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ON THE DUBLIN CORE FRONT

The future of the Anglo-American cataloguing rules

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Abstract
Purpose – Discusses the goals of RDA: resource description and access.
Design/methodology/approach – Describes some potential uses of the new code.
Findings – Contends that RDA will be a powerful tool adopted by a large array of information providers.
Originality/value – Provokes thought on an internationally-important topic.
Keywords Resource description languages, Collections management, Cataloguing
Paper type Viewpoint

He has all the virtues I dislike and none of the vices I admire (Sir Winston Churchill).

Each summer, circulation staff in my library inventories a section of the stacks and brings collection issues to the attention of appropriate bibliographers. Since I am responsible for the economics collection, I see an array of government documents that have managed to elude the cataloging process. Many of these titles are decades old, having squatted in the library undisturbed and uncirculated since our online catalog was implemented in 1990. This summer’s group of cunning books included annual reports from the Comptroller of the Currency; FALK Project reports, and texts of various legislative acts. My favorite book in the group, however, is the 1949 edition of the Dictionary of Occupational Titles, published by the United States Employment Service. Not surprisingly, the first occupation I flipped to was “librarian”, which carried a definition that still pertains today (United States Employment Service, 1949):

Manages a library, supervising assistants and performing specific duties according to size of library: Selects books to be purchased by library, or approves or rejects list of books prepared by subordinates. Determines library policies and coordinates work of departments. Supervises the classification, cataloging, shelving, and circulation of books and periodicals. Works with schools or organizations, giving advice in courses of reading and references for research. Furnishes expert service in giving information from books on subjects of general or special interest to groups or individuals.

Specialty occupations cross-referenced were “Librarian, Reference”, “Medical Librarian”, and “Patients’ Librarian”. There was no heading for “Librarian, Technical Services” or even “Catalog Librarian”. “Cataloger” was listed, with the following brief definition:
Classifies books, magazines, or other library materials according to desired group headings, such as history, drama or fiction.

By comparison, the latest version of the dictionary expands this definition significantly, though it is still inadequate by today’s standards (Dictionary of Occupational Titles, 1991):

Compiles information on library materials, such as books and periodicals, and prepares catalog cards to identify materials and to integrate information into library catalog: Verifies author, title, and classification number on sample catalog card received from CLASSIFIER (library) against corresponding data on title page. Fills in additional information, such as publisher, date of publication, and edition. Examines material and notes additional information, such as bibliographies, illustrations, maps, and appendices. Copies classification number from sample card into library material for identification. Files cards into assigned sections of catalog. Tabulates number of sample cards according to quantity of material and catalog subject headings to determine amount of new cards to be ordered or reproduced. Prepares inventory card to record purchase information and location of library material. Requisitions additional cards. Records new information, such as death date of author and revised edition date, to amend cataloged cards. May supervise activities of other workers in unit.

As the definitions above illustrate, change is inherent in libraries, and not more so than in cataloging. Whether systems, standards, or tasks, the cataloging community seems to remain in a constant state of transition. It is not going to get any easier in the near future. The hot topic in cataloging circles at the recent American Library Association Annual Conference was RDA: resource description and access, the successor to AACR2. When the Joint Steering Committee for Revision of AACR (JSC) announced that the new text would veer from the original path that was to be AACR3, many catalogers were stunned. Rather than the original plan to simply evolve in a natural way to AACR3, which seemed to be accepted by the cataloging community at large, RDA takes a more progressive approach to providing relatively simple content rules that could be adopted by various metadata communities in need of such guidance.

What will RDA mean to me?
Since learning about RDA and some of the motivations behind it, I have thought about the consequences for my library staff, as well as the larger information world. I will go on record as saying I applaud the shift from AACR3 to RDA. The JSC was courageous to make such a move, especially knowing that many catalogers would think RDA’s simplification a deterioration of cataloging standards. Although this may be the case, development of a code that could be far-reaching in the international community is a bold move, and if successful, will facilitate meaningful data exchange across disparate metadata providers, not to mention place ALA and its counterpart associations in high esteem among metadata communities in desperate need of simple, useful content rules.

That said, training and system redesign will require significant budget allocations. More difficult that the financial preparation may be the emotional distress some catalog librarians will undergo while adjusting to this new code. Comments I overheard while attending ALA lead me to believe this emotional hurdle will not be small for some.
RDA in practice

Our cataloguing rules need to remain independent of any communication format. They also provide a content standard for elements of bibliographic description and access that could be used by any of the emerging metadata standards (Joint Steering Committee for Revision of AACR, 2005).

It is exciting to imagine a world where use of RDA extends to metadata projects outside of the library system. Even my small library is involved in a number of non-MARC bibliographic projects that would benefit from RDA’s guidance. The strength and ultimate long-term value of RDA, however, will not be measured by library acceptance and utilization. Instead RDA will be judged by how well it accommodates the needs of cultural institutions outside the world of libraries. Will these communities find the rules easy to understand and implement? Are the rules appropriate and sensible? Can the value of adhering to RDA be quantified and illustrated? These are the questions that will need affirmative answers in order for RDA to achieve the JSC’s bold vision.

Conclusion

Discussion about RDA will only get hotter as the JSC makes available sample chapters and an overall prospectus later this summer. It is highly unlikely RDA will take any drastic turns from its present course, but input from the cataloging community may play a role as RDA is finalized over the next two years. This is in some ways a risky step for the JSC, and one that will continue to draw attention. Much like early detractors of Dublin Core and other non-MARC metadata schemes, I suspect RDA will ultimately convert even the most staunch traditionalists.

References


Digital image library development in academic environment: designing and testing usability

Claudia Roda, Ann Murphy Borel, Eugeni Gentchev and Julie Thomas
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Abstract
Purpose – By reporting the experience gained in the development of a digital image library in the academic environment, this paper aims at providing perspective developers with insights on the main usability issues raised by this type of project.

Design/methodology/approach – The paper addresses three common needs in academia with respect to image collections: preservation, access, and reuse. In the framework of the specific project experience, it discusses how usability issues have been tackled at design time, highlights the usability problems revealed by tests on the first implemented prototype, and advances proposals on how these problems may be addressed.

Findings – Team formation and high turn-over impact usability design; collection management functionalities effect final product usability; usability and resource reuse levels are severely reduced if the services are limited to those of classic digital libraries.

Research limitations/implications – All usability issues are discussed with respect to the specific project characterized by a small, in-house development team with high turn-over; a participatory design approach; a fairly small, accessible, and heterogeneous user (and stakeholder) population; very limited financial resources but also limited time constraints.

Practical implications – A usability guide for future developers of digital image libraries in academia.

Originality/value – Addressing usability issues related specifically to the design of digital image libraries rather than text-based digital libraries. Addressing the objectives of image reuse and of widespread adoption. Discussing usability design by a team of students with heterogeneous background in academic environment.

Keywords Digital libraries, Students, Project management, Participative planning

Paper type Case study

1. Introduction
1.1 Needs and objectives
The art history department of the American University of Paris owns a significant collection of slides that professors use for teaching, in conjunction with, and as a

The project described in this paper was funded by a grant from the A.W. Mellon Foundation. It was first proposed and then supervised by the director of the Academic Resource Center, Ann Borel. Students who participated in the project include: Dharit Anjaria, Paul Cociuba, Joumana Hassan, Sarah Rozelle, Nathania Stambouli, Isabelle Ulfsdotter, Emine Sarpyener, Alessandro Anderes-Bologna, Apostol Bakalov, Linn Boré, Shayla Rocamora, Florian Ruebartsch. The supervising professors are: Professors Evgeni Gentchev, Claudia Roda, Julie Thomas, Kathleen Wilson-Chevalier.
complement to regular museum visits, and field trips. In recent years, both faculty and students have begun facing the problems of preservation, access, and reuse.

The preservation problem is one faced on many campuses today: traditional slides used to enhance the curriculum are rapidly deteriorating, along with their mounts. Frequent use and handling puts the often irreplaceable collections at high-risk. This leads institutions of all sizes to seek methods and solutions that will ensure the preservation of their valuable materials.

The access problem, due to the growth of departments, to preservation constraints, and to increasing students (or end-users) expectations, must also be urgently addressed. The very limited availability of slides to professors and students who need to view or manipulate the images for their homework or research is frustrating and inconvenient. Ideal access usually requires possibility of remote use of the resources at any time (24/7).

Reuse refers to the ability for professors and students, to re-use images in the digital collection in order to create new sub-collections corresponding to, for example, lectures or presentations. Obviously, reuse of physical slides presents the problems of time/space constraints (no two professors or students can use the slides at the same time in different places), and the management of a slide-lending library is difficult especially when handling of slides should be kept to a minimum.

1.2 Approach

In order to address these problems, the university decided to purchase a professional slide/film scanner and begin to digitize the collection, to store the digital objects in a database, and to make the images accessible through a web-based interface. The university faced the decision of either acquiring specialized software providing the above services, or developing in-house software. The latter solution was chosen for various reasons. First of all, in-house development would allow customizing the service so that it would respond exactly to the needs of the university as well as forming the basis for further developments and future integration with legacy software (such as regular library services and learning management systems). Second, the development task would provide a very interesting interdisciplinary project within which students and faculty from several departments could interact, collaborate, and experiment. Third, the cost to the university would be significantly reduced.

A participatory design approach was selected for the in-house development project.

Advocates of participatory […] design emphasize the importance of meaningful end-user participation and influence in all phases of the design process (Kuhn, 1996, p. 284).

This approach had the advantage of involving the main user group (students and faculty of the art history department) in the development of the system increasing the likelihood of high levels of adoption and good usability. The two objectives of developing usable systems, and empowering users with respect to the use of new technologies are in fact the ultimate goals of participatory design (Beyer and Holtzblatt, 1995; Ehn, 1992; Kuhn, 1996). Participatory design techniques had also the advantage of creating a natural interdisciplinary, collaborative, learning environment where domain experts (the art history users) worked together with designers (the computer science students and faculty) to build the system.
Making the slide collection available online, however, required addressing the issue of copyright management. Access to the slides, in fact, would not be restricted to classroom usage anymore and the collection would become available to a wider audience. Whilst wider availability was one of the goals of the project, control over access had to be addressed to ensure that no copyright protection would be infringed. To explore this core concern, faculty and students of the international communication department were entrusted with the task of analyzing current digital copyrights laws and practices in France and the United States (the American University of Paris operates in France but it is registered and accredited in the United States) and in the context of several types of usage with emphasis on academic usage.

1.3 Pedagogical aspects
One of the objectives of the project was to promote the acquisition of knowledge and skills in several disciplines by all members of the development team which included students and faculty in the computer science, art history, and international communication departments. The learning objectives included: developing the skills necessary to work in interdisciplinary teams; appreciating the skill necessary to participate in, and manage a large project; learn about the affordances of some of the essential hardware and software components of information systems; learn about the management of art collections; learn about the essential issues in digital assets management, including diverse laws enforced in different countries, and how they apply to different types of use.

A more detailed study of the pedagogical aspects of this project, and an explanation of how participatory system design was used for a constructivist approach to achieving the learning objectives can be found in Roda (2004).

1.4 Structure of this paper
This paper is organized in three parts. The first part discusses how usability issues have been addressed at design time, several design processes are considered, and those decisions that impact overall system usability are analyzed. The second part reports on the usability problems revealed by usability studies on the first implemented prototype of the system. The solutions currently considered in order to address these problems are also introduced. Finally, some conclusions to-date and plans for the work ahead are presented.

2. Designing usability
Usability design was based on several classic techniques. Workshops within the design team and comparative studies of relevant existing systems allowed addressing specific issues including the definition of functional requirements, data requirements, user types, etc. Field observations of the use of slides in art history classes resulted both in a better appreciation of user needs and in an increased awareness amongst stakeholders of the project. Users interviews (which included questions about the current use of physical slides and the level of confidence with technology) together with results from field observations, allowed the definition of several scenarios for task descriptions. On-paper prototypes and mock-up interactive systems were extensively used to gather fast feedback from sample users and to ensure that the development
team had a common understanding of the desired system. This section overviews the main usability issues that were raised at design time.

2.1 Usability issues with project management

When participatory design techniques are applied, project team formation may have a significant impact on the usability qualities of the resulting system. This project also required addressing the problem of project maintenance in presence of high turnover.

For project team formation it was necessary to involve representatives from several stakeholder groups. These included students, professors, IT managers, librarians, and members of the administration. All stakeholders’ representatives have been continuously kept informed of the project status through emails and a dedicated web site where all progress reports have been regularly published. All meetings were kept open to all project participants (no matter how general or specific the agenda was) and individual participation seemed to self-regulate very smoothly, with people choosing to participate in those meetings that were relevant to them. The organization of presentations open to the whole university community has been very useful (although time consuming) in order to create awareness, stimulate interest, gather new ideas, and recruit new members for the team. The experience with this project demonstrated that, in the case of a fairly small, accessible, and heterogeneous stakeholder population, these communication activities, which are often overlooked in IT projects, are vital to the design of products that match stakeholders’ expectations and to ensure fast adoption. Another issue related to team formation is that system design, and consequently user experience, may differ significantly depending on the members of the design team. The project was characterized by a small group of privileged users: the art history professors. The size of this group was neither small enough to have all members of the group in the design team, nor large enough to involve representatives from sub-groups. In this situation, i.e. when dealing with small, influential, user groups, an effective approach is to involve those users that are not part of the design team in other activities, such as field observations and interviews.

The project was characterized by a high turnover of the project team’s members; in fact, students were mostly working at the project for the duration of one or two semesters (as part of a course project, or an internship) whilst professors have remained throughout the project so far. High turnover requires a frequent “training” of new team members to ensure that they understand the project and its development, and that they integrate smoothly with the team. One obvious solution to the problem has been to create a repository of documents describing project progresses. As the project advanced, the time necessary for bringing new students up to speed increased significantly; however, new students were normally assigned more specific responsibilities than those undertaken by students in previous semesters. This greater focus had the advantage of limiting the knowledge that new students needed to acquire about the details of the project development so far. Greater focus also affected usability design. On the one hand, as one may expect, the team moved from general usability goals (e.g. simplicity, memorability, consistency, error recovery and prevention) to more specific goals (e.g. only a subset of the metadata should be displayed by default and remaining metadata is accessible on request, default metadata available should be customizable, etc.). On the other hand, more specific responsibilities – such as research on copyrights issues, or design of the interface for
database population – allowed students to analyze user tasks from different perspectives, often resulting in novel suggestions toward increased usability. Differently from most standard development projects, in the case of participatory design, under conditions of limited time constraints, a well-defined documentation procedure, and as long as a small but influential part of the team remains constant, high turn-over in the development team may be an advantage for usability rather than a disadvantage.

2.2 Usability issues with functional and data requirements

The first round of team workshops concentrated on functional and data requirements. At this time, two fundamental needs where identified:

1. the system should allow users to store in a database the digital versions of slides and the associated metadata; and

2. users should be offered services for retrieving, through search queries and browsing, the images and the metadata.

This system definition, which corresponds to the definition of a digital image library, guided all the first part of the project. As a prerequisite to these functionalities a scanning procedure had to be defined to ensure preservation of image quality.

One of the main usability issues that emerged early on in the project, and kept recurring, was the selection, and appropriate naming, of the metadata fields. Whilst the efforts that the team placed in trying to rigorously define these fields was a valuable learning experience and allowed the creation of a shared vocabulary amongst members with different disciplinary backgrounds, the most valuable input for this definition came from a study of existing classifications. In particular, the investigation of classification and metadata fields, which included reviewing several de-facto or official standards (DCMI, 2004; Getty, 2004; Library of Congress, 2004; National Information Standard Organization, 2004), was instrumental in the final decision to chose Dublin Core, and for art history, a subset of the approved Getty vocabularies for art and architecture (Getty, 2004). The selection of this subset was completed by a group of art history and computer science students. The recording of this activity consisted in the definition of the types and names of the metadata database entries; however, at the time, a human-readable list of these fields and their descriptions was not generated. This lack of informal record, later caused usability problems for the users of the interface who often misinterpreted the meaning of some of the metadata fields. The lesson learned from this experience is that in the case of complex or quantitatively large problems (such as the definition of the metadata fields) adapting existing research, standards, or tools is a much more efficient way of tackling the problem. It requires, however, a very disciplined approach ensuring the recording of the specific interpretations and choices made by the team at the time of analysis and/or at the time of selection of the pre-existing work.

A second usability issue, that was identified and resolved only after the first prototype implementation, was an undetected mismatch between the mental model of a small group of team members (including, amongst others, all of the computer scientists) and the rest of the team. This mismatch reveals the importance of metaphorical system representations, and it is a very good demonstration that reaching an agreement on functional requirements does not necessarily imply having a
common understanding of the system as a whole. Figure 1 shows the mismatching mental models of the two groups. Figures 1(A) shows the mental model of the first group who saw the system as a two entrances library, with a back entrance for book delivery and shelving (corresponding to the entering of images in the database), and a front entrance for client to access books (retrieving images), but also for a multitude of other services that had not been formally addressed at the time of the first prototype implementation. Figure 1(B) shows the conceptual model that the other team members had. In this case, although the library metaphor still holds, only one access point was imagined, it was also assumed that the minimal set of functional requirements defined at the time of the first prototype implementation would have somehow supported functions not formalized yet (see discussion in the section on reuse). Given that all of the computer scientists shared the model 1A, the system design and implementation followed such a conceptual model which was, however, both non-explicit, and unknowingly by the team members, non-shared. When the decision was made to develop the first coded prototype by implementing the first functional requirement (i.e. entering the digital versions of slides and the associated metadata) people with mental model 1B expected that the second requirement (image retrieval) would have been automatically satisfied. This was true to a certain extent (because some minimal search facilities are necessary to support the input process) but users of the back-end system were often disappointed by the minimal access capabilities of the prototype. The lesson learned in this case is that agreed upon functional specifications must be accompanied by the assessment of user’s mental models and a conceptual model, including metaphorical definitions, must also be agreed upon if participatory design is to lead to user satisfaction, improved user experience, and ultimately good usability.

