A Usability Evaluation of Colorado State University Libraries' Digital Collections and the Western Waters Digital Library Web Sites

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Abstract:

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To assess ease of use, participants (n = 18) completed 11 usability tasks for each Web site and then a Web site perception questionnaire. Participants rated both Web sites positively, but 25% and 36% could not complete all tasks; doing so required more than a minute to complete.

INTRODUCTION

Over the past ten to fifteen years, academic research libraries have been creating, storing, managing, and preserving more and more of their resources electronically and making them available on the Web via digital repositories. These repositories offer unprecedented opportunities to access an ever-growing array of subject-specific collections of materials that include photographs, maps, documents, posters, newspapers, diaries, oral histories, films, legal transcripts, project records, correspondence, and many other items.[2] The focus of these digital repositories may be materials of local, regional, national, or international significance.[3,4,5,6,7,8]

Digital repositories offer distinct advantages to libraries that host them. Access to their contents is immediate, direct, and unrestricted in most cases. They greatly expand the availability of research materials, reduce or eliminate the handling of precious and fragile physical items, and serve as a valuable promotional tool, often for resources that were previously little-known. Users can exploit conventional research collections in fresh and unusual ways because of robust full-text searching and advanced cross-collection indexing capabilities.[9] Digital repositories also enrich information content with intellectual context and enable the collation and widespread dissemination of "gray literature." Huwe notes, "The real potential of digital repositories lies in their ability to capture ephemeral documents and combine them with more familiar formats".[10]

Diverse students and faculty who use digital repositories have a variety of research needs and experiences with Web-based resources. Many of these resources are complex information systems that feature a variety of tools and functionalities. It is challenging for librarians and archivists to create interfaces for digital repositories that

are user-centric, intuitive, and easy-to-use. One method of ensuring this is to employ usability testing at various stages of development. As Lack states, "Libraries and archives must cut through the complexity of information systems, or at least make the complexity transparent to patrons, in order to provide the best possible services." [11]

The following section reviews the research literature on the emergence of usability testing methodology for library Web sites, including digital collections, and advances in Web site evaluation. This is followed by an evaluation of two digital repositories for usability. Working under the authors' supervision, students in a graduate-level interface design class performed Web site interface usability testing on nine Colorado State University Libraries digital collections and the Western Waters Digital Library.

LITERATURE REVIEW

Emerging Usability Evaluation Methodologies

Since the late 1990s, authors have encouraged library staff to evaluate their Web sites. [12] They have also suggested establishing policies on how to integrate usability testing into library Web site development, [13, 14] and provided guidelines for conducting diverse methodologies.[15, 16, 17] They have also reported the results of usability testing, often case studies [18-32] and audience analyses.[15]

The American Library Association's seminal *Usability Testing for Library Web Sites: a Hands-on Guide*[33] and *Usability Assessment of Library-Related Web Sites: Methods and Cases*[19] is a monograph reporting eight case studies. Based on data from the early 2000s, Norlin and Winters provide a brief overview of usability testing; suggest Web site guidelines; discuss how to get buy-in from others; and how to plan, prepare, and

conduct usability testing. They conclude with an actual case study. Campbell [19] provides an overview of usability testing methods and then covers eight case studies illustrating different aspects of usability testing and reports results of evaluations of specific library Web sites.

Teal Anderson and Sayeed Chouhdury, the Digital Knowledge Center, Sheridan Libraries, John Hopkins University [34], support enhancing the usability testing of digital libraries. Their research agenda includes: using quantitative measures; conducting remote testing with users; testing with diverse user populations; testing part or whole digital library collections; testing in natural and laboratory settings; and balancing decisions between user feedback and librarian expertise.

Besides the efforts noted above, a few articles specifically explore the usability of digital repositories. [35, 36, 37, 38, 39]

Bostian[35] conducted focus groups and card sorting activities to guide the development of the *Meeting of Frontiers* Web site (http://lcweb2.loc.gov/intldl/mtfhtml/mfsplash.html), a collaborative digital library of 83 collections from 20 institutions. As of September 2004, it included more than 580,000 digital items and more than 15,000 library items. The project began with two focus groups of American and Russian K-12 teachers. They found that mixing geographical categories and themes was not a good organizational strategy. Based on card sorting activities, Bostian reported they organized the site along geographic focus and reiterated the themes under each geographic region.

Zani-Sabihi, Ghinea, & Chen [36]reviewed definitions of digital libraries. They focused on two digital collections: Science Direct (www.sciencedirect.com); and the

Classical Music Library (www.alexandererstreetpress.com/products/clmu.htm). They asked participants (n =48) to find information on each Web site. Based on their experiences and analysis of the data, the researchers reported on the functionality features (n=10), interface/usability characteristics (n=6), and content (n=2) that they would like to see in these Web sites. Next, they compared the suggestions by types of users (novice, intermediate, and advanced). Novice users focused on ease of use, search engine reliability, information accuracy, and content. Intermediate users focused on search engine reliability, categorization of books by subject, and ease of use. Advanced users suggested that digital libraries be structured like physical libraries and offer lists of their most important resources.

L. Johnston [37] reported on the development and assessment of the public discovery and delivery interface for the Fedora repository system. She covered internal review of the design, classroom testing, and usability testing with faculty and staff. She included a process model for assessments of future library projects.

Norberg, Vassiliadis, Ferguson, & Smith[38] integrated usability testing and iterative design of the *Documenting the American South* (DocSouth) digital library, University of North Carolina at Chapel Hill (http://docsouth.unc.edu/). Their work shows how informal usability testing and iterative design provided insights into the information needs and behaviors of users of cultural heritage digital libraries.

Roda, Borel, Gentchev, & Thomas [39] used participatory design techniques to enhance the development of a digital image library of slides of the art history department of the American University of Paris. The project team was composed of students, professors, IT managers, librarians, and administrators. Activities included workshops

within the design teams, observations of slide use in classes, user interviews, and reactions to paper prototypes of Web sites. The authors found that team formation had a high turn-over impact on usability design; collection management influenced the usability of the final design; and usability and resource reuses were severely reduced if the services were limited to classical digital libraries.

