highlighted in the following five areas:

1. User catalog preference between the FRBR prototype and the regular catalog,
2. Success rate on various tasks,
3. User evaluation on catalog features,
4. User evaluation on catalog display approaches, and helpfulness, and
5. User evaluation on catalog helpfulness.

User Catalog Preference

After the completion of the search and interview session, the participants were asked to indicate their catalog preference based on their overall experience with both systems in light of the different ways each system made use of displays and navigation. Additionally, the participants were asked to indicate their catalog preference based on certain scenarios. The catalog preferences are summarized in Table 4.

Overall, 85% of the participants preferred the FRBR prototype catalog while only 6% preferred the regular catalog. Another 6% did not have a preference and 3% did not like either catalog. When asked about their catalog preference under certain search scenarios, interestingly, the participants’ preferences varied, although the majority preferred the prototype in

<table>
<thead>
<tr>
<th>Overall or Scenarios</th>
<th>FRBR Prototype Catalog</th>
<th>Regular Catalog</th>
<th>Either</th>
<th>Neither</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>29 (85%)</td>
<td>2 (6%)</td>
<td>2 (6%)</td>
<td>1 (3%)</td>
<td>34 (100%)</td>
</tr>
<tr>
<td>For a specific language or type of material</td>
<td>34 (100%)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>34 (100%)</td>
</tr>
<tr>
<td>For a specific author</td>
<td>30 (88%)</td>
<td>—</td>
<td>4 (12%)</td>
<td>—</td>
<td>34 (100%)</td>
</tr>
<tr>
<td>For a specific title</td>
<td>28 (82%)</td>
<td>5 (15%)</td>
<td>1 (3%)</td>
<td>—</td>
<td>34 (100%)</td>
</tr>
<tr>
<td>For a specific title and publication info</td>
<td>27 (79%)</td>
<td>7 (21%)</td>
<td>—</td>
<td>—</td>
<td>34 (100%)</td>
</tr>
<tr>
<td>For entertainment</td>
<td>24 (71%)</td>
<td>4 (12%)</td>
<td>1 (3%)</td>
<td>5 (15%)</td>
<td>34 (100%)</td>
</tr>
<tr>
<td>For research</td>
<td>21 (62%)</td>
<td>11 (32%)</td>
<td>2 (6%)</td>
<td>—</td>
<td>34 (100%)</td>
</tr>
<tr>
<td>For a general topic without a specific title</td>
<td>20 (59%)</td>
<td>10 (29%)</td>
<td>3 (9%)</td>
<td>1 (3%)</td>
<td>34 (100%)</td>
</tr>
</tbody>
</table>
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In all scenarios. All participants would prefer the FRBR prototype catalog when looking for a specific language or type of material, which was not surprising given that the prototype catalog offers expression groups while the regular catalog does not indicate the language of the material or type of material. It should be noted that the regular catalog built in Koha does not offer language or form facets for refining searches, while some other catalogs may have these features.

In descending order of preference, the FRBR prototype catalog was also preferred when looking for a specific author (88%), a specific title (82%), a specific title and publication information such as edition, date, or publisher (79%), something for entertainment (71%), and something for research (62%). Although the prototype was still preferred over the regular catalog by most participants (59%), the prototype was not as heavily favored compared as the other search scenarios when the participants were looking for a generic topic without a specific title. The preference suggests that the prototype worked best when participants were looking for something very specific.

**Success Rate on Tasks**

Overall, participants were highly successful in completing the FRBR tasks in this study:

- For the work task, 33 (97%) of the participants were able to find, identify, and select the work given the title or author using the prototype catalog. Using the regular catalog, the participants were only able to find, identify, and select a manifestation of the work without knowing specifically the total number of results that matched the criteria.
- For the expression task, the FRBR prototype had a great advantage with its expression-based groupings by language and form that were readily available. Using this catalog, 31 (91%) participants were able to complete this task successfully. The regular catalog did not offer the language field and users had to assume the content language was based on the catalog record language. Additionally, the regular catalog only provided the form information (e.g., audio cassette) included as part of its record description, which was difficult for users to see. With the language assumption, only 15 (44%) of the participants completed the task successfully.
- For the manifestation task, all participants completed this task successfully using the FRBR prototype catalog, while 94% of them completed the task successfully using the regular catalog.

**User Evaluation on Catalog Features**

The participants commented on the features in the prototype catalog that were helpful:
• Groupings/categorizations: 21 (65%) of the 34 participants found the groupings to be helpful. The two groupings most frequently mentioned as helpful were groupings by language and material type. Six participants (18%) found the groupings by material type helpful, whereas 5 participants (15%) found the groupings by language helpful.

• Refining results: 8 (24%) found the ability to refine the search to be helpful.

• Display order: 5 (15%) found the use of alphabetical order to be helpful.

• Interface appearance: 8 (24%) found the interface appearance helpful. Such features included displaying all the search results in only one page with fewer entries, using a larger font size, and highlighting the matched terms.

Only a few participants pointed out some features that were not helpful and could be improved: 5 (15%) would have liked additional information displayed above the manifestation level for work and expression displays; 3 (9%) found the groupings to be unhelpful in some way with one participant wishing to see individual results immediately; and another participant suggested that a multiple-language result should only be listed under one language instead of under each of the languages involved in the display.