2.3 Usability issues with user types
Users were categorized as belonging to one of the following four types:

(1) university professors (art history professors in particular) whose main objectives would include storing and retrieving images to create course material, presentations, and sub-collections that would fit their research purposes;

(2) personnel (normally teacher assistants) who would enter the images and metadata in the database on behalf of professors;

(3) the university students (art history students in particular) who would need to retrieve individual images and course materials, and may want to create personal views of the collection; and

(4) external (not part of the university community) users who would be allowed access to the library.

Figure 1. Digital library mental models
Whilst all of the above users could be experts or novices to the system, the essential
difference in terms of usability design was related to the access rights that these
types of users would have. Such access rights had to be regulated in compliance with current
copyright laws. For this reason several parallel research projects on copyright law
were launched. These included the study of the Fair Use policy as specified in the US
Copyright Act 1976 section 107, and the TEACH act from sections 110(1) and 110(2) of
the Copyright Act[1]. From these studies the need for the system to identify whether a
user is currently enrolled in a course became obvious. In this case, due to the TEACH
Act, he/she would have access to all the images used within that course no matter what
their level of copyright protection. One important aspect of access rights is user
awareness: users who do not have the right to access an image must be informed of its
existence in the database along with the user’s limited access rights. This is necessary
especially in the case of changing rights (due, for example, to the end of a course or a
course session) so as to avoid leaving users wondering why they can no longer find an
image they had accessed some time earlier.

2.4 Comparative studies
The comparative analysis of existing digital image libraries includes the following:
Library (2004) and Virginia Tech (2004). From this analysis the members of the
development team derived a set of usability recommendations which included the
following:

- Image thumbnails are very useful for quick reference and they should be well
  organized into tables with a one or two word metadata caption.
- A help section should be included with search instructions and contact
  information for a person who could answer questions. Perhaps include an FAQ
  once the site has been up long enough.
- Make sure the images are reduced to as small a size as possible for online
  viewing (separate access to higher resolution versions for enlargements and
  printing). Database sites that are too long to load are practically pointless to use.
- Include a search function on the home page and in a navigation bar on
  subsequent pages.
- Include a home button on each page and menus available from every page to
  avoid using the browser back button.
- Avoid too much scrolling: users should be able to input or retrieve metadata
  fields without scrolling many pages.

3. Testing usability
Usability testing started as soon as the first implemented prototype was completed. As
discussed earlier, the first prototype implemented the back-end functionalities (i.e. the
data-entry part of the system). Many of the same techniques used to address usability
in the design phase (workshops, comparative studies, field observations, user
interviews, on-paper prototypes, and mock-up interactive systems) were also used in
the testing phase. At this point, however, it was possible to have better feedback from
users who could also use the implemented prototype. Sessions observing the use of the
prototype (by new and experienced users) were organized and users’ feedback was
elicited through formal and informal interviews. The use of questionnaires, which was also attempted, did not result in significant input because of the small size of the user group for the back-end interface (about ten people).

Interestingly, because of the mismatching mental models described above, usability testing of the back-end implemented prototype not only revealed this mismatch, but it also provided a much better understanding of users’ expectations with respect to the front-end interface. One flow with on-paper or mock-up prototypes, experienced in this project, was that users had difficulty distinguishing what parts of the system were not part of the prototype because they could not be represented (e.g. users do not see real search results because no database is implemented), and what parts of the system were not there because the designer did not plan to include them in the final product.

The usability study highlighted three major issues with the first prototype. First, not enough collection management functions were supplied to ensure the correct input of data and metadata. Second, customization of metadata fields’ relevance appeared as a fundamental usability requirement rather than a “nice to have” feature as originally estimated. Third, image reuse required a much better support than just accessibility.

The following subsections analyze each one of these usability problems and the envisioned solutions.

3.1 Collection management
The usability study highlighted that efficient collection management should satisfy at least two main requirements. First, from an administrative point of view, it should ensure that the university’s property is preserved. Second, given the dynamic nature of the database (images are added, metadata is added and updated) and the heterogeneity of the contributors, it is important to be able to control the reliability and timeliness of the information.

3.1.1 Preservation and image identity. Since the beginning of the project, procedures for scanning the images were defined ensuring that copies were kept both in formats for safe storage and printing, and for video display. The usability study revealed that this preservation effort was not sufficient. Original slides, in fact, were not catalogued as one collection: some of the slides were catalogued as part of the university collection; most of them, however, being the property of individual professors, had no associated identifier. This implied that users could not easily associate physical slides with their digital representation, nor could the system have simple identifiers (e.g. the physical slide’s catalogue number) ensuring that the database contained no identical duplicates.

The issue of image identification is, however, a common problem of digital image libraries. The solution employed by many digital image libraries is to use an arbitrary identifier which often follows a specific syntax, e.g. GIF1234 may identify a gif image, JPG1234 may identify a jpeg image, etc. (University of Virginia Library, 2004). Whilst some textual resources can easily be compared for equality, and they can often be uniquely identified by fields such as author, title, and date (if not simply through an ISBN), images, such as the ones in the project collection, do not have this property. For example, there are no simple and easily available data that constitute a non-arbitrary unique identifier for two slides representing the same painting viewed from more or less the same position, in similar light conditions, etc. In order to constitute a non-arbitrary unique identifier, one would need at least the sum of the unique identifier of the painting (e.g. title: “La Gioconda”, author: “Leonardo”, museum:
“Louvre”) plus the unique identifier of the slide (e.g. author: “Professor Corel”, date: “3/6/2000”, time: “15 h 38 min 23 s”). This latter information is frequently not available. In fact, what was originally considered to be a reasonable set of key fields for images identification (title, type, and date of creation) appeared to be an inappropriate choice once the usability tests were started. Figures 2 and 3 show the first two screens of the back-end prototype.

The users scanning and uploading slides complained that they were forced to enter information they did not have at hand, for example, the title of a particular art piece. Whilst the developers argued that there was not much value in the whole project if slides could not be searched for, the effective situation was that only a limited amount of information was available. This lack of knowledge about metadata was sometimes simply due to the fact that a student rather than the image owner was inputting the data. In other cases the information was not available or arbitrary (e.g. what is the title of an image representing the third person from the top left in the second column of a given colonnade?). The solution proposed for the former case of data unavailability is described in the next section on the “control of the input process”. For the data unavailability problem, in the latter case a modification of the interface has been planned so that all input fields can be easily skipped. This solution will also require implementing a flag for images that have been entered without specifying any of a sub-set of metadata fields that constitute a minimal image identifier (this will allow some control over extreme cases in which, for example, only an image file has been entered but no metadata field). This flag will be used in the input control process described in the next section. Perhaps the most problematic usability issue caused by

![Figure 2. The first screen of the back-end interface (image file upload)](image-url)
difficulties with slide identification was that images were often entered several times with slightly different metadata fields. Whilst a partial solution to the problem is a better control of the input process as described in the next section, the possibility of employing existing software (Bolide Software Inc., 2005; NoClone, 2005) to verify the existence of duplicate images in the database is being considered. Amongst other parameters, software compatibility, time requirements, and costs will be evaluated to assess the viability of this solution.

One more usability problem, related to the fact that the system had no function allowing users to associate digital images with their physical counterpart (the original slide), was that the frequent requirement to contact the slide owner, or to understand the context in which the slide was produced, could not be satisfied. In order to satisfy this need meta-metadata fields are required which would include information about the slide owner, how the slide was acquired (for example, was it taken by the owner or bought), the date of acquisition, whether the owner was willing to supply further information, etc. Part of this information is also obviously related to copyright issues and the original solution where copyright control was encoded in a system of access control was not sufficient. Users interviews revealed that they would often need to have explicit information allowing them to decide whether certain uses of the images would be legal, or simply correct. Consider, for example, the case of a slide owned and produced by a professor A that shows a panorama and has no access restriction in the database. If a professor B decides to use that image as the cover of her forthcoming book, she needs to contact professor A, if not to avoid breaking the law, at least out of politeness.
Summarizing, the above usability issues may be addressed by implementing all of the following:

- an arbitrary image identifier;
- allowing users to skip all fields in the input phase;
- defining a set of minimal image identifiers and a flag system for images not identified;
- introducing a catalogue system for physical images to take place at the same time as scanning;
- including the metadata fields necessary for the description of the physical image (catalogue number, owner, date of creation, acquisition mode, etc.); and
- integrating existing software for the recognition of exact duplicates of images.

3.1.2 Control of input process. The slides’ input process includes: scanning slides following agreed procedures, and entering images and metadata fields. Data entering is normally performed by teacher assistants. As discussed above, the usability study revealed that this process was much more error prone than expected. Interviews with users highlighted the necessity of a set of services currently under consideration for implementation in the second prototype.

First of all, developers had chosen to use look-up tables for data entry of certain fields such as author and location. The rationale for this choice was to keep data consistent, avoid spelling errors and thus facilitate the search process. In the first prototype implementation of the back-end interface, however, users confronted the inconvenience of having to interrupt the data-entry process in case data were missing in the appropriate look-up table. For example, in the screen shot of Figure 4, if the image author does not appear in the field showing the available persons (toward the top left of the screen, only containing Theo and Vincent Van Gogh’s names), users would have to interrupt data entry, click on the new person tab, enter the new author using the screen shown in Figure 5, and then resume the entering process. In practice, users are expected to first fill in the look-up tables and then to start entering the metadata for a new slide. This is obviously not an intuitive approach and it also raises the problem that users normally would not know whether the data is available in the table or not. The solution under consideration for this problem is similar to the one examined for the slide identity problem: allowing users to enter just a minimal set of data for look-up tables (e.g. just an author name, or a location name). This would make it possible for users to enter the data directly in the screen of Figure 4 with no context switching. It would, however, raise the need for a flagging system similar to the one described above for general slide entry.

Second it seems necessary to institute a system of confirmation for the data entered. For example, by marking as unconfirmed all data entered until a data confirmation action is taken by an editor. Editors are users with special authorization to perform confirmation actions (these would normally be professors). Users of the front-end interface would still be able to see unconfirmed data but they would be aware that they might contain errors. One of the issues under discussion is whether it would be possible to add a suggested-editor field for each image identifying the professor who is most likely to be able to confirm the data for the image. This would allow the system to create a “waiting list” for each editor who would, in this manner, be able to quickly
Figure 4. The user can select or skip screens for metadata entry.

Figure 5. New person entering screen.

Digital image library development
scroll through the images and data waiting for his/her confirmation. This confirmation process would also partially solve the problem (mentioned in the section above) of missing metadata fields unknown to the user who had input the data. The editor in fact would be able to enter the missing data at confirmation time. In the case of flagged images (images with insufficient metadata fields) the editor could decide either to enter the missing data or to remove the image. An editor could not confirm flagged images without supplying a minimal set of identification data.

Third, users who performed the input processes often mentioned that it would have been helpful to be able to discuss input procedures with other users performing the same task. A recurrent issue, for example, was the use that others had made of the date field. As shown in Figures 3 and 5, dates can be entered in an exact or approximate manner. Often users would have liked to consult each other on the way this field was used in the case of approximate dates. The introduction of both synchronous and asynchronous communication systems for users of the back-end interface may facilitate the task of back-end users.

Fourth, users often expressed the need to retrieve a trace of the input work done by themselves or others (e.g. what is the last slide they had entered? Or, how many slides had been entered by their colleagues?). In order to respond to this need, and also to facilitate debugging, the development team is considering designing a detailed log-book for the system with several levels of accessibility, in order to make visible, for example, a list of the last slides entered but also a detailed description of the fields entered for a given slide, or how the input process took place (e.g. did the user go back to the same screen several times?)

The confirmation procedure, together with the log-book, and easier communication amongst users of the back-end interface, should help minimize the problem of duplicate slides. Also, it is foreseen that the results of the duplicate finding procedure mentioned earlier will be reported to editors who will decide whether a slide should be deleted or not. With respect to slide deletion and editing (by a non-editor back-end interface user), the same confirmation procedure should be in place; however, special cases could be recognized by the system as not needing a confirmation procedure (e.g. a wrong image file has been selected by mistake in the very first phase of the input process and it needs to be deleted, a minor spelling mistake has been corrected in the “additional information” metadata field). The confirmation procedure by editors is obviously a bottleneck for the system and it heavily depends on the willingness of a small group of influential users to take the time to verify and confirm the content of the database.

Finally, no matter how good the user interface is, the data-entry process will remain tedious and time consuming. End-users are generally happy to be able to search for a piece of art, to browse the collection, to create their own collections, but let someone else fill the database. Thus automatic collection of metadata from different sources like the web, publicly available collections, or paid archiving services is currently being considered. Obviously, the metadata will not match exactly the university’s collection; having a set of predefined authors, locations, and image types, however, would significantly reduce error rates and the time required for metadata input.

3.2 Customised access to metadata fields
The usability study demonstrated that effective access to metadata fields, both when entering information (back-end) or retrieving it (front-end), is key for a digital image
repository where the very large number of metadata fields may make scrolling through each one of them very frustrating. For the back-end interface, for example, the initial solution was to force the users to start with the first data-entry screen and to move consecutively to the last one, even in cases where there was no data available. The current version allows users to select or skip the screens as appropriate (Figure 4). The current solution, however, is still not completely satisfactory. Individual users, in fact, tend to access the same metadata fields and it would be preferable to have the system make this access easier rather than having users repeatedly select the same set of fields. As the usability study proceeded, it became clear that this type of customization was necessary not only in the case of image use for different disciplinary studies, but also for use within the same discipline to support users’ specific objectives. As a consequence, two types of access customizations are currently being considered. They are both based on assigning a relevance factor to sets of metadata fields (e.g. the set of fields defining an author, or a location, or a date). The first type of customization is an attempt to define relevance by discipline, for example, location and date may be more relevant for image searches done by students in political studies, whilst author and type may be more relevant for art history students. The second type of customization is based on a user model (which may in an initial state take into account the discipline(s) of interest of the user) that keeps track of the fields accessed by the user and allows the system to recognize as most relevant the fields most often accessed. Allowing users to access and modify their user models would also enable them to explicitly indicate which fields are most relevant at any given time, consequently customizing every subsequent input screen sequence, or search result screen.

A further customization issue relates to fields naming. Although currently the project addresses only art history related fields, field naming was carefully discussed, and a standard fields set was used, users still had problems in understanding the meaning of certain fields’ names. To address this problem, the next version of the prototype will include the possibility of visualizing an explanation for each field’s name; however, this may not be sufficient in the case of use within different disciplines. It is foreseen that the extension of the prototype for extensive use in disciplines other than art history will require the introduction of an ontology system to ensure that relationships amongst concepts with different names are recognized.

3.3 Reuse
Reuse refers to the ability for professors and students to use images to create new sub-collections corresponding to, for example, lectures, or presentations. In the first analysis it was tacitly assumed that reuse would have been a sort of derivative of access. Basically it was assumed that once users had found the images they needed they would naturally organize them, using some other software (e.g. presentation software, learning management systems), in sub-collections. Although this was a very reasonable working assumption because it limited the initial project complexity, it did not correspond to the user’s mental model of the system. The mental model most users shared, sketched in Figure 1(B), was that a set of services enabled by access would actually be provided by the system. For example, users expected to be able to access not only simple slides but also slide collections corresponding, for example, to class presentations; they also expected to be able to recreate class presentations (which normally are run using two slide projectors, one next to the other) directly via the
system. These expectations revealed by the usability study are in line with the findings of other researchers. Sumner and Dawe (2001, p. 416), for example, state that:

In order for reuse to be successful, a usability line cannot be drawn at the library boundary, but instead must encompass both the library system and the educational resources themselves.

Basing their study on research on software reuse they state that “reuse involves three closely intertwined cognitive activities: location, comprehension and modification” (Sumner and Dawe, 2001, p. 417). Users must be able to find resources that respond to their needs, they must be able to understand whether the resource is relevant, in which context it has been and can be used, how it is structured, etc. And finally they must be able to modify the resource, which in the case of the project considered here, may mean adding or changing some of the metadata fields, and integrating the resource in a personal sub-collection. The focus then shifts from individual images to collections of images that, in a sense, provide the context for each individual image. Figure 6 shows a screen of a mock-up prototype for this new vision of the system. Each square in the figure represents a collection. Users can search collections (by, for example, creator or subject), edit them, create new collections by adding images from the database, or view collections (this is done by clicking on the box representing the collection).

Because collections are often seen as corresponding to a (class) presentation, the available modes for collection display constitute an important usability factor. Since users were comfortable with the current system of double (or multiple) projectors, the new mock-up prototype implements a system that mimics that structure. Figure 7 shows a screen for collection display. Users can drag and drop slides from the collection (thumbnails on the bottom of the screen) into the main view window(s) in the center of the screen. The number of slides displayed on the screen can be dynamically

Figure 6.
Shift from individual images to image collections
selected (see top of the screen). The main menu can be hidden to provide better screen view, for example, for in-class display. Clicking on an image will open a separate window giving access to the image metadata. Currently, art history professors prepare for classes by loading the slides they will need in the projector(s) loader(s). This sequence creating activity is not reflected well in the interface proposed in Figure 7. Such interface may be better suited for a more unguided discussion where slides are selected as the discussion shapes. In order to allow users to prepare sequences of slides similar to those generated by loading slides in the projector, a second version (Figure 8) of the viewing screen is also being evaluated.

Apart from showing a view with four slides per screen, which could have been achieved also with the display of Figure 7, the new version shown by Figure 8 is characterized by the fact that view sequences (organized over one, two, three, or four windows) can be defined and associated with a collection. View sequences are created by dragging and dropping slides from the collection (thumbnails on the bottom of the screen) into the sequences associated with each window (thumbnails arranged vertically next to each view window).

Observing the current use of slides in art history classes not only revealed the importance of image sequencing but it also highlighted the intensive use of slide comparison. Images are continuously related to one another to discuss similarities or differences in styles, use of techniques, and also because of more factual relations. For example, one image may be “part of” another one (e.g. the image of a church and a close up view of its portal), or it may be “next to” another one (e.g. a set of images portraying each person in a painting of the Last Supper), or it may be an “other view of” of the
same subject (e.g. two images showing the front and the side of the same statue). All these types of relations, whether they are factual or not, if added to the database, would greatly increase its value. It is currently being studied how such image relations could be dynamically integrated in the database. Other issues related to link creation include: how to manage the selection of images for linking purposes, how to treat bidirectional links, how to make sure that a confirmation process takes place if necessary, and how to allow users to create both public and private relational links amongst slides. Figure 9 shows the initial screen for adding links in the mock-up interface.