Advances in Web Site Evaluation

Researchers focusing on Web site design and evaluation have developed and refined a wide range of evaluation methodologies that provide guidance for assessing library Web sites. Researchers now widely recognize the value of research and evaluation methodologies used by the empirical social sciences, psychology, sociology, and education—to name a few fields using both qualitative and quantitative methodologies. [40, 41, 42] Over the last 30 years, a growing body of evaluation research methodologies has emerged that can be applied to developing and assessing Web sites. [43,44,45,46]

Since the mid-1980s, the Usability Professionals Association has grown as a professional organization with an annual international conference, an online trade magazine, and a peer-reviewed online publication, *Journal of Usability Studies* (see http://www.upassoc.org/upa_publications/jus/jus_home.html). Both academics and usability practitioners actively advance this field.

Of special note is the research on using Web sites to deliver health information. The National Cancer Institute (NCI) has developed one of the more comprehensive reviews of research-based guidelines for designing and evaluating Web sites (www.usability.gov).[47,48] The NCI Web site not only provides guidance for using diverse

usability methodologies, it offers some 200+ research and evaluation-based guidelines for Web site designs.

Researchers have explored a wide range of interface design and iterative Web site design that integrates research and evaluations, and human factors, that can be applied to Web site development.[49, 50, 51, 52]

Consultants have also authored a diverse range of guidelines based on their experiences. [53,54, 55]

Several authors have summarized factors associated with Internet health communication programs and Web sites.[56,57,58,59] Others have conducted controlled field experiments that have assessed audience analyses, and integrated iterative design and , usability testing into their research projects [60]

OBJECTIVES OF THE STUDY

This article describes how the authors assessed the usability of two digital repositories referenced earlier: the Colorado State University Libraries' Digital Collections Web site (http://digital.library.colostate.edu/); and the Western Waters Digital Library (http://www.westernwaters.org/. In our evaluation of both sites, we focused on these two criteria:

- The ease of use of the Web site when participants actually search for specific information;
- Participants' perceptions of the Web site and its ease of use.

Research Setting

Colorado State University (CSU) is a public, land-grant institution founded as the Colorado Agricultural College in 1870, six years before the Colorado Territory gained

statehood. Enrollment is currently about 26,000, and extramural funding exceeds $300 million annually. As a Carnegie/Doctoral Research University-Extensive University, Colorado State is a leader in science and technology research, particularly in infectious diseases, environmental science, clean energy technologies, and atmospheric science. CSU's exceptional professional programs include veterinary medicine (ranked second in the nation by *U.S. News and World Report*), construction management, journalism and technical communication, occupational therapy, and agriculture.

The CSU Libraries (CSUL) includes Morgan Library and two branch libraries that support the Atmospheric Science Department and the College of Veterinary Medicine and Biomedical Sciences. Print holdings total more than 2 million books, bound journals, and government documents. More than 30,000 electronic resources are accessible from the Libraries' Web site, which has grown rapidly in size and complexity since the late 1990s. This includes books, journals, and locally digitized reports, posters, slides, photographs, oral histories, and other primary resource materials.

The CSU Libraries implemented its first Web-based repository of digital collections in 2000-2001 with images from its International Poster Collection (IPC). The IPC currently contains over 1,700 poster entries from the university's biennial Colorado International Invitational Poster Exhibition (CIIPE), the singular event of its kind held in the United States. Initiated in 1979, the Department of Art established CIIPE "to bring outstanding examples of graphic communication from around the world to an American audience to 'share ideas' and through this sharing to increase cultural dialogue and understanding.". [61] CIIPE has showcased the work of artists from over forty countries.

A second collection deposited during the launch of the repository was the Garst Wildlife Photographic Collection. It contains over 1,300 digitized slides selected from the nearly 20,000 donated to the Libraries by Warren and Genevieve Garst. The Garsts photographed more than 700 animal species worldwide over a twenty-five year period while filming for the Mutual of Omaha's *Wild Kingdom* television series. Many of the images in the collection are unique and include mammals, birds, reptiles, insects, and aquatic animals, some of which are now difficult to visually recapture given extinction rates and the number of endangered species.

Since 2001, the Libraries' digital collections have grown to include an additional six collections spanning: historical documents and maps; agricultural industries; reports on water resources development and water supply; award-winning student research projects; and historical collections focusing on individuals. Users link to the Digital Collections Web site from the University Libraries' home page. The basic design includes title and horizontal navigation bar with buttons: home; view collections; browse items; advanced search; preferences; my favorites; and help (Figure 1).

INSERT FIGURE 1 ABOUT HERE

The Western Waters Digital Library (WWDL), a collaborative regional project of twelve university libraries (including CSUL) in eight western states, represents an extensive collection of government reports, personal papers, photographs and other images, legal transcripts, water project records, and videos about the Columbia, Colorado, Platte, and Rio Grande river basins. The objective of this project, funded

during its first phase from 2003-2005 by the Institute of Museum and Library Services, was "to lay the foundation for continued development of a comprehensive digital information resource about water in the western United States." [61] The Web page design provides links to text, images, videos, audio, search and advanced search capabilities, browse buttons, and internal links within the text (Figure 2).

INSERT FIGURE 2 ABOUT HERE

Both Web sites provide faculty, students, and staff the opportunity to conduct research using primary sources without having to physically enter library buildings or handle these frequently fragile documents. This saves the researchers time and effort and reduces wear on the materials. Neither the CSUL Digital Collections Web site nor the Western Waters Digital Library had previously been evaluated through usability testing.