USER EVALUATION ON DISPLAY APPROACHES

The FRBR prototype catalog clusters individual search results into works, expressions under each work, and manifestations under each expression. Of the 34 participants, 30 (88%) thought that the grouping made sense and provided some specific feedback concerning the helpfulness of the groupings, which made searching easier. In general, these participants seemed to feel that the groupings were intuitive and made searching faster and easier. One participant (3%) pointed out that it would take some time to get familiar with the groupings. The remaining 4 (12%) participants could not fully understand the groupings.

As for navigation of the catalog, 31 (91%) thought the navigation made sense. Overall, the participants felt that the navigation options were easy to identify and helped the user perform their searches, and the links made it easier to look for possible matches to all search criteria. The remaining 3 participants did not explicitly say that the navigation made sense.

USER EVALUATION ON HELPFULNESS

Overall, the prototype catalog system was very well received. Of the 34 participants, 28 (82%) found the prototype catalog to be more helpful than the regular catalog. Specifically,

• 7 participants (21%) found the groupings helpful;
• 4 participants (12%) found the organization helpful;
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- 4 participants (12%) found it to be faster;
- 4 participants (12%) thought it easy to use;
- 4 participants (12%) thought it easy to find a known item;
- 4 participants (12%) found it helpful that there were fewer results to search through and important information was provided in the initial display with links to more details; and
- 3 participants (9%) thought that the prototype was intuitive, which is particularly helpful to users with little search engine or library catalog experience.

Additionally, 5 (15%) participants found the prototype catalog to be helpful, but they qualified or limited their answer in one of the following ways:

- helpful except subject search,
- personally helpful and found groupings by material type and language helpful,
- helpful to some extent and found organization and ability to refine search by author helpful,
- more helpful as a freshman and found it to be simpler, and
- more helpful if a user is looking for an unknown item.

Only one participant (3%) in the study found the prototype to be less helpful than the regular catalog. This participant found the prototype catalog to be helpful only when looking for a topic, but the user found the system to be annoying when looking for a specific title.

CONCLUSION AND DISCUSSION

This article draws from three user studies on FRBR-based catalogs, which were designed and conducted in sequence with later studies building on the former. While each study yielded its own unique findings and insights on the research and development of FRBR-based catalogs, the findings from each study also served as the basis for the subsequent system design and user study. Collectively, the three studies evaluated various implementations of FRBR-based catalogs from the users’ perspective and identified user-preferred implementation options for future development based on user research.

The results of these studies demonstrate that such user research can help design better catalogs by identifying system design and implementation options that are more helpful and preferable to users. As shown in Study 1, different FRBR-based catalogs had varied success in supporting the same set of user tasks, confirming the value of comparative user studies of different FRBR-based catalogs. As shown in Study 2 and Study 3, different FRBR-based
displays could be improved based on user input. Such comparative user studies should be applied to evaluate different FRBR systems and various approaches that system developers take when interpreting and implementing FRBR in future development efforts.

The value of such user research is most evident when user-suggested system design and interface preferences are integrated into system development, allowing users to be more successful in completing their tasks using the systems. As shown in Study 3, a FRBR prototype catalog with improved design and implementation based on Study 1 and Study 2 could be more successful in supporting user tasks and be better received by users than its counterpart regular catalog with the same collection. This is particularly the case for the work and expression tasks that current regular catalogs cannot support and previous FRBR-based catalogs were not successful in supporting.

The user studies further demonstrate that engaging users in FRBR system development is not only valuable at the very end of the design and implementation process, but also valuable during the design process to make critical design decisions. This user participatory design approach is reported in the recently published book entitled *Scholarly practice, participatory design and the eXtensible Catalog* that details how the eXtensible Catalog (XC) project team conducted the user studies during the XC development process to make informed design decisions. The findings of their user research served as the basis for designing XC’s discovery interface and the underlying FRBR-based metadata management architecture.

The results of the studies also support the notion that FRBR-based displays do make sense to users and better support their tasks. As shown in Study 3, 88% of the users understood the FRBR-based work, expression, and manifestation groupings and felt that the displays are intuitive. These systems also make their searching faster and easier. Overall, 85% of the users preferred the FRBR prototype catalog over the regular catalog for the tasks, while only 6% preferred the regular catalog. At the same time, it was also noted that there is an initial learning curve for some users to get familiar with the FRBR-based groupings. Also, there was room for interface improvements to make the displays more intuitive in future development.

As discussed early in the literature review, FRBR user research has been the least addressed area in the FRBR research and development. This article addresses the research gap by evaluating and designing catalogs based on FRBR user research. It demonstrates the values of such research, which is beneficial for developing systems that enhance user information seeking. While the findings of the user studies help provide insight on user understanding of the FRBRized results and FRBR-based displays as implemented in the catalogs evaluated in these studies, additional user research is needed to evaluate other implementation approaches in a comparative way in order to yield the best FRBR implementation practices, and provide guidelines that
can be used for developing FRBR-based catalogs that effectively support user tasks.

NOTES

8. Carlyle, “Understanding FRBR As a Conceptual Model.”