As stated above, the primary objective was to preserve the art history slide collection; therefore, an art history image archive was the immediate goal of the project. For this archive to make pedagogical sense to the user, however, images must be treated as only one level or type of informational data, with text supplying further levels of data, linking to multiple images, and complementing and completing the original image accessed. Thus in one sense describing the library as a digital image library is misleading, as textual data must be integrated from the beginning. In the future, when other media (the moving images of film or video, for example) are also made available to the user, this early awareness of the necessity to link image and text as equal partners in the archive and practical experience of such symbiotic linking can serve as model.

Overall, supporting reuse has required an augmented digital library that also provides some of the services of a management system for images seen as learning objects. The original main system functionalities (storage and access) must be, for
example, integrated by functionalities supporting the organization of class/personal collections, and the definition of relationships between images.

4. Future work
Participants began to formulate possible future avenues of development for the project, and to consider what alternatives and provisions might be built into the system to accommodate these developments. First, the repository would be expanded in future to include disciplines other than art history, such as cultural studies, history, international communications, film studies. This would involve further input of metadata, making such metadata available on a selection basis, and the addition of archives of other forms of media than simply still images (video, film, sound, etc. as well as text). Further, usability studies would be needed to make access to such data clear, easy, and efficient; the possibility of integrating several media in future implies that consideration is given from the beginning not simply to supplying easy access to varied media archives for interdisciplinary study, nor even to linking relevant archives clearly, but also to displaying the underlying logic of such links to users from different disciplines with multiple goals (the possible use of ontologies to such an end has been mentioned above). For example, an early photograph archive might be variously and simultaneously linked to art history images and text which demonstrate the impact of photography on painting; clips from early cinema with text discussing the importance and manipulation of light in the creation of an image; a documentary video on early forms of photography; extracts from Benjamin and others on visual consumption, the gaze, and the seeds of contemporary visual culture; essays on the rise of the use of

Figure 9.
Adding relational links between slides
photography in war journalism, advertising, and as propaganda; etc. Such links are often consciously created for specific course sites, but in a digital archive such links should integrate several media unselfconsciously and clearly so that the user may tailor exploration of the archive’s metadata to his/her own research and disciplinary demands.

Secondly, issues concerning the future sharing of this digital archive must be considered in more depth in the future and further user research would be demanded. As it is, the user-centered design of a digital archive for The American University of Paris is good preparation for future sharing because of the international and multi-cultural nature of this small university community – but a larger international user community would necessitate further usability study, as Butterworth (2005) has pointed out.

Whatever form this digital resource takes in future, these aspects are certainly to be hoped for: it will never be “final”, it will continue to be the valuable learning experience to users/designers that it has already proved to be in its early interdisciplinary development, and it will reinforce the university’s sense of “learning community”.

5. Conclusions
By describing the experience in the development of a system enabled to preserve and ensure access to a university’s slide collection, the following usability issues, raised in various phases of the project, have been discussed. Choices made at the project management level may impact usability quality by enabling stakeholders’ involvement, and integration of new team members. Functional and data specifications may result in mismatching mental and conceptual models if metaphorical representations are not considered, and the documentation of such specifications may influence the ability to design a usable system. Copyrights regulations are an important factor in the definition of user types and making these regulations intelligible to users increases usability. Finally, in order to meet users expectations, services cannot be limited to those usually offered by digital libraries, but such services must be augmented with a set of functionalities supporting collection management and resources reuse.

When the project began in 2004 with art history, computer science, and international communications students participating, the fact that builders and users were operating within the context of the small community of AUP was identified by all as a major advantage. Group meetings and exchange of information between the participants made it easier to establish preliminary prerequisites and focus on core questions of usability. Knowledge about software, and knowledge about the domain of application, were significantly exercised. Students of all three disciplines were involved in decisions as to metadata, they learned discipline specific vocabularies, and they were made aware that complex copyright issues were a crucial element of end usability. Negotiation of solutions for problems of access which took into account both user ease and convenience (for example, the need for students to access the image database off-campus, modes of allowing restricted access, etc.) and problems of copyright were major issues addressed. Another problem encountered was the need for clarity and simplicity of presentation of information accompanying the images while maintaining a certain complexity of detail and the possibility of access to further background information in the form of text as well as linked images. All students,
therefore, were of necessity required to participate in decisions as to content, presentation, and design in order to complete their own portion of the project successfully.

Students themselves commented that, apart from their own individual research and learning experiences, they felt the opportunity to understand the demands of different disciplines and how to cooperate across disciplines were the most invaluable lessons of the project.

Notes
1. The study of European copyright laws, which seem to be more restrictive in the case of academic use than the US laws, is currently being pursued.
2. By non-arbitrary is meant that there exists some semantic relationship between the identifier and the object being identified. An identifier formed by title + author + date, for example, is non-arbitrary, a serial number is arbitrary.

References


Sustainable design for multiple audiences

The usability study and iterative redesign of the Documenting the American South digital library

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Abstract

Purpose – To demonstrate the value in conducting a usability study and following an iterative design process to create a more user-centered and sustainable digital library.

Design/methodology/approach – After identifying three key user groups, a series of usability tests and focus groups were conducted to assess how users interact with the site’s interface. An iterative design process followed involving the development and testing of prototypes by representative users and stakeholders.

Findings – Users’ interaction with a digital library is task-oriented and context dependent. Serving the needs of multiple audiences is an iterative process and requires an ongoing dialog with users.

Research limitations/implications – Like most usability studies, the results are not generalizable.

Practical implications – It offers an example of how an informal usability study and iterative design process can be conducted to create a more user-centered digital library.

Originality/value – This paper provides new insights into the information needs and behaviors of users of cultural heritage digital libraries and builds on the literature on usability and iterative design.

Keywords Digital libraries, Culture, Heritage, United States of America

Paper type Case study

Introduction

As digital libraries mature, librarians are beginning to understand the importance of listening to our users and creating sites that are simple to use and engaging to explore. “As librarians, we know that the complexity behind providing digital services is significant. What we have yet to learn, however, is that we cannot continue to pass this complexity on to the user” (Frumkin, 2004, p. 55). While the importance of user-centered design is well-known (Mao et al., 2005), applying the principles and implementing such a design presumes some knowledge of who the audience is and what their information needs are. Yet as Lynch (2002) points out and the experience of
the authors confirms, librarians are often lousy at predicting who the audience is or will be. Therefore, the first step in the process of creating a user-centered digital library is not only to identify your audience and assess their information needs, but also to understand the iterative nature of design and view it as a continual process rather than an end product.

The idea of sustainability in web design is particularly important for digital collections of cultural heritage information. In this context, sustainability refers to more than the economic viability of a project or even measures taken for digital preservation. According to Lynch (2002), it requires “interpretation, annotation, and reuse”. Documenting the American South (DocSouth) digital library (http://docsouth.unc.edu/) includes large collections of slave narratives, public documents, letters, and images that taken out of the context – the time and place from which they originate – can be misinterpreted. Currently, each of the collections in DocSouth is heavily annotated by scholars who provide much of the necessary historical context. To sustain these collections over time, however, the design of the digital library must support future interpretation and interaction with users. This paper describes the redesign of the DocSouth digital library of the University of North Carolina at Chapel Hill based on the results of a usability study conducted and the iterative design process that followed, and continues with each collection added.

**Background of research collection**

DocSouth is a digital library sponsored by the University Library of the University of North Carolina at Chapel Hill. The site provides access to digitized primary materials to bring Southern history, literature, and culture online. These collections of literary texts, letters, diaries, photographs, oral history interviews, and artifacts were originally intended to serve researchers of the American South. Over time, user comments confirmed that these digital resources were being accessed and used by an international audience of educators, genealogists, amateur historians, and other lifelong learners. The digital library began with an effort to digitize half a dozen highly-circulated slave narratives from the general collections of the University of North Carolina at Chapel Hill Library, with the results of this initiative launched in January 1996 as part of the University’s bicentennial celebration. Through the support of the National Endowment for the Humanities, the Institute of Museum and Library Services, the Library of Congress/Ameritech National Digital Library Competition, the State Library of North Carolina, and private foundations, DocSouth has grown into an ongoing mature electronic publishing initiative. It made available more than a thousand texts (over 175,000 pages) of primary source materials, hundreds of pages of supporting and interpretive materials, thousands of images, posters, oral history interviews, songs, and artifacts on a variety of different subjects. All digitized materials offer unique perspectives on the past and how people lived in the southeast United States.

The texts, images, and other materials come primarily from the Southern collections in the libraries at the University of North Carolina at Chapel Hill – the southern historical collection, one of the largest collections of southern manuscripts in the country; the North Carolina Collection, the most complete-printed documentation of a single state; the Rare Book Collection, which holds an extensive southern pamphlet collection; and Davis Library, which offers holdings of printed materials on the southeast.
Research problem
As work on DocSouth continued after its launch in 1996, emphasis was placed on creating content of the highest scholarly level. By all accounts, its creators had succeeded in building an impressive set of digital library collections. As the collections grew, however, the internal database and the external web interface began to show their age and did not reflect considerable changes in applied technology and current practices as well as the general site evolution.

Originally intended for researchers, the reach of the digital library had expanded to encompass an international audience of educators, genealogists, amateur historians, and other lifelong learners. Staff acknowledged the need to evaluate how well the site’s interface was working for its increasingly diverse audience. Finally, in 2002, an effort to review the site’s usability and overall design was undertaken by the Library staff. This endeavor coincided with a global restructuring of the main DocSouth MySQL database, the backend of the site. The database was redesigned to address the requirements of converting legacy data from SGML to XML and to enhance the site’s ability to handle new formats.

In general, research questions for all users were:

RQ1. How do users interact with the DocSouth interface and how would they like to?

RQ2. What search methods do they use to find primary source materials?

RQ3. What design features are needed to make the digital collections more accessible and useful to them?

Usability tests
In an effort to better understand participants’ interaction with the DocSouth digital library interface, a series of usability tests were conducted to assess the site’s interface design. The purpose of the usability study was to collect verbal feedback and performance data from participants representing DocSouth’s multiple audiences. The authors were interested in discovering how participants interacted with the website, including how easy it was to browse, how easy it was to search for specific information, and what features could be added to enhance the participants’ experience using the site. In addition to the site’s functionality, the authors were also interested in assessing the site’s visual aesthetic. The latter is often neglected or left out of traditional usability tests, yet visual aesthetics can have an impact on how information on the site is communicated and how the site is perceived (Hoffman and Krauss, 2004).

Test participants
Based on an earlier analysis of readers’ comments (Hewitt, 2002), three key audiences were identified for inclusion in the study: university students and researchers, K-12 educators, and members of the general public. Participants were recruited through invitations posted on student and faculty e-mail lists, sent to area schools, and through flyers distributed around campus, in area public libraries, and local historical and genealogical societies, and associations. All participants were asked to sign the appropriate consent form and were instructed on the voluntary nature of their participation and their right to privacy and to leave the study at any time.
The academic user base included six graduate students from the University of North Carolina at Chapel Hill – three were in masters’ degree programs and three were working on PhDs. They represented the fields of history, literature, and information and library science. There was an even split between those who had used the site and were familiar with it, and those who had never used DocSouth prior to the test. Three teachers from area middle and high schools represented K-12 educators, while two members of the surrounding communities of Durham and Chapel Hill, a social worker and a retired librarian and amateur genealogist, represented the general public. The number of participants tested was relatively small, however, the authors know from the literature that only a small sample size is needed to identify most of the problems with a site (Nielsen, 2000; Virzi, 1992; Lewis, 1994).

**Test procedures**
Prior to the administration of the tests, the authors ran a trial with volunteers from the staff to determine an average length of time needed to complete the tasks and interview questions. The tests were conducted at the Interaction Design Lab of the UNC School of Information and Library Science. The lab consisted of two rooms, a testing room with a personal computer, cameras and a microphone, and an observation room, separated with a two-way mirror. As study participants arrived, the authors introduced themselves and explained the protocols for the test. One person administered the test, while one observed, and the third monitored the recording devices.

**Usability tests**
The usability tests varied slightly depending on the audience group. The tests given to the academics and representatives of the general public were task-centered and primarily designed to assess the navigation and searchability of the DocSouth site. A similar series of tasks were administered to a commercial digital library for the purpose of comparison. Chosen for its similarities in content, scope, and audience to those of DocSouth, the commercial site also included a number of search features that the authors thought users might find useful when attempting to explore primary sources materials.

The test given to K-12 teachers included a series of scenario-based questions. Teachers received a hypothetical class and topic to teach, and were asked to find appropriate digital content using both the DocSouth site as well as other digital libraries, with extensive sections devoted to supporting teachers with lesson plans and activities[1]. All tests used “think aloud” protocols encouraging participants to express their thoughts as they completed the tasks. Having the participants verbalize their thoughts as they worked through the tasks, helped the authors to understand what they expected to find when they clicked on a link, as well as any specific problems they encountered during their interactions with the website’s interface (Benbunan-Fich, 2001).

At the completion of the tests, all participants were asked a series of follow-up interview questions. The questions were intended to gather further information on their general satisfaction with the DocSouth site, its contents, organization, and visual aesthetic appeal. The questions were open-ended to give participants the opportunity to elaborate on their opinions of the site or offer suggestions on how it could be improved (Appendix 1).
Results and analysis
The usability tests were designed to assess the site’s interface design (i.e. page organization and layout, placement and language of titles/headings and links, use of color, font and graphics, etc.), searching (indexing, search, and retrieval), browsing (scanning), and visual aesthetic appeal.

Among the interface design problems found on the site’s homepage:

- the side and bottom navigation links were difficult to see;
- the browse tools, including the search box, author, subject, and title indexes, were difficult to find;
- there was not enough color contrast between the sidebar (navy blue) and visited links (purple);
- participants found the labels on the collections unclear and uninformative; and
- the location of the link for user feedback was difficult to find, and the feedback itself should be a form instead of an e-mail address (Figure 1).
Other usability concerns that affected the site as a whole included:

- the amount of text on the document page prohibited easy scanning;
- more graphics were needed to help illustrate the content; and
- several links used library-related jargon, such as “index” and “bibliography” in contexts that participants did not understand.

On keyword searching, the DocSouth site performed quite well from the participants’ perspective, especially in comparison to the commercial digital library that was tested. The explanation for this assessment by users was unquestionably due to the fact that the DocSouth site uses a Google powered search, in addition to its author, title, and subject index. The Google search was preferable to the more sophisticated indexing of the commercial site used for comparison. It is worth noting that even when specifically asked to find an author or a title, participants preferred to use keyword searches using the Google search box, rather than the relevant indexes also available and displayed prominently on the site. Participants noted the desire for an advanced search option to be able to narrow their search to a specific collection or to search by geography, race, gender, and document genre and format.

Most participants found the DocSouth site easy to browse and noted how the linked subject headings facilitated navigation through the collections[2]. Nevertheless, the language used for some of the links was sometimes difficult for participants to interpret accurately, the amount of text on many of the pages made scanning difficult, and participants were frequently confused by the metadata located at the beginning of the text documents[3].

Participants found the overall appearance of the DocSouth site to be dated and unattractive; the colors were reported to be dull and lacking in eye-catching graphics. Some suggested the site looked “unprofessional”. These findings seem to support the correlation between a site’s aesthetic appeal and its usability or functionality (Tractinsky et al., 2000). While visual aesthetics cannot be isolated as a single factor in assessing a site’s quality (Krauss, 2004; Hoffman and Krauss, 2004), they are inextricably tied to how information is communicated and to the users’ overall experience using the site (Tractinsky, 1997; Krauss, 2004).

The results of the tests administered to the K-12 teachers were particularly enlightening, and helped the authors realize how little they understood this important user base. While there was general agreement that lesson plans and activities were useful, they were overwhelmingly resistant to indexes of lessons broken down by grade level. Each preferred to search an entire site for their specific topic, rather than drill down the list of age or grade appropriate subjects provided in an area clearly marked “for teachers”. When pressed as to why they preferred to search through all lesson plans and other materials, one teacher stated “no one knows my kids better than I do … my sixth graders do eighth grade work”. Another indicated that they were capable of adapting a lesson plan or activity for their class regardless of the initially intended audience. These findings support those of an earlier study by Small et al. (1998). Earlier studies also found many teachers to be novice internet searchers (Fitzgerald et al., 2003; Carlson and Reidy, 2004), however, the authors’ experience suggested that they were becoming increasingly sophisticated in their ability to locate materials on the web. The tests and follow-up interview did, however, confirm what other studies had found (Sumner et al., 2003), which was that their time was limited and
finding quality materials from a credible source was critical. They also indicated that in order to be useful in the classroom, the lesson plans using primary source materials had to be directly tied to the North Carolina Standard Course of Study[4].

Focus groups
Following the usability testing phase of the study, a series of focus groups were conducted. The focus group protocols were designed to delve further into the needs and wants of our users. The guiding question in all of the focus groups was “how do you find the information you are looking for and how would you like to use it?”

Methodology
Each focus group was shown the original site, along with prototype redesigns, and asked open-ended questions to elicit further feedback. With the feedback from each group, the design of the site was revised.

Participants
The focus groups were conducted with similar audiences as the usability tests. The first focus group consisted of first-year students enrolled in an English composition course. They had been using the site for their research throughout the semester and were familiar with the depth and breadth of the collection, but were also aware of the site’s limitations. The authors then conducted two focus groups made up by friends of the library volunteers. They demonstrated various degrees of familiarity with the site. Some had used it previously for genealogical research, and others were seeing it for the first time. The authors asked them to complete a series of tasks taken from the usability test to familiarize themselves with the site’s design and layout. The authors were also able to solicit feedback from 24 North Carolina teachers who were participating in a summer three-day workshop (June 2003). The workshop was designed to introduce North Carolina social studies teachers to Documenting American South’s online collection of historical resources.

Results and analysis of focus groups
The focus groups proved very beneficial, not only in the evaluation of the current site, but also as participants in the redesign of the site. Based on some of the preliminary comments made during the usability testing, the authors were able to mock up a few prototype designs to solicit more comments and suggestions. This gave the participants a chance to compare the current design with the prototypes and share their thoughts on changes, features, and enhancements they liked and those they did not. Although the participants viewed the site from very different perspectives, they tended to echo each others’ suggestions. Overall, they reinforced the findings of the usability tests, but added important insights and valuable suggestions for improving the site such as a clear alphabetical breakdown of the indexes and the addition of new indexes based on geography, genre, and race.