PROCEDURES

The Research Team and Test Participants

The research team consisted of the authors and students enrolled in a graduate-level interface design class that culminates with their conducting usability testing of Web sites. The class is offered as part of a master's degree in technical communication (see http://www.colostate.edu/Depts/TJ/grad/mstc.html) that focuses heavily on empirical social science research methodologies, statistical analyses, and communication theories empirically testing communication processes, products and effects. Graduates of the program enter a variety of professional communication careers in scientific, technical, and public communication areas.

The primary users of the Libraries' Digital Collections Web site include university students and faculty from a wide range of backgrounds. The WWDL users share a common interest in conducting research on water resources and issues in the West. Working under the authors' supervision, the students recruited 18 participants for usability testing from university classes and the authors' and research team's contacts. Participants were sought at all class ranks and across diverse disciplines.

The selection of appropriate participants is paramount to successful usability testing. Running usability testing on participants not representative of the intended users of the Web site can produce erroneous data and conclusions.

Designing the Tasks

` A series of tasks was created for both Web sites by the research team. Participants were asked to locate specific information using each Web site. The methodology relied on the protocol that the senior author has developed since the late 1980s for usability testing in general and since the mid-1990s for Web sites.[63, 64, 65] The methodology was adapted to ensure key aspects of assessing the digital repositories were evaluated. Evaluations would assess both the Web site interface design and presentation of the Web site content. To begin, the members of the research team navigated through the Web sites to familiarize themselves with their designs and contents, and then mapped the Web sites showing their branches, organizational structures, levels, and depth.

Next, the authors and the teams designed two sets of tasks: initial tasks so that participants could find selected information easily; and subsequent tasks that would require skillful searching of the respective Web site. Tasks were created for (1) each major interface design (some Web sites have different interface designs in different

locations on the Web site); (2) all levels and branches of the Web site; (3) individual pages more than one screen deep—i.e., they require scrolling to the bottom to find the needed information; and (4) problems that were encountered while learning to use the Web site. In all, the research team generated 11 tasks for each Web site and designed them so participants could complete them within 30 minutes.

To assess the usability of the Web sites, the team used a talk-aloud protocol and measured the successful completion of the tasks and time required to complete each task. To gather the data, participants were asked to talk aloud as they worked, and describe what they were thinking and doing. The team observed them, took notes on their movements and comments, and videotaped them. The participants' verbal elaborations were recorded to determine possible reasons for the problems they encountered. If a specific task was not completed within three minutes, it was considered a failure and the team asked participants to move to the next task.

To assess individuals' perceptions of the Web sites, the research team developed a six-part questionnaire. It began with open-ended questions and then included a scale of questions about their overall impression of the Web sites and their reactions to specific features. Participants were also asked about their general library use, computer expertise, and demographic composition. The team used open-ended questions so they would not set the agenda or lead participants when they were asked to identify the major strengths and weaknesses of the Web sites.

The University's Institutional Review Board reviewed and approved the protocol for data collection.

Data Collection Protocol

The usability sessions were in late afternoons and early evenings over a two-week period. Participants received instructions on how to find the usability laboratory and the specific time of their individual usability testing appointment by email. The day before their usability session, each participant received an e-mail reminder of the times and locations for the data collection sessions.

When participants arrived, research team members briefed them, asked them to sign the consent form required by our University's Institutional Review Board, gave them a $20 gift certificate for the university bookstore, and asked them to sign a receipt for the gift certificate.

Team members escorted each participant to the usability laboratory and familiarized the individual with the computer system and browser. Next, the participant received a set of 11 tasks to search the Libraries' Digital Collections Web site and a set of 11 tasks to search the WWDL. We instructed participants to talk aloud as they worked and record brief answers for each task on the printed task lists. Team members observed the participants, took notes on their actions and comments, timed them, and videotaped them. Once they completed the usability protocol sessions, participants completed a six-part questionnaire (described above).

Data Analysis

The data analyses included both quantitative and qualitative analyses of the observations and questionnaires. From the observations, the research team generated tables documenting the times required to complete each task, and whether participants successfully completed each task. The research team noted participant comments that

provided helpful insights to their interactions with the Web sites. If needed, the team reviewed the videotapes from the respective sessions.

For the closed-ended questions on the questionnaires, the team followed routine protocol for data analyses that included creating a codebook for entering data into SPSS-PC—a statistical software program, cleaning up the data, running descriptive statistics, and then inferential statistics as needed. The team also transcribed participants' responses to the open-ended questions and analyzed them as qualitative data. Specifically, the team looked for responses that identified areas of specific problems, responses that provided insights and/or elaborated on findings from the quantitative analyses, responses that provided insight and/or elaborated on team observations of participants' interactions with the Web sites, and recurring responses that generated patterns identifying specific problems or difficulties that users encounter.

FINDINGS AND DISCUSSION

Participant Demographics

Eighteen participants assisted with the usability testing, one of whom did not answer the demographic questions. Of the remaining seventeen participants, twelve were female and five were male. Five participants were freshmen, four were sophomores, five were juniors, one was a senior, one was a graduate student, and one was in a special program. While participants ranged from eighteen to twenty-nine years old, fourteen of the participants were eighteen to twenty-one years old, reflecting the traditional undergraduate university population. Although our purposeful sample of users may not be representative of the CSU Libraries' users overall, our findings suggest the need for additional research assessing library Web site usage by this institution's general college

population, including more graduate students and faculty and other users of the Digital Collections.

Participant Computer Expertise

Participants brought substantial computer experience and expertise to the project (Tables 1 & 2). They averaged more than ten years of personal computer experience and more than eight years of World Wide Web experience. They had, however, substantially less experience downloading and installing software (Table 1.). Surprisingly, when asked to assess their levels of experience with different computer use tasks, they rated all skills relatively highly on a 1 to 7 scale where 1 = none to 7= A Great Deal (Table 2).