The redesign process
The redesign process was iterative and participatory. It was guided by project managers and key stakeholders, including the DocSouth staff and the instructional services unit. The authors continued to consult with members of the DocSouth user
community, scholarly advisors to the digital collections, and the DocSouth editorial board. Oversight and approval for the project came from the Library’s Administrative Council. Technical advice was provided by our host, ibibio and the library’s web team.

One major goal of the redesign process was to create a site that would accommodate future collections and support continued interaction with users. The authors wanted to create a flexible design using style sheets which would allow them to easily make global changes to the site’s look and feel such as changing the color scheme, fonts or positioning of elements.

The initial prototype attempted to address a common complaint that the site was “too flat”. An almost three-dimensional look using a large collage of images that changed color as users moused over them was created (Figure 2).

Reaction was mixed with different parties voicing concern that the images were dominating the page and the navigation and search tools were lost. Accessibility was also raised as an issue, with the concern that images that large would make the page slow to load with a slow connection.

The second prototype was lighter in tone with more whitespace and smaller images (Figure 3).

Figure 2.
First DocSouth prototype
Most user groups and stakeholders were pleased with the design, which included more whitespace and a more visible navigation bar and search box. Whitespace was considered a key element in the redesign. “Medium levels of whitespace should produce higher levels of satisfaction and overall preference than very dense or very spread-out use of space” (Bernard et al., 2000). The authors recognized that the use of whitespace highlighted the key information on the page, such as the selected images from each collection, the standardized top and bottom toolbars, or the search box at the top of the screen. The change to include more whitespace also signaled a dramatic departure from the original design, as it contained colored shading as a background for all sections of the page.

It is unlikely that a magic number can be attained since content, structure, and layout of a website may also contribute to search performance. One prominent scholarly advisor, however, objected to the use of Booker T. Washington’s image on the index page. The authors were also concerned that maintaining the list of collections on the index page would be problematic as the number of collections continued to grow.

The final prototype and current design emphasize the rich content of DocSouth collections, and achieves many of the goals we set for the project based on user feedback (Figure 4).

- consistent top and bottom menu bar throughout the site;
- browse tools, including the search box, author, subject, title, and (new) geography indexes are easier to locate and consistent throughout the site;
The authors wanted to make use of the associated graphics that partner with the texts to visually engage our users. The graphics were chosen in their simplest form to complement the texts. Images included book covers, graphics, manuscript page images, and illustrations. The menus are given more prominence, as there are fewer items on the page to distract or overwhelm the user. Another mission of the design was to mirror the elegance of the site to the nature of the collections and the university library. Based on this goal, we substituted subtle colors such as dark shades of gray for black and chose other muted tones. A subdued shade of Carolina blue was selected as

![New DocSouth index page](image-url)
the key color. The new design also incorporates more images to better illustrate the content within each collection and engage the user.

Discussion
When the new design was publicly launched, the authors reflected on the results of the usability studies, focus groups and input from key stakeholders, and how many of these results were able to be incorporated in the final product. The main goal of creating a flexible structure that is sustainable for future growth, based on multiple audience input, was achieved. Much of the time in the design process went to standardization of the look and feel, the high level collections entry pages and overall construction of the site.

Style sheets and Server Side Includes (SSIs) were added and used throughout the site to increase its design flexibility. The SSIs have already allowed staff to easily add in a new section highlighting significant materials held in the digital library, which displays as a link at the top of all pages in the standardized toolbar.

Although the authors began to alter the design of the actual documents, these currently remain the same with the exceptions of the new standardized header and footer, which include the navigation toolbars. Future plans include revisiting the structure of the documents in an effort to display the TEI header and associated metadata in a less obtrusive manner.

The authors focused efforts on incorporating the feedback from our K-12 educators and added a classroom section which includes lesson plans and links to the LEARN NC[5] website and the standard course of study for North Carolina. Interactive graphic geographic indexes for both the United States and counties in North Carolina were added for enhanced searchability. Future plans include the incorporation of more educational materials, including learning objects and tools for building digital narratives. Gender and race indexes are also on the list.

Conclusion
The usability tests and focus groups conducted helped the authors understand more about user behavior, and how task oriented and context dependent their use of digital collections are. Through an iterative design process the authors dealt with organizational, structural, and technical issues as they worked to respond to the information needs of different user groups. Nevertheless, creating a sustainable digital library for multiple audiences requires more than a single usability study or an iterative design process. It requires a mindset on the part of developers to constantly look for ways to interact and gather feedback from your audience. For digital libraries with rich collections of cultural heritage information to retain their importance for generations to come, they must be user-centered. The redesign of the DocSouth digital library has provided an institutional, as well as technological, structure for continual growth and development of our digital collections. It has also opened a dialog with the users that we intend to sustain.

Notes
1. Sites used included the Library of Congress’ American Memory Project (http://memory.loc.gov/ammem/), PBS (www.pbs.org/), and EDSITEment (http://edsitement.neh.fed.us/).
2. All documents receive a full MARC catalog record including Library of Congress Subject Headings.
3. All the documents are encoded in TEI and have TEI Header that includes detailed information about original document and its electronic edition.

4. “The North Carolina Standard Course of Study provides every content area a set of competencies for each grade and high school course. Its intent is to ensure rigorous student academic performance standards that are uniform across the state. It is based on a philosophy of teaching and learning that is consistent with current research, exemplary practices, and national standards.” For more information, visit the web site: www.ncpublicschools.org/curriculum/.

5. LEARN NC is a program of the University of North Carolina at Chapel Hill School of Education. Their website offers a wide array of quality resources for K-12 classroom instruction and teacher professional development, all tied to the North Carolina Standard Course of Study.

References


Further reading

Appendix 1

Usability Test Questions & Tasks

1. I have used the DocSouth site:
   Never 1 2 3 4 5 6 7 8 9 10 Frequently

2. In general, I use the Web to find specific information: (Please circle one)
   Never 1 2 3 4 5 6 7 8 9 10 Frequently

3. In general, I browse the Web to see what information I might find that interests me:
   Never 1 2 3 4 5 6 7 8 9 10 Frequently

Tasks:
Please complete the following tasks. As you work, we encourage you to share your thoughts on the site and let us know if you have any questions or encounter any problems. There is no time constraint so proceed with the questions at your own pace.

1. From the UNC website (http://www.unc.edu) click on Libraries, then click on the icon in the lower right-hand corner for Documenting the American South website.
   a. Find documents on the Amistad.
   c. Find a document written by Charles Hyams.

2. From the Google website (http://www.google.com) enter the phrase “North American slave narratives” and click on the first link in the results list.
   a. Describe the type of documents contained in this site.
   b. Search for the slave Henry Bibb.
   c. Find the biography of a slave from 1826.

3. Under the browser’s Bookmarks is a link to a commercial digital library.
   a. Describe the types of documents contained in this site.
   b. Find a letter from the 1692 Salem Witch Trials.
   c. Find a diary written by Elizabeth Blackwell.

Follow-Up Questions:

1. How would you describe your overall experience with the Documenting the American South website?
Appendix 2. Focus group questions

1. After browsing the DocSouth website, what three words would you use to describe DocSouth's overall appearance? Its overall usability (how easy or intuitive it is to navigate)?

2. What would you be most likely to use the DocSouth website for (historical research, genealogical research, leisure reading, self-directed education or lifelong learning, etc)?

3. What areas of DocSouth do you like most? What areas of DocSouth do you like least?

4. In your opinion, what could the DocSouth website offer its users to make using it easier or more enjoyable to browse?

5. What features would make DocSouth easier for the following tasks:
   - Writing a research paper
   - Conducting historical research
   - Conducting genealogical research
   - Browsing various documents
   - Reading for pleasure or self-education

6. Comparing the DocSouth website and that of the commercial site, which did you find:
   a. Easier to search: _______ DocSouth _______ Commercial Site
   b. Easier to browse: _______ DocSouth _______ Commercial Site
   c. More attractive interface: _______ DocSouth _______ Commercial Site
   d. Better organized: _______ DocSouth _______ Commercial Site
   e. Easier to access documents: _______ DocSouth _______ Commercial Site

7. Were there features of the commercial site that you found particularly useful?

8. Do you have any other comments regarding the DocSouth site you would like to share with us?

Appendix 2. Focus group questions

1. After browsing the DocSouth website, what three words would you use to describe DocSouth's overall appearance? Its overall usability (how easy or intuitive it is to navigate)?

2. What would you be most likely to use the DocSouth website for (historical research, genealogical research, leisure reading, self-directed education or lifelong learning, etc)?

3. What areas of DocSouth do you like most? What areas of DocSouth do you like least?

4. In your opinion, what could the DocSouth website offer its users to make using it easier or more enjoyable to browse?

5. What features would make DocSouth easier for the following tasks:
   - Writing a research paper
   - Conducting historical research
   - Conducting genealogical research
   - Browsing various documents
   - Reading for pleasure or self-education
Designing effective tasks for digital library user tests: lessons learned

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Abstract

Purpose – To describe lessons learned about the process of designing effective tasks for digital library user tests.

Design/methodology/approach – Illustrated examples are drawn from eight separate user tests run over the course of three years during development of Variations2, the Indiana University digital music library.

Findings – Four major considerations for effective task design are described and illustrated. Areas explored include iterative task development, design of authentic activities, recruitment of authentic users and how to deal with unrealistic testing scenarios.

Practical implications – Lessons learned in task design are matched with examples that illustrate how to balance real-world constraints with ideal testing conditions to gather useful results.

Originality/value – User tests that consider a balance between real-world constraints and ideal conditions are more apt to provide useful design ideas for complex systems such as digital libraries. Practitioners may use these guidelines to develop and run their own effective user tests.

Keywords User interfaces, Digital libraries, Music

Paper type Case study

Introduction

Digital library (DL) systems often undergo usability tests at some point during their development (Covey, 2002). A usability test (or user test) places representative users in front of the system of interest, and the testers – who are often the developers themselves – ask the test participants to work through a sequence of tasks. The testers observe the participants (users), usually one at a time, noting problems with the system, and discuss the issues and the system with the participants after the test.

DL developers conduct such tests to identify likely problems so that those problems can be fixed before the system is released, or to assess the current state of the system in order to improve the next version. Crucial to the effectiveness of the test is the design of the tasks test participants will be asked to perform. Ideally, test tasks reflect real-world activities, motivations, and complexities, but common project constraints make each of these characteristics difficult to achieve. This paper describes lessons learned from designing and running user tests on Variations2: the Indiana University Digital Music
Library (Variations2, 2005). In particular, after giving an overview of Variations2, this paper describes considerations for effective task design for DL user tests, illustrating each consideration with examples drawn from eight separate tests, run during three years’ work on Variations2.

Variations2 overview
The Variations2 project began in 2000 with a $3M Digital Libraries Initiative Phase 2 grant from the US National Science Foundation and National Endowment for the Humanities. The goal of Variations2 is to “establish a digital music library testbed system containing music in a variety of formats, involving research and development in the areas of system architecture, metadata standards, component-based application architecture, and network services” (Variations2, 2005). To that end, the Variations2 system has been developed through successive versions to include not only core storage and retrieval functionality for thousands of recordings and hundreds of scores, but also a rich set of pedagogical tools for classroom, library and personal use.

Variations2 is implemented as a Java-based networked application. The client software for end-user use works on both Macintosh and Windows operating systems. Table I lists the functionality of main user interface components of Variations2. Patrons in Indiana University’s Cook Music Library can use Variations2 on any of 120 computers to access the entire online collection. Faculties also have full access from their offices and computer-equipped classrooms. Students can install Variations2 at home, but the Variations2 access control mechanism limits their out-of-library access to those materials which are on reserve for their current classes (Figure 1).

The IU Cook Music Library has had an online course reserves system for audio recordings in place since 1996, Variations (Dunn and Mayer, 1999). The Variations2 collection is largely based on the items digitized for Variations. On 9 May 2005, Variations2 replaced Variations as the reserve system at the music library for scores and recordings. In addition to providing a testbed for research, Variations2 is now a production system in daily use by a large (>1,500 student) school of music.

User testing overview
The heavy use Variations2 would receive was a major motivation for the extensive user testing that was performed. Table II summarizes the user tests conducted on Variations2.

All tests were conducted in the usability lab belonging to the IU School of Library and Information Science. Typically, sessions were videotaped, including video capture of the computer screen with a scan converter. Most tests, in addition to requiring participants to work through tasks, also collected demographic information on the participants and were followed by a satisfaction questionnaire. Full reports from all tests are available for download from the Variations2 project site (Variations2, 2005).

Considerations for effective task design
Task development is an iterative process
The development of effective tasks for usability studies can be strengthened if it is an iterative process. The first draft of a task list is rarely the final product. Given the complexity and uniqueness of the Variations2 software, task lists often needed to be tweaked to promote successful user tests and ensure that the data collected were
relevant to study goals. To reduce the risk of participant distraction, confusion, and frustration during the user test, a pilot test was run prior to actual test sessions. Especially in the early stages of system design, unavailable features or controls are likely to hamper a user’s ability to complete a particular task and indirectly affect completion of other tasks. A pilot run helped to identify and circumvent these issues. Other common problem areas identified in pilot tests were inconsistencies in task flow, overly complex tasks, or tasks that took too long.

### Component Functionality

<table>
<thead>
<tr>
<th>Component</th>
<th>Functionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search window</td>
<td>Using a metadata model designed specifically for cataloging and finding classical and popular music, the search window lets users input such music-specific criteria as composer, performer, work, and key. The search results present, for example, all the performances of a particular work, along with information about performers so that users can pick out the performance of interest.</td>
</tr>
<tr>
<td>Audio player</td>
<td>The audio player provides navigation and listening controls for an entire album of streaming audio. Locations within the recording can be bookmarked for future direct access.</td>
</tr>
<tr>
<td>Playlist</td>
<td>Users can send tracks from different albums to a single playlist. Playlist tracks can be rearranged, annotated, and truncated. Any playlist can be used as the basis for a self-test listening drill.</td>
</tr>
<tr>
<td>Timeliner</td>
<td>The audio timeline tool provides users with graphical and textual analysis and annotation tools for audio. Users pick an audio track or group of tracks, and create a timeline by clicking to create timepoints while listening. Each timepoint creates a “bubble” on the timeline which can be labeled and annotated. Adjacent bubbles may be grouped to support hierarchical analysis (Figure 1). The bubbles provide an additional navigation mechanism. Timelines can be created from streamed audio or from personal audio files in MP3, WAV, or other formats.</td>
</tr>
<tr>
<td>Score viewer</td>
<td>The score viewer displays scanned, bitmapped images of scores. Pages within the score can be bookmarked for easy access. Pages can be zoomed for closer inspection, or pages can be displayed two at a time. Users can annotate score images with a variety of drawing and music-specific annotation tools. A special version of the score viewer, the Opus window, permits synchronized listening and score viewing.</td>
</tr>
<tr>
<td>Bookmark editor</td>
<td>The Bookmark editor lets users edit, group, annotate, and export their bookmarks. Bookmarks can be exported as a web page, making it easy for instructors to create listening lists or assignments for their students.</td>
</tr>
</tbody>
</table>

Table I. Variations in user interface components and functionality.
Designing tasks for DL user tests

Figure 1. A Variations2 timeline
The task refinements made after the pre-release version 1 pilot test illustrate the benefits of making a pilot run. Since the software was in a pre-release state, the content was incomplete and some features of the interface was not yet implemented. During the pilot test, the participant was observed spending an inordinate amount of time on inputting search queries. Since the system was in an early stage of development, most of the content was “dummy” content, and this caused queries that might normally have been valid to return no results. After the pilot test, the task list was reworked to guide queries better and provide a more thorough introduction to the system explaining that certain queries might not work. This change proved useful in the real tests, as users spent less time on futile tasks and more time exploring the functioning features of the system. The pilot test also revealed system bugs that hindered task completion, such as the incorrect track playing in the audio player. Although it was impossible to fix all bugs before conducting the test, observations of bugs made testers aware of potential problem areas and enabled the planning of any necessary interventions. After the same pilot, a few tasks were also reworded. For example, in a task that required adding text to bookmarks, the text “Add the label” was changed to “Add the comment”. The pilot participant had been confused by the labels on the interface, and so the task was changed to make the language less technical. Although some of these changes were minor, they had a large impact on the effectiveness of the tasks.

**Lessons learned**

- Task development is an ongoing process; one is always “testing the test”.
- Task refinements can have a large impact on task performance.

**Authentic activities are complex**

Kuniavsky (2003, p. 270), in offering advice for creating user test tasks, writes that tasks “need to be representative of typical user activities and sufficiently isolated to focus attention on a single feature”. There is a fundamental tension latent in this advice. Tasks that are too simple misrepresent the complexity of real-world work, but tasks that are too complex may frustrate the test participant, who is already under pressure from the perceived evaluative flavor of participating in a “test”. Moreover,
crafting tasks to focus on isolated features undermines authenticity because users rarely set out to “use features” but rather to accomplish meaningful work, without regard for where the software or feature boundaries lie. At the same time, development teams think in terms of features and want to know whether they have made effective design decisions. The experience testing Variations2 reported here illustrates the struggle to balance these concerns.

Early Variations2 tests were designed to ensure tasks addressed all topics of interest in a meaningful way by having participants complete activities structured around scenarios. Scenarios introduce the context within which the tasks will be completed. Scenarios ask participants to imagine themselves in typical classroom or study situations. The ideal result is that participants view tasks not as merely “clicking and following instructions”, but as doing something that would actually make sense if they decided to use Variations2.

To create realistic scenarios, test designers drew heavily on results from field studies (Notess, 2004). Users were observed in typical use situations (e.g. in the music library) and data pulled from surveys and interviews with music students and faculty. These observations revealed that real-world tasks were embedded in a variety of contexts and that work was often further complicated by use of a variety of resources. The temptation in a time-limited user test is to isolate the tool or features and just test those. But creating realistic scenarios requires an expanded view that encompasses the larger software environment, which could include such resources as course web pages, online library catalogs, internet search engines, e-mail, desktop applications, and course management systems.

Based on observations, the following scenario was used to introduce users to a task for which they were required to create a webpage to supplement a classroom presentation:

You are using Variations2 to work on an assignment for your music history class. The assignment requires that you give a short presentation about different instrumentation found in movement IV of Beethoven’s 9th symphony. To make access to Variations2 easier, your professor has put the assignment on the web.

To Begin: Open a browser window and enter the following URL:

The scenario gained authenticity by placing the assignment on the web; this authenticity proved useful in helping users orient themselves before attempting to complete a fairly complex and unfamiliar task.

Because real-world contexts of use are complex, authentic tasks may also be complex. Representing this complexity in scenarios can be problematic. Lengthy scenario narratives can cause participants to gloss over the instructions or get lost if they miss a step in a task sequence. In these cases, more direct instructions (“do this”, “do that”) may be easier for both participants and researchers. The two sides to consider in this situation are that when participants read scenarios, they can get frustrated; when they simply follow instructions, they may not engage. Similarly, with scenarios, users may be more creative; with instructions the focus on getting through the steps. A lengthy scenario can also cause users to judge a task to be too hard to understand and simply skip it. A more effective way to present scenarios is as a combination of introductory, context-setting prose followed by a list of more directive steps. This presentation helps reduce cognitive load and shift user focus from figuring out what a task is about to actual performance.
A scenario that is authentic for one group of test participants may not be authentic for another group. In such cases, the scenario was adapted such that the same task was required, but for a different, more authentic purpose. For example, in an early Variations2 test, both music majors and non-music majors were given the same tasks but were introduced to them in different ways, as shown below.

- **Music major scenario.** You have a quiz next week in your music history class and decide to use Variations2 to prepare. The listening reserve list for the quiz includes the following composers and pieces.

- **Non-music major scenario.** A friend has asked you to accompany her to an orchestra concert. Before you say yes, you decide to listen to the program pieces to make sure you will enjoy the concert. After getting a list of the concert pieces, you arrive at the music library to listen to them online.

**Lessons learned**

- Scenarios based on field data can add authenticity to a set of tasks.
- Authentic activity incorporates whatever tools it needs to, without regard for the boundaries of what we want to test.
- Lengthy instructions may interfere with performance; combine paragraphed scenario context-setting with steps formatted as lists.
- The same tasks can be set within different scenarios to become authentic for different user groups.

**Authentic users are hard to find**

Creation of user profiles and participant recruitment for user studies may seem to be separate issues from task development. However, these are actually two of the most crucial aspects of task development. The results of carefully planned tasks can be rendered invalid if test participants are not authentic; their interactions will not reflect typical usage patterns.

Unfortunately, it is often hard to find participants that match the target audience. Finding participants was somewhat easier than for many DL projects, because the software has a very specific, local user base (e.g. IU music students and faculty). Potential users of Variations2 differ in their academic status (undergraduates, graduates, teaching assistants and associate instructors, professors), major, and level of computer literacy (from novices to experts), and embody a wide range of social and demographic characteristics. All of these factors mediate participants’ expectations and performance and, in turn, task effectiveness.

Test tasks assume participants will have a certain level of computer literacy. Although less technical participants are less likely to volunteer, they are also more likely to be nervous and fail to complete the tasks. To address this tension, tasks can be written to be appropriate for a range of user competencies by avoiding technical or software-specific terminology. For example, in a recent test of the score annotation tool, an effort was made not to use the terms “annotation” or “annotated score” too often; instead, terms were used that would better reflect how music students think about marking up scores.

When customizing tasks for multiple groups of users, tasks should reflect the most important factors that characterize particular groups. For instance, Variations2 studies typically employ tasks that are suitable for music students in general, but have also
included tasks geared to music students at different levels of study (undergraduate vs graduate), major (music theory vs performance) or even, as mentioned in the previous section, non-music majors.

Tasks will be more effective if they reflect authentic users and their behaviors outside the lab. For example, pairs of test participants working together tended to use Variations2 in a much more exploratory and informal fashion and were more talkative to each other during sessions. Individual users tended to be more task-focused and likely to ask the facilitator for help. These behaviors were a reflection of users’ typical work style. Exploratory use of Variations2 is more typical in the library and computer lab settings in which students work. Observations further indicated that it is common for students to work in the library or labs in groups or with a partner to study for tests or complete class assignments. In at least one case, people signing up to participate in a user test requested that they be allowed to work as a team rather than as individual participants.

Of course, researchers cannot prepare for every possible participant characteristic that may affect task performance. For example, in one Variations2 test that focused on the timeline tool, participants were asked to complete music diagramming tasks involving manipulation of colored bubbles. Halfway through one session, the user announced he was color-blind and proceeded to complete the tasks in a completely unexpected manner. Although this was unanticipated, the outcome of this experience was positive in that system developers were presented with an important accessibility issue that might otherwise have been neglected.

Not all participants understand the tasks and act on them in the way that is intended. Despite efforts to design tasks that are clear and specific, there will be participants who misunderstand tasks and diverge from expectations. For example, participants used track titles from bookmarks on a web page to search for pieces of music instead of clicking on the URLs on the same web page as they had been directed to do. In another task, one participant drew annotations with a pencil instead of the tools expected for use. And participants used outside resources to find answers to questions instead of the help system. User deviations may not provide a lot of useful feedback about particular test items of interest, but it helps to remain open-minded; deviant cases are usually notable and may form the basis for future test considerations.

*Lessons learned*

- Tasks can be written to fit a range of user characteristics (e.g. degree of technical expertise).
- The degree to which lab conditions reflect the real use context (e.g. users who work in pairs or groups) may affect observed behaviors and performance during lab testing.
- One cannot prepare for every type of user, but one can usually learn something of value from every type of user.

*There will always be inauthentic tasks*

It is nearly impossible to design a usability test that is wholly “authentic”. Additionally, to uncover all problem areas in a system, it may be necessary to test a wide range of system components, including advanced features that are rarely used. Complex systems may have many components and functionalities to be tested. Some of these may be more or less commonly accessed or desirable to users. One of the most difficult issues in creating tasks is to address these more “unrealistic” activities or
rarely used functions. One approach to testing such features is to specifically instruct participants to use the desired feature to accomplish the task. In this case, participants might be hesitant or reluctant to perform the task because they have been asked to do something they would be unlikely to do in real life. However, the directed question will at least guide them to the area of interest. Other less obtrusive ways to test “unrealistic” scenarios include asking the participant to explore the software or providing additional visual aids.

To get information about how participants would use the Variations2 search and bibliographic details display, scenarios containing direct questions were developed. Participants were asked to determine the number of recordings available as well as the duration of particular pieces (Figure 2). Even though questions were aimed to elicit information actual users might rarely try to find, the answers helped identify what was salient and what was not in Variations2 interface. Note that even though the tasks are embedded in a scenario, some of the steps are quite artificial (e.g. “How many variant names for Beethoven exist?”). In this case, test goals superceded the importance of the authenticity of the scenario.

Asking users to explore the software may help reveal patterns of learning and use of rarely activated features. For example, most Variations2 surveys and studies show that users rarely consult help pages. Nevertheless, for the overall supportability of our DL, the help pages need to be usable. To better understand how users learned the system, and more specifically the help pages, participants were asked simply to explore Variations2.

Now take 15 minutes to explore Variations2:

- click on the shortcut on your desktop to start Variations2;
- try to search for Beethoven and explore the results (note: you may not be able to listen to the music, except the Symphony No. 5); and
- try to figure out what other features are in Variations2.

Observations of users’ behaviors during this exploratory phase helped researchers better understand how participants learned the system and, in turn, approached the

Figure 2.
Excerpt from a task scenario showing some inauthentic tasks
help pages. Those participants who used the help pages were then probed further about it during a debriefing session. This method provided researchers with valuable feedback and suggestions.

In another usability study, additional materials were used to engage participants in particular activities. This study examined a variety of different score annotation tools. Therefore, it was necessary to make users try different tools. The first task included a hint (you may use different colors) to elicit particular actions, but participants tended to ignore this hint. The second task suggested they use Variations2 to replicate a paper-based analysis. Since the printed analysis contained various colors and shapes, participants were eager to explore and use different tools on the computer that would allow them to create the same types of visual effects.

**Presentation preparation**

During the semester we worked on an analysis of Beethoven’s piano sonata Op. 2, no. 1. You will be presenting this analysis in class next week and you need to make it look nice. Use the hand-written analysis (attached) to replicate the first two pages of the annotated score in Variations2. Use different colors. When you are done, print the annotated score and save it on the desktop as “Beethoven_username” (substitute *username* with your username).

**Lessons learned**

- The need to discover problems with specific aspects of software may sometimes supersede the authenticity of the test.
- Unrealistic tasks can be approached via directed questions, requests to explore the software, or additional materials such as sketches, diagrams, etc.
- Visual aids may make users more comfortable with inauthentic tasks.

**Conclusion**

The previous sections describe lessons learned about how to design effective tasks for DL user tests. Illustrated from our Variations2 studies, these observations offer a balanced response to the tension between ideal testing ambitions and the variety of real-world constraints. Table III shows, at a high level, the main issues requiring balance in task design. The goal is neither to abandon the ideal for the real, nor to

<table>
<thead>
<tr>
<th>Ideals</th>
<th>Real-world constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable task definitions for more “scientific” results</td>
<td>Continuous improvement of tasks for more useful results</td>
</tr>
<tr>
<td>Authentic scenarios with rich context</td>
<td>Simple instructions that will not overwhelm participants</td>
</tr>
<tr>
<td>Tasks focus on use of our product</td>
<td>Ecosystem within which our product exists also is tested</td>
</tr>
<tr>
<td>General-purpose scenario that will work for all user groups</td>
<td>Adapted scenarios for different user groups</td>
</tr>
<tr>
<td>Test participants represent actual users</td>
<td>Test participants approximate some aspects of actual users but are available</td>
</tr>
<tr>
<td>Test planning anticipates all types of participants</td>
<td>Participants surprise us, yielding unanticipated results</td>
</tr>
<tr>
<td>Authentic, engaging tasks</td>
<td>Development team has specific questions they want answered</td>
</tr>
</tbody>
</table>

| Table III. Balancing ideals with real-world constraints |
neglect the real in pursuit of the ideal. By achieving a balance between the ideals and constraints, a wealth of test results useful in system design can be obtained.

References


Usability of digital libraries
A study based on the areas of information science and human-computer-interaction

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Abstract
Purpose – The conception, planning and implementation of digital libraries, in any area of knowledge, demand innumerable studies in order to verify and guarantee their adequacy to the users' necessities. Such studies find methodological, conceptual and theoretical support in some areas of knowledge, such as human-computer-interaction (HCI) (usability studies, in particular) and information science (IS) (especially studies about users' necessities and behavior in information search and use). This research, therefore, intends to integrate concepts and techniques from these two areas, that is, to analyze the usability of the InfoHab digital library, having as theoretical base the constructivist model of user study proposed by Carol Kuhlthau and the criteria of usability established by Jacob Nielsen.

Design/methodology/approach – In order to do so, a qualitative study with six users with different levels of academic formation and experience in the use of recovery systems was developed. Data were collected through personal interviews, prototype of the library, direct observation, image and sound records. The variables of this study included the following criteria: learnability, efficiency and effectiveness of the digital library, management of errors, memorability and the user's satisfaction from the perspective of cognitive and affective aspects and the actions taken by the users during the information search process.

Findings – The aspects identified in the collected data are discussed and the results are evidence of the possible synergy between the HCI and IS fields.

Originality/value – The authors expect to contribute conceptually for a discussion about a model of usability study that can be more inclusive and incorporate the aspects pointed by the constructivist model.

Keywords Digital libraries, Design, Modelling

Paper type Research paper

1. Introduction
The conception, planning and implementation of digital libraries, in any area of knowledge, demands innumerable studies in order to verify and guarantee the final product adequacy to the users' necessities. Such studies find methodological, conceptual and theoretical support in some areas, such as human-computer-interaction (HCI), for the usability studies, and information science (IS), for the studies about information needs and user's behavior during the information search and use processes.

According to Norman and Draper (1986), the area of HCI studies the contact between computer systems and human use, more specifically, the interaction that occurs in this process. Norman continues, “the properties attributed to the system as the interface, the language, the orientation on the tools and devices, the work load, flexibility, compatibility with other systems, communication, as well as the effort to work, intervene directly in this interaction”. In this context, usability is understood as
“the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (ISO 9241-11, 1998).

IS, in turn, proposes “the holistic understanding of the human being while individuals with cognitive, affective and physiological needs and they operate inside of projects that are part of an environment with partner-cultural, economic and politics restrictions. These needs, the projects and the environment form the base of the context of the behavior of information search” (Ferreira, 1996). Studies with such focus make it possible to the planners of digital systems to better understand the users’ mental models, and make it easier the development of more useful and adherent design according the target-public’s necessities.

This research intends to integrate concepts and techniques of these two fields, carrying out a usability study theoretically based on Carol Kuhlthau’s constructivist model of user study and Jacob Nielsen’s quality components of usability. Based on Kuhlthau (1991), the presuppose of this study is that by observing the information search process (ISP) from the user’s perspective and analyzing the cognitive and affective aspects involved that are present during the interaction with the system, the authors can diminish the gap between the user’s natural process of information use and the one proposed by the information systems.

InfoHab, the Center of Reference and Information in Habitation, was studied. This center is a digital library in the area of construction that offers researchers, professionals and companies a free digital databank on Brazilian technical and academic production in the construction field.

Since 2000, this library intends to integrate associate entities, government agencies and universities. In order to incorporate new scientific communication support services, InfoHab reorganized its system, and in particular, its interface of access. Currently, the library allows the user to search for publications about the subject, as well as chances for divulgation and participation in events of Civil Engineering.

This paper is a qualitative study. It starts with a review of the fundamental concepts of HCI and IS used in this research. Then it presents the methodology applied, analyzes the results found, and recommends future studies.

2. Literature review
The late twentieth century was marked by the following characteristics derived from the internet: a boom of the available information and a fast growth in the number of connected computers. Researchers like Castells (2003) and Lévy (2003) have argued about the social, economic and political changes originated by the use of the new technologies of information and communication for the net connected society. These great alterations in all the scopes of human activity have only become possible to the extent that the new technological resources of information and communication have been accessible to people without specialized formation in computer science.

The proliferation of information systems (including databases, digital libraries, web sites, among others) show the difficulty designers are faced with in the attempt to catch and to satisfy users’ expectations and interests. This situation implies a rethink of systems planning and designing, in order to add differentiated values.

As a result of innumerable research projects into this direction, one can note that to guarantee and to add value to the systems implies drawing and projecting products
and services centered on the users’ needs and focused on the way users perform their
tasks. It is essential, therefore, to consider both cognitive and operational aspects
involved in the process of information search and use (Norman and Draper, 1986;
Dervin and Nilan, 1986).

Norman (1986, p. 61) defines the user-centered system as the design carried out from
the user’s point of view, thus emphasizing people rather than technologies. This
proposal refers to planning and developing a system, specifically interfaces, focusing
on the users’ necessities, perceptions, mental models and information processing
structures.

Researchers of various areas of knowledge have studied methodologies and
developed methods and techniques aiming at guaranteeing systems with the
characteristics mentioned above. Some examples are the usability studies detailed by
the area of HCI, and the studies about information search and use behavior prescribed
by the alternative approaches of user studies in the IS field.

2.1 Usability

According to Nielsen (2000a), usability has became a question of survival in the
economy of the internet. The author affirms “there is an abundance of available sites,
therefore] to leave is the first defense mechanism when the users find difficulties”.
These difficulties are usually related to the organization schemes, navigation systems,
search system and labeling systems of information in the web. That is, because of the
great number of available options today, the information architecture can determine
the user permanence or abandonment of the virtual systems (Rosenfeld and Morville,
2002).

Usability, as Nilsen (2003) argues, is a quality attribute that assesses how easy user
interfaces are to use, making it possible to the customers to develop tasks in a clear,
transparent, agile and useful way. This concept corroborates the one prescribed by
norm ISO 9241-11 (1998), which considers usability the “capacity that an interactive
system offers its users, in a determined operation context, for the accomplishment of
tasks, in an effective, efficient and pleasant way”. For the Usability Professional’s
Association – UPA (web site institucional, Disponível em: www.upassoc.org/),
usability is directly related to quality of the product, as well as to the user’s efficiency,
effectiveness and satisfaction. This same association defines usability as a set of
techniques developed to create usable products, with a user-centered approach.

Nilsen (2003) considers that the usability of a system can have five quality
components:

1. Learnability. How easy is it for the users to accomplish basic tasks the first time
   they encounter the design?
2. Efficiency. Once users have learned the design, how quickly can they perform
tasks?
3. Memorability. When users return to the design after a period not using it, how
easily can they reestablish proficiency?
4. Errors. How many errors do users make, how severe are these errors, and how
easily can they recover from the errors?
5. Satisfaction. How pleasant is it to use the design?
Usability tests play an important role in each stage of the process of virtual systems development, specially in the drawing of the interface, “space” in which the interaction between the user and the system’s available content, services and products occurs.

2.2 Users study – information search and use behavior

The “user-centered” perspective or alternative studies, as referred to by Dervin and Nilan (1986) was initiated in the 1970s, in the IS field, when the necessity to extend the focus of the research appeared, concentrating in the individual actors of the information search and use processes, in social, practical and cultural contexts. “The approach focuses on the user’s problems and on the production of meaning, pointing out that the efficiency of the information recovery depends on the integration of the results with the user’s life and specially on the evaluation the user makes about the utility of the information to solve problems” (James, 1983; Hall, 1981; Ingwersen, 1983; Kuhlthau, 1991).

While the system-oriented studies (studies of use and usability) examine what happens in the informational environment external to the individual, the user-oriented studies also examine the individual’s psychological and cognitive necessities and preferences and how they affect the standards of search and use of information (Choo, 1998). Therefore, such studies focus on the analysis of internal behavior and/or behavior externalized through non-verbal communication, allowing individuals to construct and project their movement through time and space.

The development of users studies, from this perspective, has been searched and described by three distinct approaches: the user-values approach by Taylor (1994), the constructivist model by Kuhlthau (1991) and the sense-making approach by Dervin and Nilan (1986).