INSERT TABLES 1 & 2 ABOUT HERE

Participant Use of Libraries' Web Site

On the 1 to 7 scale, where 1 = strongly disagree to 7 = strongly agree, participants do not appear to be frequent visitors to the Libraries' Web site ($M = 4.06 \pm 1.73$), but reported the Web site useful ($M = 5.12 \pm 0.93$; Table 3). Only one participant had used the Digital Collections Web site in the past (Table 3).

INSERT TABLE 3 ABOUT HERE

The low usage of the digital repository warrants the need to increase awareness of its availability. This could be accomplished by greatly expanding marketing and communication activities. To date these have included the distribution of bookmarks within the Libraries and at select events for new students, dissemination of announcements via email upon the launch of new digital collections, promotion of

collections on the Libraries' Web site, and presentations given at library conferences, meetings, and workshops. For example, the faculty librarians could distribute brochures, flyers, and other informational products such as copies of digital images; give on-site presentations within departments on use of the repository to support research and classroom instruction; conduct training sessions for target audiences; and organize tours that showcase library collections and incorporate information about digitized resources that can be found in the repository.

From a library policy perspective, research may be needed to determine how to prioritize the development of the digital repository collections in light of limited resources. Further research may be needed to assess those who are currently using the digital repository and which collections are of more potential value to users. If further research substantiates the low usage, the Libraries may need to embark on an assertive information campaign to increase awareness of its resources and Web sites for identifying all materials available to students, faculty, and other users.

Libraries' Digital Collections Site Usability Task Performance

Overall, participants performed relatively well on completing the tasks, but nearly 25% of the participants could not complete four of the tasks (Table 4). That said, eight of the tasks took more than one minute to complete and only three were under one minute (Table 4).

INSERT TABLE 4 ABOUT HERE

Our usability testing of the Libraries' Digital Collections Web site identified a number of problems. Although achieving a 100% successful task completion rate for all

participants may not be possible, having fewer than 100% of them complete tasks fully supports the need to revise and enhance the Web site. Likewise, participants should be able to find the information they seek in less than one minute and preferably less than 30 seconds. Of the 11 tasks evaluating the Libraries' Digital Collections site usability, all participants only completed two of the tasks, and doing so often required them to spend more than one minute searching for the information (Table 4).

About one-quarter of the participants could not locate information for Task 2 that asked them to find guidance on copyright usage of the images provided on the Web site. It is possible they were not familiar enough with copyright issues to successfully complete this specific task.

About one-quarter of the participants could not complete Task 6, which required them to customize the Digital Collections interface for personal use. The task required them to think about potential changes and then attempt to make those changes. The Web site needs to be so designed to make it easier for users to customize the interface. Engaging users in making changes helps to ensure their repeated use. Generally, individuals who become engaged in using technology use it more frequently.

About two-fifths of the participants also encountered problems (Task 11) saving items that they would frequently consult. Features that allow saving need to be easier to use. If participants have difficulty with the Web site, it will discourage them from returning to it again.

For about 80% of the tasks, participants either took close to one minute or more than one minute to find the information they sought. If participants cannot find the information they seek quickly, it discourages them from using the Web site and returning

to it for future searches. The Digital Collections interface needs to be revised so that fewer participants encounter problems finding information they seek.

The research team's evaluation did not explore participants' content knowledge of the respective collections in the Digital Collections. However, we do not believe that the tasks created required specific content knowledge. Most tasks were cast in terminology that should not have been foreign to the students, such as finding images; photographs; drawings and illustrations; information about water and animals; and library staff contact information.

Western Waters Digital Library Usability Task Performance

More participants had problems with all of the tasks requiring them to find information for the Western Waters Digital Library than on the Libraries' Digital Collections Web site. While participants successfully completed only 64% of the tasks, they did so in less time (Table 5). They completed six of the tasks in less than one minute, and most of the remaining tasks took slightly more than one minute.

INSERT TABLE 5 ABOUT HERE

Our results signal the need to conduct more usability testing of the Western Digital Library Web site. Task questions need to explore the difficulties that participants had in using specific functions and an extended questionnaire needs to explore participants' perceptions of the features.

When conducting the usability testing for both Web sites, the research team did not tell participants they obtained the incorrect information. The rationale is as follows: if

participants were searching for information on their own—i.e., not in a laboratory setting—once they find information, and they are satisfied, they have no way of knowing. In future usability tests, we need to include a confidence assessment—i.e., the question we need to ask participants is how confident are they that they have identified the correct answer.

Assessment of the Libraries' Digital Collections Web Site Features

The research team asked more in-depth questions to assess participants' perceptions of the Libraries' Digital Collection Web site features because the Libraries' programming staff could readily make at least some of the necessary changes. Based on the scale questions on specific features of this Web site, the scores suggest participants found most features easy to understand and use (Table 6).

INSERT TABLE 6 ABOUT HERE

Overall, participants rated the respective features of the Digital Collections Web site higher than we expected based on our observations of their Web site use. Generally, participants rated the functions relatively high on the 1 to 7 scale where 1 = Strongly disagrees to 7 = Strongly agrees. They rated about 93% of the features in the M = 4.50 to 6.10 range, but of those, only two averaged above 6. The standard deviations of the responses with means about 5 are generally around 1, suggesting several participants rated these items highly.

Of special note are the ratings of the My Favorites feature on the Libraries' Digital Collections site. Generally, most participants' responses averaged above 5,

(Table 6), but the wide standard deviations of the responses suggest that some participants recognized that they had problems using this function while others did not. These data lend some support to our observations that participants had difficulties with Task 11 (Table 4) in saving items to My Favorites.

Our probe of their overall perceptions of the Digital Collections site suggests they found the information useful to their research (M= 5.41±1.28), and they rated their likelihood of using the Web site again relatively high (Q.29, Table 6, M = 4.83± 1.47). While we probed their perceptions of the help, browse, zoom, and advanced features, no clear pattern emerged from the data on these features.