Among these, the constructivist model suggested by Kuhlthau (1994) emphasizes the occurrence of affective and cognitive states that certainly appear in an ISP. Its central axle is the “ISP” considered as “the user’s constructive activity of finding meaning from information in order to extend his or her state of knowledge on a particular problem or topic”. This process occurs in phases experienced by individuals as they build their view of the world by assimilating new information (Kelly, 1963; Kuhlthau, 1991). The analysis of these phases must incorporate three aspects of activities: physical (real actions performed by the users); affective (experienced feelings) and cognitive (ideas related both to the process and to the content).

Kuhlthau (1991) identified, analyzed and described six phases of her model for ISP: initiation, selection, exploration, formulation, collection and presentation. The first one, initiation, is marked by feelings such as uncertainty and apprehension, whose commonest thought is the search for something vague and general. Thus, the user’s task is to recognize the necessity of information and to talk to other researchers so as to look for similar experiences. In the second stage, the selection, the task is to identify the general topic of the research, in which feelings such as optimism after the task is completed appear. After the general topic is selected, the user goes to the third stage of the ISP, exploration, in which confusion, frustration and doubtful feelings occur, since the user’s task is to investigate about the general topic and search for new and relevant information. The fourth stage is the formulation, in which the task is to formulate a perspective focused on the needed information. Therefore, feelings of uncertainty and doubt turn into confidence and clarity. Kuhlthau considers this stage as the critical
point of the ISP, because if the user cannot determine the focus of the search, he or she will probably have difficulties in the following stages. In the fifth stage, the collection, a sense of direction starts to appear, as well as the researcher’s interest for the subject. The most common actions are seeking the pertinent or focused information in more appropriate sources, such as the libraries. The sixth stage, presentation, is the moment to finish the search and the production and to present the final knowledge resultant from the research.

Table I summarizes the set of feelings, thoughts, actions and tasks that occur during each stage of the ISP.

These stages identified by Kuhlthau evidence that the emotional and cognitive aspects can influence the success of the information seeking. At the moments when there is a feeling of uncertainty, causing doubt, confusion and anxiety, as in the stages one (initiation) and three (exploration), there is a great risk that these feelings provoke the mismanagement of the task, compromising the course of the following phases. In phase four, considered crucial and thus highlighted in the table, for example, if the user is fully successful in the research, it is important that when he or she performs the task he or she feels prepared to continue, with sufficient security, because without the focus of the research, the user is unlikely to reach his/her goal fully.

A review of the users studies (IS field) such as usability (HCI field) points to the existence of various feelings during the information search or other kind of interaction with a web system. Nielsen (2000a), for example, affirms that the users can feel anguish and uncertainty during a visit to a web site, and he attributes these feelings to mistakes in the systems interfaces (Figure 1). Based on these evidences, this research aims at checking out whether the integration between the concepts and methods proposed by Carol Kuhlthau’s constructivist model and the quality components of usability established by Jacob Nielsen, in a study with a specific digital library, contributes to the enlargement of our knowledge about the subject.

<table>
<thead>
<tr>
<th>Stages in ISP</th>
<th>Common feelings in each stage</th>
<th>Common thoughts in each stage</th>
<th>Common actions in each stage</th>
<th>Appropriate task according to Kuhlthau’s model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiation</td>
<td>Uncertainty</td>
<td>General/vague</td>
<td>Seeking background information</td>
<td>Recognize</td>
</tr>
<tr>
<td>Selection</td>
<td>Optimism</td>
<td></td>
<td>Seeking relevant information</td>
<td>Identify</td>
</tr>
<tr>
<td>Exploration</td>
<td>Confusion/frustration/doubt</td>
<td></td>
<td>Formulate</td>
<td>Investigate</td>
</tr>
<tr>
<td>Formulation</td>
<td>Clarity</td>
<td>Narrowed/clearer/Increased interest</td>
<td>Seek relevant or focused information</td>
<td>Gather</td>
</tr>
<tr>
<td>Collection</td>
<td>Sense of direction/confidence</td>
<td>Clearer or focused</td>
<td>Complete</td>
<td></td>
</tr>
<tr>
<td>Presentation</td>
<td>Relief/satisfaction or</td>
<td></td>
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<td></td>
<td>disappointment</td>
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</table>

Source: Kuhlthau (1991, p. 367)
3. Research methods

This is a qualitative empirical research that analyzed the interaction and use made by a group of users of the InfoHab digital library, considering specifically the affective and cognitive aspects found and the actions the users took to solve situations presented to them. This study also describes the selected sample, the variables and the methods of data collection.

3.1 Definition of the sample

To Nilsen (2000b), the number of test users can influence the identification of the problems of usability of a website. One user makes it possible to identify about 25 percent of usability problems, while 15 users allow us to identify 100 percent of the problems.

On the one hand, Nielsen (2000a) shows that the usability evaluation would have to be made with 15 users but, on the other hand, he considers the test can be trustful enough with five users. According to him, by testing the site with five users it is possible to identify a great part of the usability problems (about 85 percent) without the unnecessary involvement of many resources or users. He recommends, however, that studies should be made systematically each time the site project is reformulated, so as to correct errors of usability pointed out by the users and other errors generated by the reformulation itself (Nielsen, 2000a).

For this research, the authors first analyzed the users registrations in the InfoHab Library and noticed a significant presence (about 80 percent of the 7,789 registrations) of students (under-graduate and graduate students) and professors.

Among this academic public, this research selected users from the Department of Civil Engineering of the Polytechnical School of the University of São Paulo (USP) in Brazil. From the 33 professors and 65 students in this department, 19 professors and 44 students are registered in InfoHab. This research works only with the academic public, following Nielsen’s (2000b) recommendation. Six users were invited to compose the sample of this study: an experienced doctor professor, a professor recently awarded a doctorate, a master’s course freshman, a doctorate student and two under-graduate students. Fifty percent of this sample already use InfoHab.

**Figure 1.**
The number of usability problems found in a usability test with \( n \) users

**Source:** Nielsen (2000a, p. 1)
3.2 Variables of the study
This research considered the five variables by Nilsen (2003): learnability, efficiency, memorability, errors and satisfaction – all observed from the perspective of the feelings, thoughts and actions taken by the users during the interaction with the digital library (following the model by Kuhlthau (1991)), which, therefore, have become variables of the study. Each variable used in this study is defined as follows:

- **Learnability.** Users’ assimilation of distinct ways of solving problems or using InfoHab.
- **Efficiency.** Easiness of task accomplishment, verified through the fluency and difficulty felt by the user during the task performance in InfoHab.
- **Memorability.** The possibility of the user to remember interactions with the system, explaining them or acting in order to repeat correctness and prevent errors.
- **Errors.** Errors occurred due to internal problems of the system or to users’ misuse, as well as the analysis of the answers that the system emits in the various interactions with the users.
- **Satisfaction.** Pleasantness in the use of the site as well as the way efficiency and effectiveness of the system was perceived by the user.
- **Feelings.** User’s feelings revealed during each phase of the ISP: first contact and knowledge of the new InfoHab interface and its use for the solution of a given task and its conclusion.
- **Thoughts.** Thoughts formulated by the user during the phases involved in the accomplishment of a task.
- **Action.** Actions taken by the users to know the new interface and to accomplish the task.

3.3 Data collection
Appealing to an online prototype of the InfoHab digital library, the data collection was divided in three phases: random exploration of the new interface of InfoHab, performance of a task predefined for the research team, and an interview at the end of the meeting. In the phase of the random exploration, the researcher explained the objectives of the research and questioned the users about how they used to search information about events and scientific publication as well as about their expectation about the services that a library should offer. After that, the digital library was presented and the user was requested to visit InfoHab freely and to say out loud each and every idea and thought that came to their minds. After a short period of navigation, the researcher made some questions about their impressions and opinions.

After that, the users had to perform two predefined tasks of information search request, which demanded the use of the system. Also, during this interaction, the user was requested to say out loud his/her thoughts and actions. The tasks, designed to demand the use of some available functionalities in InfoHab, were:

- to save a list of the master’s theses on “rice rind ash” defended at the Federal University of Santa Catarina and to access the complete document; and
- to identify the events that will take place in 2005.
After the tasks were completed, the researcher carried out a half-structured interview, whose objective was to identify the user’s perception about his/her performance and difficulties, strong and weak points of the system, level of satisfaction, emotional and cognitive aspects involved in the interaction with the system. Also, the authors made prospective questions aiming at identifying the user’s expectations, priorities and suggestions. The script defined for the accompaniment of all the phases, including the questions to be asked is found in Appendix 1. The guidance for the interviewer observation activity is in Appendix 2.

All the three phases of data collection were filmed with a digital camera, placed so as to follow the face and corporal expressions of the participants. Sound files were also generated to record the interviews. The software Screen Record was used to follow and to register the users’ actions during the interaction with the systems. Direct observation of the interaction with the prototype of the system was used as a tool of data collection. In order to increase the degree of trustworthiness of the research, the authors used triangulation of empirical information collected from various sources of evidence. The duration of user participation in every stage of this research was about 35 minutes.

4. Data analysis and results

It was possible to obtain much data as evidence of the validity of studies that integrate criteria of the two fields (IS and HCI), identification of the users’ mental model when faced with the InfoHab web site, finding of information architecture and content implementation problems. Owing to the great diversity and depth of the data and results, this paper presents some aspects of the results specifically related to the convergence and possible synergy between the mentioned areas, presenting them in accordance to the collection phases described in the methodology section.

4.1 Phase 1 – random exploration

During the phase of random exploration, the authors aimed at collecting the initial impressions about InfoHab, as well as the main references of other informational resources periodically used by the participants as a source of scientific information.

InfoHab was immediately identified as a service for the access of scientific publications in the area. It was also compared by some of the users to other systems of the USP (Dedalus System of the library). Normally, the users use as information source databases Scirus for Scientific Information, Science Direct and CAPES journals portal. Beyond these, sites of research groups from other universities and scientific associations were cited.

The users considered themselves capable of easily using InfoHab, and believed that they would find the same logical structure of the systems mentioned above: “I tend to remember logical things, if the path is logical, I’ll remember it”. Systems that apply and/or adopt a design that is familiar to the users’ cognitive model tend to become more logical, which increases the possibility of memorization of its characteristics and functionalities.

All the users’ first impression about InfoHab was that it is a pleasant site in terms of visual aspects, organization and distribution of information. One of the users, however, specifically commented on the used labeling system, inferring that it used unnecessary and unclear terms for the understanding of the content:
I would like to have a more defined image of what it is, for example, virtual nuclei or management of events [...] I would like to get a brief glimpse and already understand a little more before going on.

4.2 Phase 2 – task performance
The users, in this phase, provided evidence of their previous experiences with other search systems (cited in phase 1) when they tried to talk back their models of development of the requested task, for example the use of the word-key strategy, simple and advanced search. There was no consensus about the strategies used by the users, so various paths were followed, but all of them remade the search more than once. Some examples of the users’ commentaries during these activities are: “can the research be refined?”, “what happened with my search that it generated zero register”. Other users brought suggestions of new available interesting and complementary functionalities in similar systems:

... maybe here in the key-words, look! There are ash, rice. This might be a link to other works. Dedalus is like this. There you have the key-word, so you click ...

In general, in the information search, not all the users showed fluency to deal with the specific site (it took them from 15 to 25 minutes to complete the task), although they are experienced users in activities of bibliographical searching. It happened due to problems of usability and architecture of information in the digital library that generated feelings of unreliability, anguish and discomfort during the process. Besides, the task involved more actions than a mere simple search, since users were supposed to save a list of references and to access the documents. Despite being able to locate the documents, none of users completed the task, although some declared they did. Therefore, although the user was apparently satisfied with his/her own performance, the system offered more possibilities and these were not identified by the user, what certainly would have had a direct impact on the understanding of the mentioned satisfaction.

It should be noted that the subject was not of interest to the users and this might not have generated great motivation. This is why a more detailed inquiry should be carried out to verify how the variable personal motivation derived from a necessity of real information influences the users’ actions and decisions.

The same happened to the second search, for 2005 events. The users used the cognitive model they had consolidated from their experiences with the other systems of the University. None of them was able to complete the task, generating a direct impact onto their self-esteem and confidence: “I feel a little ... I don't know if I got everything ...” – “I felt insecure, for example, did I do right, there in the events?” Another user compared the system with the previous one and considered that the events were divulged better in the previous system. Both results corroborate the proposal by Borgman (1986), adapted by Bishop *et al.* (2003) when it describes the three abilities that are necessary to the users to carry out a search in digital libraries: conceptual knowledge about the process of recovery of information, semantic and syntactic knowledge of the area to implement an adequate query and, finally, technical abilities in the use of the selected source to perform the search.

In relation to the memorization and learning variables, the authors observed that the problems mentioned above generated an impact directly onto these components of the digital library in question, since when the authors change a preexisting model, they
must justify it logically so that the user recognizes it as valid and rethink and reformat his/her previous standard.

In the analysis of the digital library efficiency, some technical errors were observed (for example, once the site did not offer the user the chance to return to the previous movement and obliged him/her to restart the task from the beginning), others were due to the search tool specification, which did not offer certain expected functionalities (such as: refinement of the search result). In those situations, the most common feelings were insecurity, anguish, scare, discomfort, impatience and frustration, besides the great deal of time spent to finish the task. This demanded intervention by the interviewer to maintain users’ motivation, and assistance so that they could solve the problems and continue the task. One of the users felt embarrassed and thought: “I think I do not know how to make a research any more”.

4.3 Phase 3 – interview

The final interview was important to analyze some aspects of the memorization easiness, learning of the dynamics, general impressions after use and final satisfaction with the InfoHab digital library.

In general, the users demonstrated easiness in learning and remembering the steps they had taken to perform the task, when asked during the interview. However, it is not possible to affirm that the page is easy to memorize, since there are many conflicts between the proposed model and the users’ mental models. It is also necessary to verify whether after a period of absence the user remembers the steps to perform those tasks made during this research.

Although the users were faced with difficulties during the accomplishment of the tasks, they felt satisfied at the end, in part due to the interaction in the interview process, in which they were presented with other services not identified before or other forms of search task performance that they did not know. Thus, Dervin’s (1984) comment can be confirmed when he says that qualitative studies that make the user remember and speak out his/her previous experiences help his/her learning, because they lead to a process of systematization and understanding of the problem that, usually, ends up extending his/her initial perception of the problem and of the ISP.

In relation to the satisfaction with the site, the users suggested ways to improve it, such as: to diminish the amount of text, to increase the size of the font type, to allow refinement in the search and inclusion of new search criteria (like by date and geographical location).

5. Final considerations

The results evidenced the synergy between the areas of HCI and IS, according to the theory by Kuhlthau (1991) and the proposal by Nielsen (2000a, 2003). Therefore, through the test of usability in the site of a digital library it was possible to evidence that to analyze information search and use behavior validates and adds new perspectives to the analysis of usability aspects. Thus, it was possible to observe that the users’ actions, feelings and thoughts, as well as their experiences disclose significant indications to learning components, memorization, errors, efficiency of the digital library and mainly users’ satisfaction.

This synergy, however, still needs other deeper studies that incorporate contributions from other areas of knowledge to explain still not investigated
phenomena about this relation between usability, information necessity, ISP and users’ satisfaction. Another item that also deserves attention is related to specific studies on users’ nonverbal communication, since, as identified in this research, their body movements (noted by the interviewer and also registered by the tools of data collection) can evidence other factors related to cognitive and/or affective aspects that can contribute to the design of digital libraries.

References
Further reading


Appendix 1. Interview script

*After the site visit task*

**Site**
In general, what do you think about the biblioteca digital? Satisfaction, feelings, thoughts
What did you like the most? What did you like the least? What would you change in the site? Who do you think the site is most appropriate to? What are the digital library objectives? Did you find it difficult to understand any term used in the site? Which one?

*After finishing the task*
Do you usually make this search in the site? User’s experience Do you think it is easy to reach the task goal? Feelings, thoughts

*After each task*
Task
Do you think you reached the task goals? Efficiency, satisfaction, feelings, thoughts, action Did you reach the task goals the way you would like to? Did you find any difficulty to accomplish a task? Which one? Do you remember the steps taken during the performance of the task? Which were they? Did you follow those steps? Why? Did you take into account your previous experiences? What did you feel when you were presented with the task?

*After the interview*
Prospecting
If you needed to use the site again to perform a task, do you think you would find it difficult? Learnability, memorability, thoughts If you were to implement an Information System like InfoHab, how would you do it? What would you put in it and prioritize? Learnability, efficiency, memorability, errors, satisfaction, feelings, thoughts

Table AI.
User identification
Name:
Age:
Major:
How long:

Phase 1 – random exploration
Do you usually search on the internet for works that are relevant in your area? Which sites do you usually search?
Do you know InfoHab? How do you use it?
How do you get to know about events that are going to take place, technical journals and national research projects?
Do you think it is important that there is a site that gathers information about calls for papers or events that facilitate communication among researchers?
How would you like to receive that information? How do you divulge them in a site?
Do you think InfoHab could play that role? Why? How?
What does a Center of Reference and Information in Habitation mean to you? What would you expect from it?

Appendix 2. Observation script
During task performance, the following aspects are observed:

<table>
<thead>
<tr>
<th>Task</th>
<th>The steps taken to the task performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learnability, efficiency, errors, action</td>
<td>Task time spending</td>
</tr>
<tr>
<td>Efficiency, action</td>
<td>Strategy used to perform the task</td>
</tr>
<tr>
<td>Efficiency, action</td>
<td>Doubts, difficulties in the search steps performance</td>
</tr>
<tr>
<td>Efficiency, learnability, errors, action</td>
<td>Errors made and how the user managed the situation</td>
</tr>
<tr>
<td>Errors, action</td>
<td>Feeling shown or spoken out loud</td>
</tr>
<tr>
<td>Satisfaction, efficiency, feelings</td>
<td></td>
</tr>
</tbody>
</table>

Table AII.
The flight plan of a digital initiatives project, part 2
Usability testing in the context of user-centered design

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Abstract
Purpose – To provide the results of research to evaluate the usability of a University of Colorado at Boulder Libraries digital initiatives project that provides online access to historical Aerial Photographs of Colorado.

Design/methodology/approach – This paper describes usability testing conducted as a part of a user-centered redesign. The three stages of the evaluation – a requirements analysis, a heuristic evaluation, and user testing – are explained and the findings are discussed.

Findings – The usability testing revealed the needs of the project’s target user group and identified issues with the interface that will be addressed in its redesign. It has also contributed to the larger understanding of how researchers use digital Aerial Photographs and their preferred methods of access and desired functionalities.

Practical implications – Results from the study will be used to guide the redesign of the Aerial Photographs of Colorado digital library and can be generalized to add to a broader understanding of the usability requirements for a digital library of geospatial materials. Libraries providing a digital collection of geospatial materials may use these findings to inform design decisions.

Originality/value – Much research has been done on the use and evaluation of digital libraries, but few articles have reported on usability studies of online collections of cartographic materials similar in structure to Aerial Photographs of Colorado. It is hoped that these findings will be instructive to librarians designing and evaluating similar digital libraries.

Keywords Digital libraries, Cartography, User interfaces, User studies

Paper type Research paper

Introduction
This paper reports and analyzes the findings from a usability study conducted on a prototype of Aerial Photographs of Colorado (http://ucblibraries.colorado.edu/aerialphotos/home.asp), a digital initiatives project at the University of Colorado at Boulder Libraries. A team of librarians from the systems department, earth sciences and map library, and cataloging department collaborated to test the usability of the project’s interface by conducting a requirements analysis, a heuristic evaluation, and user testing with members of the site’s target audience: faculty, staff, and students on campus. This usability study was conducted as part of a redesign of the digital library and was guided by principles of user-centered design. The paper will describe the methodologies used, document and analyze the data collected, and outline how the libraries are using the data to redesign the website in order to enhance its usability. The project team hopes this analysis will prove instructive to librarians designing and evaluating similar digital collections of geospatial materials.
Background on the Aerial Photographs of Colorado project
The Aerial Photographs of Colorado website is a digital library collection of more than 1,700 scanned Aerial Photographs of Colorado taken by the United States Forest Service (USFS) in 1938, 1940, 1946, and 1947. The project began with a grant from the Collaborative Digitization Program (CDP) to scan, georeference[1], and create an online searchable interface for a portion of a collection of print aerial photographs donated to the Jerry Crail Johnson Earth Science and Map Library in 2001 by the University’s geography department. This collection consists of approximately 20,000 print photographs taken by several federal agencies from 1937 through the 1970s. Since the completion of the grant in 2004, the library has continued scanning and georeferencing the print collection of aerial photographs, working with the Rocky Mountain regional office of the USFS, in preparation to add them to the online database.

Aerial photographs are both historical image documents and geospatial materials, giving the photographs qualities that may require different methods of access and retrieval, depending on the user’s perspective. Therefore, this digital library was designed to offer two search interfaces: a Colorado map that facilitates spatially-oriented searching, and a geographic keyword interface for textual searching (Figures 1 and 2).

User-centered design of the initial prototype of the Aerial Photographs of Colorado digital library was precluded both by a short deadline for the grant, and because the project team itself was formed gradually, only coming together as a whole toward the
end of the grant. Making a conscious decision to focus on functionality as they
developed the first iteration of the site, the team gathered functional requirements
through informal conversations with librarians who had knowledge of how people
search for and use aerial photographs. Because of the time constraints, the intent was
to build a functional prototype, with usability testing to follow in the next iteration of
development. For more information about the first stage of the project, including
georeferencing, metadata provision, scanning procedures, website architecture, and
database design (Cronin et al., 2005).

Digital library usability
Designing a usable interface is a critical concern for digital library development.

In the case of a digital library [as opposed to a physical library], the interface is a gatekeeper
to the collection. If the interface isn’t understandable, or doesn’t work, the digital library
holdings remain essentially inaccessible (Buttenfield, 1999, p. 42).

Over time, evaluation has become an integral part of the development process. In 2000,
while the development and use of digital libraries was growing exponentially,
“evaluation [of digital libraries] was not a conspicuous thing” (Saracevic, 2000, p. 351).
By 2002, the topic had gained significantly more visibility, and the Joint Conference on
Digital Libraries (JCDL) held a workshop on usability. As a result of that workshop, the
International Journal on Digital Libraries published an issue in 2004 (Vol. 4, No. 2)
containing articles on usability and evaluation of digital library interfaces in different
disciplines and using different methodologies. Evaluation of digital libraries continues
to increase. In 2005, at least six of the papers presented at the JCDL focused on this

Today, usability testing is widely accepted as an effective means for evaluating
digital library interfaces. Usability is defined as the “extent to which a product can be
used by specified users to achieve specified goals with effectiveness, efficiency, and
satisfaction in a specified context of use” (International Organization for
Simply stated, usability measures ease-of-use relative to a defined audience with explicit objectives. Nielsen describes usability as a multi-faceted concept with five characteristics: learnability, efficiency, memorability, errors, and satisfaction. Systems should be easy to learn and remember, efficient to use, have a low error rate, and be satisfying to use (Nielsen, 1993, p. 26).

**Literature review**

Literature on the evaluation of digital libraries has grown significantly in recent years. An enumeration of the complete body of literature is beyond the scope of this paper. This brief review will place the research completed on the Aerial Photographs of Colorado project within the context of several representative usability studies on digital libraries and geolibraries.

**Evaluation of digital libraries**

Many studies have emphasized the significance of the needs of the end-user in the evaluation process – a point particularly important for the Aerial Photographs of Colorado collection, given its distinct geospatial content. *Digital Library Use* (Bishop et al., 2003) includes several chapters on the topics of use and evaluation of digital libraries within the larger context of sociotechnical systems. In “Designing digital libraries for usability”, Borgman (2003) explores the importance of the relationship between the content in a digital library, its design, and the needs of the target audience. Her article discusses usability criteria and evaluation methods for digital libraries and emphasizes the importance of discovering “who would use the content, how, and why” (Borgman, 2003, p. 92). “The people in digital libraries: multifaceted approaches to assessing needs and impact” (Marchionini et al., 2003), focuses on user needs.

All efforts to design, implement, and evaluate digital libraries must be rooted in the information needs, characteristics, and contexts of the people who will or may use those libraries (Marchionini et al., 2003, p. 119).

The case studies presented provide an overview of user needs assessment for three digital libraries with distinct user groups. Evaluation methods include observations, interviews and user feedback, surveys, document analysis, and studies of system surrogates.

Articles addressing the evaluation of two specific digital libraries proved particularly useful when planning the usability study on Aerial Photographs of Colorado: namely, the Cypress project, and the Networked Computer Science Technical Reference Library (NCSTRL).

Cypress is a digital collection of images from the Film Library of the Department of Water Resources branch of the California State Resources Agency. It is a collection within the University of California Berkeley Digital Libraries project. Evaluators conducted heuristic testing of Cypress using Nielsen’s (2005) “Ten usability heuristics”. Van House et al. (1996) found that users outside of the Film Library were confused by the terminology used and the number of options presented in the search form. Film library staff, on the other hand, found the options and the labels to be useful. Users also wanted the ability to view and print the search results set as a contact sheet, a concept they were familiar with in viewing print images.
“Usability inspection of digital libraries: a case study” (Hartson et al., 2004), reports on a usability evaluation of NCSTRL, a collaborative project between NASA Langley, Old Dominion University, University of Virginia, and Virginia Tech. The authors conducted a usability inspection of the digital library using representative tasks that resulted in the compilation of a list of usability problems. Their analysis of problems found with the searching and browsing functions is particularly relevant to this study. While interface designers often conceive of and develop the searching and browsing functions separately, the division is less distinct to the user. The authors suggest that designers consider the different mechanisms of each function, rather than the tasks users need to accomplish and how the system might support those:

By following a functional view of keeping them separate ... the user may be discouraged from using them together in a more integrated way where the two functions can work together (Hartson et al., 2004, p. 117).

Evaluation of geolibraries
Geolibraries are not as well represented in the literature on usability evaluation as other types of digital libraries. Geolibraries are defined as libraries that contain georeferenced information, represented by the spatial footprint (i.e. geographic area of coverage) of the item. Geolibraries include a map browser, a base map to provide geographic context, and a gazetteer, that provide access to the materials within the geolibrary (Goodchild, 1998). Although these functionalities are different from those in Aerial Photographs of Colorado, an assessment of the literature addressing geolibraries is important because of their similar geospatial content.

One of the first geolibraries is the Alexandria Digital Library Project (www.alexandria.ucsb.edu/), a project of the Davidson Library at the University of California at Santa Barbara. The Alexandria Digital Library (ADL) is a distributed geolibrary, with an integrated gazetteer, that contains georeferenced materials, both cartographic and textual. Several evaluations have been conducted on the ADL. Buttenfield (1999) discusses user-centered design and usability evaluation of the ADL. Convergent evaluation was conducted over three years during the continued development of ADL and the introduction of new technologies. Convergent evaluation uses multiple methods simultaneously and compares the results. Methods used in this evaluation included ethnographic surveys of user activities, cognitive walkthroughs of screen shots, videotaping of volunteer users, focus groups, reference interactions, online user surveys, transaction logging, and task analysis. The evaluation team collected demographics on the beta testers to determine target user groups: earth scientists, “information mediators”, and middle and high school teachers (Buttenfield, 1999, p. 51). A requirement analysis conducted through interviews, focus groups, and observation of reference interactions showed that users wanted to be able to search by location, by time, and by theme (such as vegetation, geology, or land use). Transaction logs and online user surveys showed that users were often confused as they completed the various steps necessary to build a query (Buttenfield, 1999, p. 52). The Aerial Photographs of Colorado usability study concluded similar findings.

Hill et al. (2000) further explored user evaluation of the ADL. In addition to the methods mentioned by Buttenfield (1999), design review sessions and studies of use of ADL in the classroom were employed. These studies found that users need both further
help with the interactive map browser (for the novice users) and additional search capabilities (for the experts), depending on the level of expertise (Hill et al., 2000, pp. 254-5). This project also assessed the evaluation methods used and concluded that online surveys were not as useful as focus groups and user scenarios. As a result, the project team for Aerial Photographs of Colorado decided not to use online surveys, and focused on developing an evaluation methodology that would involve personal interaction with users.

Overview of research methodology

User-centered design

The usability testing employed in the evaluation of Aerial Photographs of Colorado was conducted as a part of a larger project to redesign the interface based on the principles of user-centered design. Human Centered Design Process for Interactive Systems – International Organization for Standardization (ISO) standard 13407 – outlines the principles and methodology behind user-centered design. This approach requires the varied skill sets and perspectives of a multi-disciplinary team. Ideally, the team should involve individuals who will use the system (the end-users) at every stage of the design process to ensure that the team has a complete understanding of the target audience and their needs (International Organization for Standardization, 1999, Section 5). This approach involves four activities, also outlined in ISO standard 13407. First, the design team must understand the end-user and the context in which the system will be used, through techniques such as interviews and observation. The team identifies requirements for the system, based upon user tasks, organizational goals and constraints, and creates potential prototypes. Finally, the team evaluates these prototypical designs against the requirements, testing for usability. These four stages of design are carried out in an iterative process until the system satisfies requirements defined in the early stages of this process (International Organization for Standardization 1999, Section 7).

Rationale for user-centered design

User-centered design is more time-consuming and resource-intensive than other approaches. The commercial sector, however, has widely acknowledged the benefits of usable systems: “increased productivity, enhanced quality of work, reductions in training and support costs, and improved user satisfaction” (International Organization for Standardization, 1999, Introduction).

User-centered design is just as appropriate and beneficial to libraries as it has been for the commercial sector. A methodology that places the user population at the center of the design process resonates with a profession that strives to provide resources and services that meet its clientele’s needs. Library patrons have ever-increasing options for locating information in the online environment. By designing digital library interfaces according to library clientele’s needs and using good usability practices, libraries will be better able to compete in the rapidly evolving information marketplace. Finally, the practice of user-centered design naturally builds support among stakeholders. As a result, libraries benefit in two ways. First, patrons are more likely to use a resource when they have input into its development. Second, the process of user-centered design builds a sense of community and support for the library on a
broader scale, as library clientele are more likely to perceive the library as an institution that responds to their needs.

Currently, digital libraries of geospatial resources are less common than those containing textual materials or still images. Methods of searching, manipulation, and use of cartographic materials differ from the methods used for libraries' more common text-based materials. It is important to focus on the specific needs of users of these resources. As Borgman (2003, p. 91) points out, “at the core of effective digital library design is the relationship between the content to be provided and the user community to be served”. Generalists and system designers are less familiar with the needs of these particular users, making the argument to conduct user-centered design even more compelling.

Research methods

After launching a functional prototype of the Aerial Photographs of Colorado, the design team began the second round of development, focusing on the four activities of user-centered design. The team began with a requirements analysis in order to investigate the needs of the end-users of this collection.

During the requirements analysis phase, the team identified the primary audience and conducted six interviews to learn more about that audience’s needs and tasks. Then the team identified goals for creating the online collection and constraints that would affect the final design, culminating in a list of functional requirements.

The team also conducted discount usability testing to evaluate the existing interface of the digital library. “Discount usability” is an approach that utilizes simple, inexpensive, but effective testing techniques (Hill , p. 17) with as few as three to five users (Nielsen and Mack, 1994, p. 15). While this sample size may seem small, Nielsen and Landauer conducted a study of heuristic evaluations that showed 80 percent of the usability problems were discovered by six participants (Nielsen and Mack, 1994, p. 33). For this study, six library volunteers evaluated the interface against Nielsen’s (2005) “Ten usability heuristics”. Additionally, four members of the Geological Sciences and Geography Departments at the University of Colorado at Boulder participated in user testing.

Requirements analysis

The first step in the user-centered design model is a “requirements analysis”, the stage in which the design team identifies the primary target audience and works with them to discover their needs and expectations for the system. This process has also been called a user needs assessment in the literature. The end product of this analysis is an enumeration of the initial goals for the digital library, identification of any constraints the system development faces, and a list of functional requirements, or the necessary and desired features for the system.

Identifying and understanding the users

The team began the requirements analysis by identifying the site’s audience. It was difficult to pinpoint a single group, because the aerial photograph collection has a broad appeal. Aerial photographs provide a record of the natural and human landscape at a particular point in time. An attorney might use an aerial photograph in a property or boundary dispute. An environmental planner may use historical aerial photographs
to conduct an assessment of a site slated for development or preservation. A geologist studying erosion, landslides, or evidence of past earthquakes will analyze historical aerial photographs. A geographer uses aerial photographs to view changes in land use or land cover, such as evidence of ranching, agricultural activity, or vegetation changes. Faculty, students, government employees, business people, and researchers in a variety of disciplines use aerial photographs in their research and study.

In considering all the potential users of the collection, the team designated faculty, staff, and students of the University’s Geology and Geography departments as the primary audience for two reasons. First, the libraries’ primary mission is to serve the University community, and members of these particular departments are the heaviest users of the print aerial photographs collection. Second, the team believed that the basic information-seeking behaviors of researchers in the academic environment transfers to earth sciences researchers in other environments. This target audience also includes a wide variety of skill levels, from undergraduates who use aerial photographs in introductory-level course assignments to staff who use these resources on a daily basis to create new cartographic materials. By focusing on this selected group, the team was able to create a resource that was useful for a wider community and for individuals with varying skill levels.

Because the target group includes individuals from two different departments with varying degrees of experience, and students as well as professors, the team speculated that the audience might actually represent several sub-groups. The resulting data suggests, however, that these individuals have more commonalities than differences when it comes to searching for aerial photographs in the online environment. And indeed, when the team analyzed searching methods and types of tasks by department, skill level, and academic rank, there were no clear patterns to suggest that sub-groups exist.

Requirements analysis methodology
User-centered design practitioners have a range of techniques to elicit requirements from the target audience, including conducting interviews, observing the end-users performing relevant work, or analyzing documents and other tangible work products (Preece et al., 1994, p. 384). In the evaluation of Aerial Photographs of Colorado, the team conducted interviews to gather requirements for the digital library. The team wrote 26 interview questions designed to gather information about the users’ knowledge, experience, attitude, motivation, typical tasks, and physical characteristics as these factors relate to the way they use aerial photographs (Mayhew, 1999). See Appendix 1 for a list of the interview questions.

The team recruited six participants from the Departments of Geology and Geography at the University of Colorado at Boulder through e-mails to departmental LISTSERVS and the librarians’ contacts with aerial photograph users. The test group consisted of four representatives from Geology and two representatives from Geography. The participants included one undergraduate student, one masters student, one doctoral candidate, two faculty members, and one staff member.

The team interviewed students in a library conference room equipped with a laptop and data projector; faculty and staff were interviewed in their offices. One member of the team conducted the interview, while the other two took notes. The interviews ranged from 30 minutes to an hour.
Analysis of interviews

The interviews began with questions about the participants’ use of the internet and the library’s electronic resources to get a sense of their knowledge and experience in the online environment. Half of the respondents reported spending 6-10 hours a week online doing research or school-related activities. The remaining participants spent either 0-5, 11-15 or 15+ hours a week conducting research or school-related activities on the internet. All six participants utilize the library’s electronic resources and mentioned consulting bibliographic databases, specifically GeoRef and web of science. The respondents, however, also mentioned electronic journals, the library’s online catalog, electronic reserves, the Map Library’s website, and even the online prototype for the Aerial Photographs of Colorado digital collection, which suggests that this user group is familiar with the wide range of electronic resources and services offered by the libraries. This group is also a good test group for usability issues of a digital library for two reasons. Expectations of the usability and design of digital libraries are shaped by the internet experience level of the user (Blandford et al., 2004). In addition, the ability to offer perceptive observations of usability issues is increased by internet experience and experience with digital libraries. In other words, “proficiency with digital libraries” gives credence to the perceptions users hold about digital libraries (Koohang and Ondracek, 2005). These test users’ level of internet use and familiarity with the library’s electronic resources will give their insight added authority.

In order to establish the participants’ skill level regarding aerial photographs, the team asked them to put themselves into one of three categories – novice, intermediate, or expert – and to explain why. Two of the participants reported being between novice and intermediate users. Three identified themselves as intermediate users and one as an expert user. The novice-to-intermediate and intermediate users identified themselves as such because they had used aerial photographs in GIS software or in support of their field research for either only a short period of time or for “informal” research. The expert user works with aerial photographs on a daily basis in GIS software to create new cartographic materials.