We explored the value of adding photographs and visuals as techniques to encourage Web site visits. While participants tended to indicate that adding photographs and visuals to the Web site would make it more attractive and interesting, some said that adding visuals (M=4.17±1.72) and photographs (M=4.59±1.77) would not necessarily encourage increased visits to the Web site. Participant's scoring suggests these would encourage about only two-fifths of the participants to visit it again (Table 6).

Further research needs to explore what factors would encourage returns to the Web site and what factors discourage them. Overall, our results suggest that further usability testing will be needed to see if the redesign of the Web site eliminates the problems observed and changes participants' perceptions of the Libraries' Digital Collections Web site.

Assessment of the Western Waters Digital Library's Web Site Features

The research team did not explore participants' perceptions of individual features of the Western Waters Digital Library Web site because they would have become fatigued in

lengthy usability testing sessions. Sessions from the initial briefing through completion of the questionnaire were running longer than 60 minutes. Over years of conducting usability testing, the senior author has found it prudent to limit data collection. Moreover, other usability researchers and practitioners have suggested limiting data collection sessions.

Perceptions of the Web Sites

Clearly, the open-ended questions identified strengths and weaknesses mirroring observations and scale questions. Participants reported liking the content, the amount of information available, the simple interfaces, and the photographs and images of both the Digital Collections and Western Waters Digital Libraries Web sites.

When asked about dislikes, some participants noted navigation problems, limited interactivity, and lackluster interfaces. Other participants reported having problems using features of the Libraries' Digital Collections site, such as the My Favorites, and commented on the small fonts. Some stated that the Western Waters Digital Library (WWDL) was harder to use than the Libraries' Digital Collections site, and mentioned there were fewer links on the WWDL home page. Participants noted the lack of consistency across pages on this site.

Based on answers to scale questions, participants largely felt satisfied with their experiences testing these Web sites, and they generally rated them highly (Table 7). For seven items, participants scored the Web sites near the midpoint (M = 3.50) on the 1 to 7 scale where 1= strongly disagree to 7 = agree. While such scores suggested some disagreement, their responses indicated that half of them thought they had problems using

the Web sites; understanding the links, reading the amount of information in the text and .pdf files; and feeling lost, confused, overwhelmed, or frustrated (Table 7).

INSERT TABLE 7 ABOUT HERE

Reponses to Question 24 (Table 7) align with the open-ended comments that the font was too small. About 28% of the respondents circled 4 or above on the 1 to 7 scale where 1 = Strongly disagree to 7 = Strongly agree. Clearly, font legibility is creating a problem for some college-aged users. The senior author has observed this in other usability testing over the last five years.

CONCLUSION

Our usability testing of the CSU Libraries' Digital Repository and the Western Waters Digital Library provided insights to current problems with these Web sites, suggested strategies that will improve them, and identifies additional research needs.

Once problems are identified, a Web site needs to be revised to eliminate them. To ensure new problems have not been introduced, another usability testing cycle checks the site redesign and ensures it has not introduced new problems. Such usability testing—called iterative design—focuses on a test, redesign, and test again approach. Research is needed to establish how many test-redesign-and test again cycles may be needed to achieve maximum quality of the Web site.

Usability testing must be placed in the larger context of library and library Web site use. Further research needs to explore user awareness of library resources and identify factors that affect user knowledge. These efforts will include identifying how Web site design and content encourages or discourages the use of these resources. They

will also help librarians discover how to best inform and train people to effectively and efficiently access them.

Visual appeal is key to encouraging users to explore what a Web site has to offer. First impressions of a Web site determine whether or not a user will explore it. If a user's initial reaction is positive and he or she begins exploring the Web site, then its ease of use and learning curve—how long it takes a user to successfully retrieve information—determines whether or not the Web site is visited again. Usability testing can identify Web site designs that create a positive first impression and ensure ease of use and a short learning curve.

Usability testing can help ensure good design from users' perspectives. But usability testing, like many social science evaluation methodologies, is fraught with pitfalls for the unwary. While the general principles and methodologies guiding current usability testing methodologies are applicable to evaluating library Web sites—including digital repositories—studies are needed to fine-tune usability testing of library and digital repository Web sites.

Research is needed to determine: how much Web content knowledge ensures users can quickly and easily learn how to use a Web site; how familiar they are with general Web site design and specific Web site design features unique to digital repositories; and what other factors they need to know to speed learning how to use a new Web site.

Further research is needed to develop guidelines for selecting participants. Ideally, random sampling—in the statistical sense—should be used for sampling participants for usability testing. Pulling random samples depends on having a quality list from which to

draw. Ideally, a list would include all potential users of the Web site, but such lists may not be available. In some cases, researchers and evaluators develop the lists from which they can sample, but developing such lists can be costly and time consuming.

The alternative is to draw purposeful samples—i.e., develop a screening script to ensure the participants selected come as close as possible to representing the intended users of the Web site. Clearly, research is needed to develop guidelines for recruiting, screening, and selecting for purposeful samples of the intended users.

Our case study, as reported in this article, demonstrates the importance of conducting usability testing to identify problems that users encounter with library digital collections. Investing time in usability testing will enable libraries to enhance the ease of use of their Web sites for all collections. The final results should produce Web sites that provide a positive first impression, are easy to use, and encourage users to return to the digital repository again.

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Figure 1

Screen shot of Digital Collections Web Site

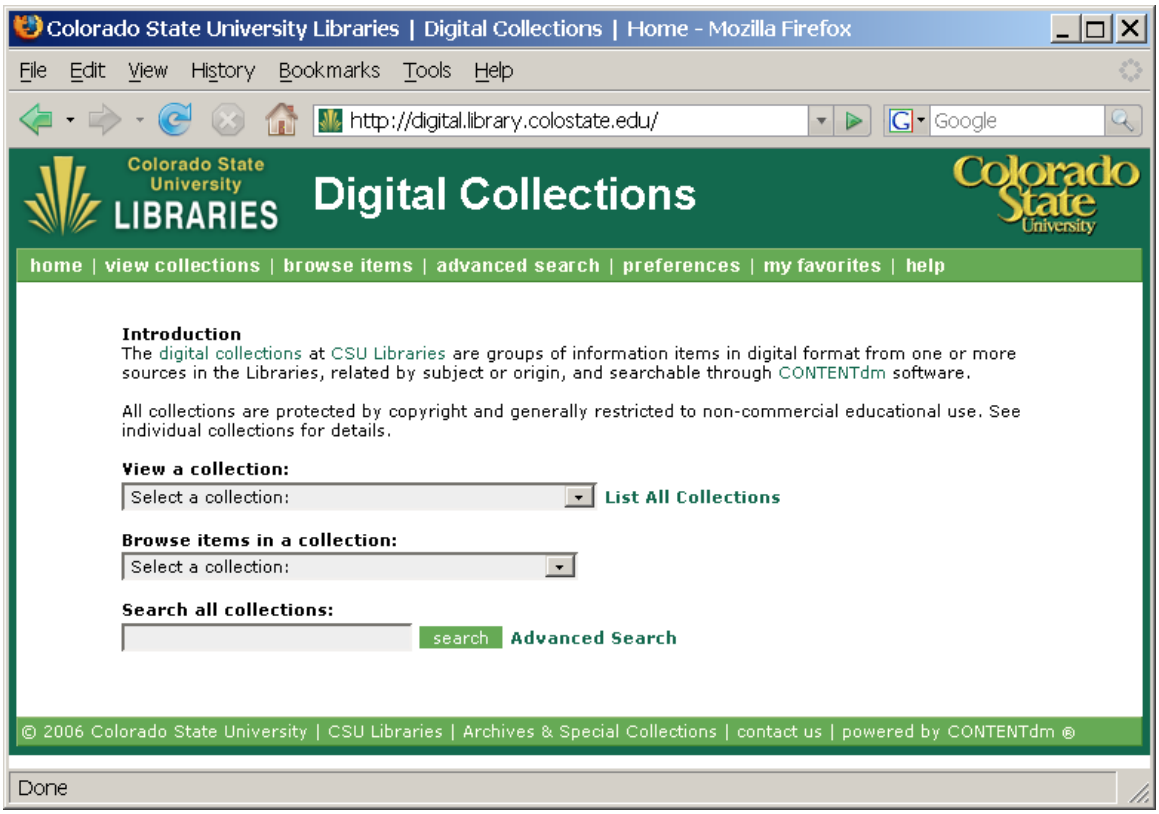

Figure 2

The Western Waters Digital Library Web Site

Table 1.

Usability Study Participants' Computer Experience – Years

Skills Category	N	Mean Years ± SD
Using a personal computer	17	10.71 ± 5.11
Using the WWW	17	8.88 ± 2.40
Personally downloading Adobe Acrobat software	17	3.24 ± 3.40
Downloading .pdf files	17	3.47 ± 2.32
Installing software	16	5.31 ± 4.25
Installing hardware	14	2.43 ± 1.87
Filling out applications/ forms online	17	4.24 ± 2.49
Installing Flash updates	14	3.86 ± 3.51

Table 2.

Usability Study Participants' Computer Experience*

		Percentage**							
		None						A Great Deal	
Skills Category	**n**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Mean ± SD**
Using a personal computer	15	-	-	6.7	6.7	46.7	13.3	26.7	5.47 ± 1.19
Using the WWW	15	-	-	-	-	53.3	13.3	33.3	5.80 ± 0.94
Personally downloading Adobe Acrobat software	14	14.3	7.1	14.3	7.1	35.7	21.4	-	4.07 ± 1.77
Downloading .pdf files	14	7.1	7.1	7.1	28.6	21.4	-	28.6	4.64 ± 1.91
Installing software	13	15.4	7.7	7.7	7.7	15.4	30.8	15.4	4.54 ± 2.15
Installing hardware	14	28.6	14.3	14.3	21.4	21.4		-	2.93 ± 1.59
Filling out applications/ forms online	15	-	6.7	-	13.3	33.3	26.7	20.0	5.33 ± 1.34
Installing Flash updates	13	23.1	-	23.1	23.1	7.7	23.1	-	3.62 ± 1.85

* Some participants did not respond to the questions on computer skills.
**1 to 7 scale where 1 = None to 7 = A great deal

Table 3

Web Site Satisfaction*

		Percentage							
		Strongly disagree							Strongly agree
	n	1	2	3	4	5	6	7	Mean ± SD
How frequently used Library Web site	18	5.6	16.7	16.7	22.2	11.1	22.2	5.6	4.06 ± 1.73
How useful Library Web site	17				29.4	35.3	29.4	5.9	5.12 ± 0.93
How frequently used Digital Collections in the past	18	94.4		5.6					1.11 ± 0.47
If used Digital Collections, how useful was it	4	50.0		25.0		25.0			2.50 ± 1.92

* 1 to 7 scale where 1 = strongly disagree and 7 = strongly agree

Table 4

Percentage Completion of Libraries' Digital Collections Usability Study Tasks and Required Average Times (n=18)

Task	Description	Percentage of Participants completing task	Average time required to complete task in minutes and second
1	Start at the Libraries Home Page and find the Digital Collections site. How many collections are available in Library Digital Collections? What topics are included? What kinds of materials are provided in the collections?	100%	1:51
2	If you had a job as a writer for a magazine, could you use the images from the Digital Collection? What guidance does the Digital Collection Web site give you?	76%	1:36
3	What organization on the site has been involved in Colorado's flower industry? Which of the collections would you use?	88%	1:11
4	If you wanted to find images, such as photographs, drawings, and other illustrations in the collections, how would you do so? Please show us by reviewing one of the collections.	93%	1:40
5	If you wanted to find information about water and animals in the collections, how would you find that information?	78%	1:24
6	Assume you would like to change how the Digital Collection looks on your computer. Using the Digital Collection functions—not your browser, determine how you could make changes using the Digital Collections settings. Answer the following questions, but do not make the changes. What changes can you make? Please tell us how you would go about making the changes? Change the display of 100 images to a table with the image, title and subject.	78%	2:13
7	If you couldn't figure out how to use the Digital Collections, where would you find an overview giving you general guidance?	100%	0:38
8	What directions does the Help function provide?	94%	0:44
9	Assume you're having a problem and need to contact the Libraries about it. How would you send a message to the Libraries about you problem with the Digital Collections site? Find a page that allows you to contact the Libraries.	94%	0:58
10	Assume you would like to know about the gestation period of the Asian false vampire bat that's pictured in the Garst Wildlife Photographic collection. Find and report that information.	83%	1:41
11	Assume you will be using the Digital Collections site frequently, and would like to save items that you would use frequently? Insert items from two of the collections into My Favorites.	59%	1:44

Table 5

Percentage Completion of Western Waters Digital Library Usability Study Tasks and Required Average Times (n=17)

Task	Description	Percentage of Participants completing task	Average time required to complete task in minutes: seconds
1	What grant funded the Western Waters Web site? Digital Library:	88%	1:28
2	Assume you are a researcher in New Mexico, and you want to know if your institution has participated in developing the Western Waters Digital Library. What institution(s) from New Mexico have participated in developing the Western Waters Digital Library?	82%	1:07
3	Search the Western Waters Digital Library for "**Columbia River**" in the **title**. How many items have Columbia River in the title?	76%	1:10
4	Next search the Western Waters Digital Library for ANY of the words "Cloud Water" in the subject.	82%	:55
5	Name two collections contained in the Colorado River Basin collection?	75%	1:11
6	Search the "Western Waters Digital Library" for the term "Whaling". How many items do you find?	88%	0:46
7	On what page of the Western Waters Digital Library do you find information on "Technical Details"?	69%	0:58
8	Conduct an "Advanced Search" from the Western Waters Digital Library using the words "Colorado Region" and using "selected fields" as search criteria. How many **items** do you find with Colorado Region in the title?	92%	0:53
9	How many collections are in the Western Waters Digital Library? Name them.	100%	0:45
10	What page of the Western Waters Digital Library contains links to other water Web sites about water resources?	86%	0:36
11	Conduct a search for **images** using the word "**fishing**." What is the 15th image returned by the search?	80%	1:16

Table 6

Libraries' Digital Collection Web Site Feature Assessment: Questions 1-19 *

		Percentage							
		Strongly disagree						Strongly agree	
	N	1	2	3	4	5	6	7	Mean ± SD
Q.1.Help feature easy to use	18	-	-	11.1	5.6	22.2	33.3	27.8	5.61 ± 1.29
Q.2. Help feature easy to understand	18	-	-	11.1	-	16.7	44.4	27.8	5.78 ± 1.22
Q.3.Help feature useful	18	-	-	5.6	5.6	22.2	44.4	22.2	5.72 ± 1.07
Q.4. Browse feature easy to use	16	-	-	6.3	12.5	18.8	43.8	18.8	5.56 ± 1.53
Q.5. Browse feature easy to understand	16	-	-	12.5	12.5	25.0	37.5	12.5	5.25 ± 1.23
Q.6. Zoom and pan feature easy to use	3	-	-	-	33.3	66.7	-	-	4.67 ± 0.58
Q.7. Zoom and pan feature helpful	3	-	-	-	66.7	-	-	33.3	5.00 ± 1.73
Q.8. Info below items (metadata) easy to find	13	-	-	-	15.4	61.5	7.7	15.4	5.23 ± 0.93
Q.9. Info below items (metadata) would be useful	14	-	-	-	35.7	28.6	21.4	14.3	5.14 ± 1.10
Q.10 Info below items (metadata) helps understand content	14	-	-	-	14.3	35.7	35.7	14.3	5.50 ± 0.94
Q11. Info below items (metadata) easy to understand	13	-	-	-	15.4	38.5	23.1	23.1	5.54 ± 1.05
Q.12. Advanced search function easy to use	16	-	-	-	-	25.0	37.5	37.5	6.13 ± 0.81
Q.13. Advanced search function easy to understand	17	-	-	5.9	5.9	23.5	29.4	35.3	5.82 ± 1.19
Q.14. Advanced search function works easily	16	-	-	-	-	37.5	18.8	43.8	6.06 ± 0.93
Q.15. Advanced search function would be helpful	17		5.9		5.9	17.6	29.4	41.2	5.88 ± 1.36
Q.16. My Favorites function easy to use	18	16.7	22.2	5.6	11.1	5.6	11.1	27.8	4.11 ± 2.40
Q.17. My Favorites function easy to understand	18	16.7	22.2	5.6	11.1	11.1	16.7	16.7	3.94 ± 2.24
Q.18. My Favorites function works easily	18	16.7	11.1	16.7	5.6	22.2	11.1	16.7	4.06 ± 2.13
Q.19. My Favorites function would be helpful	17	11.8	11.8	5.9	5.9	35.3	5.9	23.5	4.53 ± 2.07

* 1 to 7 scale where 1 = strongly disagree and 7 = strongly agree

Table 6 Cont'd.

Libraries' Digital Collection Web Site Satisfaction, Questions 20-29 *

	Percentage								
	Strongly disagree							Strongly agree	
	N	1	2	3	4	5	6	7	Mean ± SD
Q.20 Would use My Favorites function regularly	18	22.2	11.1	11.1	16.7	11.1	5.6	22.2	3.89 ± 2.27
Q.21. Photos in Digital Collection make it attractive	18	-	-	-	11.1	38.9	38.9	11.1	5.50 ± 0.86
Q.22. Photos in Digital Collection make it interesting	18	-	-	-	5.6	33.3	50.0	11.1	5.67 ± 0.77
Q.23. Photos would encourage me to visit site again	17	11.8	-	11.8	17.6	17.6	35.3	5.9	4.59 ± 1.77
Q.24. Visuals in Digital Collection make it attractive	18	-	5.6	-	11.1	44.4	27.8	11.1	5.22 ± 1.17
Q.25. Visuals in Digital Collection make it interesting	18		5.6		11.1	38.9	33.3	11.1	5.28 ± 1.18
V.26. Visuals would encourage me to visit site again	18	11.1	5.6	16.7	22.2	11.1	33.3		4.17 ± 1.72
Q.27. Information useful to my research	17			5.9	23.5	17.6	29.4	23.5	5.41 ± 1.28
Q.28. I would print copies of reports in Digital Collection	18		11.1	16.7	22.2	16.7	22.2	11.1	4.56 ± 1.58
Q.29.I would use Digital Collection in the future	18			22.2	27.8	11.1	22.2	16.7	4.83 ± 1.47

* 1 to 7 scale where 1 = strongly disagree and 7 = strongly agree

Table 7

Satisfaction Results of Using the Web Site, Questions 1-23*

		Percentage							
		Strongly disagree						Strongly agree	
	n	1	2	3	4	5	6	7	Mean ± SD
Q1. Satisfied with experience	18	-	-	11.1	27.8	50.0	5.6	5.6	4.67 ± 0.97
Q2. Links hard to understand	18	-	44.4	16.7	27.8	11.1	-	-	3.06 ± 1.11
Q3. Easy to correct errors	18	-	-	11.1	11.1	44.4	22.2	11.1	5.11 ± 1.13
Q4.Diagrams and graphics enhanced Web site	17	-	11.8	-	23.5	17.6	41.2	5.9	4.94 ± 1.44
Q5. Text has too much info	18	11.1	11.1	16.7	33.3	27.8	-	-	3.56 ± 1.34
Q6. Site navigation bar helpful	9	-	-	22.2	33.3	33.3	-	11.1	4.44 ± 1.24
Q7. Words on screen legible	18	-	-	16.7	5.6	22.2	38.9	16.7	5.33 ± 1.33
Q8. Site confusing to use	18	-	33.3	22.2	11.1	27.8	5.6	-	3.50 ± 1.38
Q9. Information easy to understand	18	-	-	5.6	16.7	38.9	27.8	11.1	5.22 ± 1.06
Q10. Site layout easy to follow	18	-	5.6	5.6	38.9	27.8	16.7	5.6	4.61 ± 1.20
Q11. Never felt lost using site	18	11.1	16.7	38.9	11.1	11.1	5.6	5.6	3.33 ± 1.16
Q12. Felt overwhelmed	18	16.7	16.7	22.2	22.2	11.1	5.6	5.6	3.33 ± 1.72
Q13. Made few errors	18	5.6	5.6	5.6	27.8	22.2	16.7	16.7	4.72 ± 1.67
Q14. Pages loaded quickly	18	-	-	5.6	5.6	5.6	27.8	55.6	6.22 ± 1.67
Q15. Site very easy to use	18	-	5.6	11.1	22.2	44.4	5.6	11.1	4.67 ± 1.29
Q16. Narrative easy to understand	16	6.3	-	18.8	31.3	18.8	25.0	-	4.31 ± 1.40
Q17.Not frustrated using site	18	11.1	11.1	27.8	22.2	22.2	-	5.6	3.56 ± 1.54
Q18. Site well-written	18	-	5.6	-	27.8	33.3	22.2	11.1	5.00 ± 1.24
Q19.Not interesting to use	18	5.6	-	27.8	22.2	27.8	11.1	5.6	4.22 ± 1.44
Q20. Site has too much info in .pdf files	11	27.3	18.2	9.1	27.3	9.1	-	9.1	3.09 ± 1.92
Q.21.I prefer to print and then read web pages	18	38.9	33.3	5.6	11.1	5.6	-	5.6	2.33 ± 1.68
Q22. Design of links inconsistent	18	27.8	33.3	22.2	5.6	5.6	5.6	-	2.44 ± 1.42
Q23. Font (typeface) hard to read	18	27.8	44.4	16.7	11.1	-	-	-	2.11 ± 0.96

* 1 to 7 scale where 1 = Strongly disagree to 7 = Strongly agree.

Table 7 Cont'd

Web Site Satisfaction Survey Results, Questions 24-33

	Percentage								
		Strongly disagree						Strongly agree	
	n	1	2	3	4	5	6	7	Mean ± SD
Q24. Font (typeface) too small	18	27.8	27.8	16.7	16.7	-	5.6	5.6	2.72 ± 1.74
Q.25. I could easily find the info I needed	17	-	11.8	23.5	23.5	29.4	11.8	-	4.06 ± 1.25
Q.26. Site design is attractive	18	5.6	11.1	11.1	27.8	22.2	16.7	5.6	4.22 ± 1.59
Q.27. The colors are pleasing	16	-	18.8	6.3	37.5	18.8	6.3	12.5	4.25 ± 1.57
Q.28. Prefer read online rather than download	17	5.9	5.9	5.9	11.8	23.5	11.8	35.3	5.18 ± 1.88
Q.29.Printing pages was easy	2	-	-	-	-	50.0	-	50.0	6.00 ± 1.41
Q.30. Text (labels) of links helpful	17	-	-	-	41.2	35.5	5.9	17.6	5.00 ± 1.12
Q.31.Prefer links in left-hand column of page	16	12.5	6.3	6.3	31.3	6.3	12.5	25.0	4.50 ± 2.07
Q32. Prefer links across top of page	18	11.1	11.1	5.6	22.2	16.7	16.7	16.7	4.39 ± 1.98
Q33. Prefer links on left and top of page	17	5.9	11.8	17.6	35.3	5.9	5.9	17.6	4.12 ± 1.80

* 1 to 7 scale where 1 = Strongly disagree to 7 = Strongly agree.