While three participants study areas throughout the western United States and two study regions worldwide, all participants study specific areas in Colorado, including the Front Range region, Boulder, Rocky Mountain National Park, Fort Carson Pinon Canyon Maneuver site, and West Bijou Creek. Three of these sites are within the area covered by the photographs scanned for this project – an indication that this digital collection serves the research, teaching, and learning needs of the target audience.

Participants described using aerial photographs to complete three types of tasks. Four of the six respondents use them to identify field sites and as aids in the field. For example, one participant uses aerial photographs to locate areas with marked vegetation changes along the border of a national park in order to identify possible study sites. Four participants reported using aerial photographs to detect changes in the landscape over time. One geologist uses historical aerial photographs from the 1930s, recent aerial photography, and other cartographic materials detect changes in erosion of arroyos over time in southeastern Colorado. Finally, two participants create new cartographic materials from aerial photographs. The undergraduate student described a class project in which he imported a digitized aerial photograph into GIS software and augmented it with additional geospatial data to create a new map.
As each respondent discussed these uses, two common sub-tasks were identified. Participants need to import digital aerial photographs into GIS software to perform much of their work. The aerial photograph must be georeferenced completely so other maps can be layered over or under it in a GIS. Depending on the level of accuracy needed, the photographs may need to be orthorectified, which involves removing the distortion inherent in aerial photographs from the digital files.

Participants also reported a second sub-task: comparing aerial photographs to other cartographic materials. For example, one respondent described a research project in which she used aerial photographs to identify likely areas for debris flows, which are easier to see on an aerial photograph. She then correlated features on an aerial photograph and a topographic map, sketching the debris flows on the map in preparation for her field work.

When searching for aerial photographs, participants frequently turn to several sources – the internet, colleagues’ collections, government agencies, or the library – before finding the photograph they need. Half of the participants reported searching for aerial photographs online first, remarking that they like to be able to search anytime and anywhere without having to know where the physical collection is located. They consistently commented, however, on the lack of high quality, free aerial photographs online. Participants also frequently stressed the importance of viewing photographs in spatial context for both print and online aerials.

At the conclusion of the interview, participants were asked to show the team their favorite websites for aerial photographs. The sites included Terraserver USA, Google and Google Image, Keyhole, Topozone, USGS Seamless Distribution System, and Visible Earth. Zooming capabilities, as well as text and map searching functions, were important to the participants. They praised sites that adequately maintained the aerial photograph in spatial context and became frustrated with sites that did not. Terraserver USA was most frequently mentioned as an exemplar for online geospatial collections. Participants found the searching and browsing capabilities easy to use, even though they occasionally lost a sense of spatial context when zooming (browsing) a map. One participant reported that the instructions and tools for downloading and using the photographs in GIS software are excellent.

Goals, constraints, and functional requirements for the digital collection
Once the needs of the primary target audience were investigated during the first stage of the requirements analysis, the team reviewed the goals for the digital collection. Because a formal requirements analysis had not been conducted, the initial goals for the digital collection were developed by librarians familiar with the research needs and methods of earth scientists. The Jerry Crail Johnson Earth Sciences and Map Library’s goal in creating this online digital collection was to make the aerial photographs available to a larger audience by providing searchable access to the collection through an online interface. The interface was planned to deliver access through searching and browsing functions that specifically address the geospatial nature of aerial photographs. The team proposed to allow users to search through an interactive map and a keyword search. The map would display regional geographic features and the location of each photograph. The user could select an area, zoom in and see enough detail to choose the appropriate photograph. A keyword search would allow for searching by administrative areas (such as county), by common geographical divisions
(such as US Geological Survey 1:24,000 topographic quadrangle name), and by prominent geographic feature (labeled “landmark” in the database).

**Constraints**

The planning, design, and implementation of the online collection recognized several constraints that regulated the development. During the initial planning and development stages of the prototype, the time constraints of the grant funding, nature and condition of the collection, staffing levels, and technological expertise all affected design decisions.

The prototype interface uses Active Server Pages (ASP) and JavaScript. Functions such as zooming and access to individual photographs were curtailed by the amount of time it would have taken to create separate pages for each zoom level and to link each photograph to its record. For example, the team initially planned to link the dot representing the center point of each photograph to the digital image. Not only did time and staffing constraints prevent this, but also the paths the airplane flew to capture the images were often quite close, creating overlap and, at times, obscuring individual flight paths (an important facet of the online display that affects a user’s understanding of the spatial context of each photograph). Therefore, the team decided to draw a line representing the airplane’s flight path (called the “flight line”) on top of the photographs’ center points, and to link to a results set of all of the photographs in that flight line.

The photographs were georeferenced using ESRI’s ArcGIS software and the team considered making the photographs available online using ESRI’s internet GIS software, called ArcIMS. An internet GIS interface would have allowed for the most flexible map searching, with the ability to zoom, identify features, turn map layers (such as topography or cities) on or off. Although the software was available to the libraries through a campus site license, neither the Libraries’ Systems Department nor the Map Library had the technical expertise or staff to implement and maintain an ArcIMS system. Also, an internet GIS interface can be slow, at times almost impossible to use over a modem, and has a learning curve that can be steep, depending on the prior experience of the user.

During the initial planning stages, the team considered georeferencing the photographs completely to make them photographs ready to load into a GIS software program. This would also have required orthorectification, a process by which the distortion inherent in aerial photographs is removed from the digital files. Time restraints in the grant funding did not permit this, but the team also had other concerns. Details about the camera such as focal length and calibration, which are needed to rectify the photographs, are unknown. In addition, these aerial photographs have been used for teaching and research purposes for years and are bent, warped, and in some cases, torn, increasing the distortion in the image. The level of accuracy needed in interpreting an aerial photograph varies by use and the team felt it was better for individual researchers to orthorectify and manipulate the photographs to their own standards rather than to provide them with a product that may not be as cartographically accurate as they wished.
**Functional specifications**

Given the initial goals of the digital library, the constraints faced by this project, and the results gathered from the target audience through the requirements analysis, the team developed a list of functional specifications for the next iteration of the online collection interface. An important function mentioned by all participants during the requirements analysis was the ability to view and download the photographs at different resolutions. Users wanted to be able manipulate the photographs within the digital library – to zoom in or zoom out on each access image. It was also important to users to have the ability to download the photographs at low, medium, and high resolutions. These functionalities will be included in the next iteration of the online collection interface.

Users from the target audience use GIS software in order to complete most of their tasks with the photographs. The team decided to georeference the photographs completely, but not to orthorectify them, given the missing information and the concerns about accuracy. This compromise will allow researchers to easily work with a usable image in GIS software and provide a good starting point for further manipulation if needed.

**Heuristic evaluation**

The requirements analysis phase is the foundation upon which the rest of the development cycle is built. This step guides the processes of creating and evaluating the digital library. Having studied the users and their tasks and developed functional specifications, the team was ready to conduct usability testing to evaluate the initial prototype.

**Methodology**

In a heuristic evaluation, a group of evaluators assesses an interface based on a set of established criteria for good design (Nielsen and Mack, 1994, p. 26). Each evaluator independently examines the site and generates a list of problems. In some cases, they will also rate the severity of the problem from “cosmetic” to “severe”. The evaluators’ lists are then aggregated and provide the development team with feedback on specific elements of the design that need to be improved.

The team chose to do a heuristic evaluation for several reasons. A heuristic evaluation is easy to conduct and provides feedback with minimal data analysis (Nielsen and Mack, 1994, pp. 27-8). It is also a valuable technique for uncovering some usability problems that may not be identified by other means of user testing (Nielsen and Mack, 1994, p. 30). Finally, non-specialists can serve as evaluators. It would have been difficult to find a large number of people with aerial photographs expertise, and the team wanted to reserve those participants for the user testing. Therefore, six evaluators were solicited from among the libraries’ faculty and staff.

While there are many published lists of heuristics, the team used Nielsen’s (2005) widely-adopted Ten usability heuristics that consist of “visibility of system status”, “match between system and the real world”, “user control and freedom”, “consistency and standards”, “error prevention”, “recognition rather than recall”, “flexibility and efficiency of use”, “aesthetic and minimalist design”, “help users recognize, diagnose, and recover from errors”, “help and documentation”. For a description of these heuristics, see Nielsen (2005).
The team developed an instrument to facilitate the heuristic evaluation, based on Xerox’s (1995) “Heuristic evaluation – a systems checklist”, available on the Society for Technical Communication’s Usability and User Experience: Usability Toolkit website. The instrument contains 94 questions in two parts. In the first part, the evaluator follows instructions to complete two typical tasks, performing searches in the map and keyword interfaces. While completing these tasks, the evaluator uses both search interfaces, reviews a results set, examines an access image and its complete metadata record, and encounters an error message. In the second part, the evaluator takes a second pass through the system and assesses the site as a whole on navigation, page layout, system status, labels, language and topography, instructions, error messages, hyperlinks, images, and color schemes. Each section contains a question that prompts the evaluator to examine some aspect of the interface and judge it against a specific heuristic. The evaluator checks a box to indicate whether a heuristic is “always”, “sometimes”, or “never” properly applied. The evaluator elaborates on a “sometimes” or “never” response in the notes field to indicate how the heuristic was violated.

Since volunteers were not domain experts, the team gave each evaluator a brief introduction to the site, described how typical users might use the site, and explained domain-specific vocabulary. Participants were encouraged to explore the site before completing the heuristic evaluation instrument. The volunteers took 45 minutes to an hour to assess the site. Afterwards, the team compiled and analyzed the results.

Heuristic evaluation results

The evaluators provided a total of 83 comments, 43 of which were considered duplicative in content, leaving a total of 32 problems the team identified as violating a heuristic. The table below lists how many times each heuristic was violated; the most problematic ones were “recognition rather than recall”, “match between system and the real world”, and “user control and freedom” (Table I).

The map search was the least intuitive function. It was found to violate multiple heuristics, particularly “recognition rather than recall”. The map search requires end-users to make selections on a series of screens, beginning with a state map and narrowing in on a smaller geographic region through consecutive screens. The first step requires users to select a date, because the photographs are grouped by date and county. Similar to findings about the ADL search interface (Buttenfield, 1999), five of the evaluators stated that this multiple step process was unclear from the beginning.

<table>
<thead>
<tr>
<th>Heuristic</th>
<th>Number of violations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visibility of system status</td>
<td>1</td>
</tr>
<tr>
<td>Match between system and the real world</td>
<td>8</td>
</tr>
<tr>
<td>User control and freedom</td>
<td>4</td>
</tr>
<tr>
<td>Consistency and standards</td>
<td>2</td>
</tr>
<tr>
<td>Recognition rather than recall</td>
<td>12</td>
</tr>
<tr>
<td>Aesthetic and minimalist design</td>
<td>3</td>
</tr>
<tr>
<td>Help users recognize, diagnose, and recover from errors</td>
<td>1</td>
</tr>
<tr>
<td>Help and documentation</td>
<td>1</td>
</tr>
</tbody>
</table>

Table I. Violations grouped by heuristic
Four evaluators did not realize that they had to select a date before clicking on a county. Two evaluators also cited this problem as a mismatch between the system and the real world. Not only does the label “map search” set the expectation of a spatial search, but also the state map is the largest and most eye-catching feature on the page. Yet, the search begins with a date selection from a drop-down menu in the upper left corner. One of the evaluators commented, “I went to the map first . . . It does say ‘start search’ above the date, but I was drawn to the map first!”

Another evaluator requested a complete drop-down box listing counties and dates on the map search site. This comment substantiates results from the usability study of the NCSTR, which found that searching and browsing (browsing being akin to the map search) functions are interrelated, and should be designed together to better respond to the tasks that users need to accomplish (Hartson et al., 2004, p. 117).

There is a list of counties and years for which photographs are available, but it is only seen on the state map page. Evaluators pointed out that this list should be available on subsequent screens as well. Failing to provide this information burdens the user’s memory load – a violation of “recognition versus recall”.

Once the user selects an aerial photograph, they can view an access image (approximately 600 × 650, though dimensions vary based on the size of the original) and its complete metadata record in a framed window. On many screens, the entire image is too large to be viewed at once, without scrolling, in the main frame. Four of the evaluators cited this as a problem. In the smaller horizontal frame that contains the complete metadata record, there is a navigational element that links to the next photographs to the north and south. One evaluator stated that these links should be moved up into the main frame, so that they are visually related to the photograph that they reference.

Most of the “match between system and the real world” problems resulted from vague terminology and jargon. Two evaluators commented that the term “identifier” – used to designate the photograph’s unique identification number – was ambiguous. An evaluator suggested using “photographs” instead of “hits” on the search results screen. Another evaluator stated that “flight line” is jargon.

The third most frequently cited heuristic, “user control and freedom”, pointed to navigational issues in the map search function and on the access image page. Evaluators found it difficult to navigate from the county map back to the state map and from the search results screen back to the county map. One evaluator mentioned that there was no easy way to navigate from the search results screen to photographs from other flight lines. The system requires the user to return to the county map and to change the parameters of the search. Several evaluators cited the lack of navigational elements from the access image back to the search results screen.

After completing the heuristic evaluation to check the prototype for elements that violate good design principles, the team started the user-testing stage of the usability investigation.

User testing
The Usability First (2005) online glossary defines user testing as “a family of methods for evaluating a user interface by collecting data from people actually using the system” (www.usabilityfirst.com/glossary/main.cgi?function = display_term &term_id = 44). Specifically, this study used a technique called “thinking aloud” in
which a user is given a set of tasks and asked to verbalize their thoughts as they accomplish them using the interface. As they work on each task, the team observes the user, taking notes on their comments and interactions with the interface. This technique is beneficial because “users allow [the team] to determine not just what they are doing with the interface, but also why they are doing it” (Nielsen, 1993, p. 18). As a result, the team understands how users are interpreting the interface’s features and functions (Nielsen, 1993, p. 195). This study also employed a variation of card sorting to determine what aerial photograph metadata users want, as well as how they want it labeled and displayed. In card sorting, concepts (the labels for metadata, in this case) are listed on separate index cards so that the user can sort and group the concepts in a logical order (Nielsen, 1993, p. 127).

Methodology
Four participants – two faculty and two students from the geology and geography departments – volunteered for the user testing. Each participant was given five tasks to complete and asked to think aloud as they worked. The session facilitator and at least one other member of the team took notes as the participant completed the tasks. The tasks reflect typical uses of the site, as determined during the previously conducted user requirements analysis.

In addition to the card sorting exercise, participants were asked to comment on the layout of the access image and metadata page, and which of the two search interfaces – map or keyword – would be more useful for their research. And, as the session concluded, they were invited to provide general feedback on the site. See Appendix 2 for a complete listing of the tasks.

User testing results
User testing uncovered problems and, in many cases, confirmed previously discovered faults in aspects of the search features, ambiguous spatial orientation, navigation, and labeling. This section will present the results of the user testing and highlight common findings from previous steps in the usability study of Aerial Photographs of Colorado.

Map search
When asked to find an aerial photograph of Eagle County from 1938 using the map search, all of the participants consistently clicked on or rolled their mouse over the map first, rather than select a date from the drop-down menu. One participant commented as he performed the task that he would prefer to roll the mouse over counties, prompting a box to display dates when photographs are available. The participants’ preference to click on a county from the map, as opposed to choosing a date first, confirms findings from the heuristic evaluation and requirements analysis.

Once they located a photograph of Eagle County in 1938, the participants were asked to navigate to a map of Eagle County in 1946. This task was included to test menu options on the county map page, which allow users to navigate to maps for other counties or years. Only one participant had difficulty with this task, stating that he expected the page to refresh without clicking the “submit” button. One participant frequently used these menus to navigate through the map search page in subsequent tasks, suggesting that this is an effective navigational tool.
Throughout the map search interface, conventional underlined blue font is used for text that is hyperlinked; Java scripting is used to indicate entire clickable regions (counties) that automatically highlight when scrolled over by the mouse. However, a few participants had difficulty determining what was hyperlinked on the county map. One participant expected all the town labels to be hyperlinked. Another participant did not notice that certain counties were hyperlinked even though they were highlighted when she rolled over them.

**Keywords search**

In the first task, participants were asked to use the geographic keyword search to find one of the photographs of Willow Creek in the Fall River Pass topographic quadrangle. The purpose of this task was to see if the participants used the landmark and topographic quadrangle drop-down menus in the keyword option to retrieve a photograph. Two participants selected the landmark “Willow Creek” from the first drop-down menu, but did not notice the other menus below it at first. One of the participants hesitated and then said, “Can I get to [the topographic quadrangle] from here?” before he saw the appropriate drop-down menu. The other participant attempted to search by keyword alone, before he returned to this screen and saw the topographic quadrangle drop-down menu on the second attempt.

During the heuristic evaluation, participants also noted that the instructions on the keyword search page were ambiguous, and may lead users to believe that they either must select a choice from only one drop-down menu or must select choices from all the drop down menus.

**Comparing the map search and geographic keyword search**

After using both the map search and geographic keyword search, the participants were given the choice to use either tool to find a photograph of the town of Boulder in 1938. Interestingly, the two participants who completed the task on the first attempt opted for the map search. The other two tried the keyword search unsuccessfully, but found an appropriate photograph using the map search on the second attempt.

When the user testing concluded, the team asked which of the two search tools the participant would be more inclined to use and why. Two participants said that they would use the map search if they were familiar with the location, but would use the keyword search when initiating a query for an unknown location. One participant said that he would be more likely to use the map search, because the region that he studies does not have any named features. The last participant said that she found the map search easier to use, because she was not familiar with topographic quadrangles, one of the drop-down menu options in the keyword search. These comments confirm the initial design decision to provide both spatial and keyword searching.

**Maintaining spatial orientation**

Aerial photographs are spatial resources and users need to have a geographic context in order to effectively search the collection and make sense of the retrieval set. In fact, the importance of maintaining spatial context has been a common theme throughout the investigation. One participant in the requirements analysis remarked: “the hardest part about aerals is to orient them”. Another stated that there was no difference between print (indices) and online environments in this regard, and that aerial
photographs must always be presented in their spatial context. During the user testing, participants reported difficulties with spatial contextualization on the county map page, on the retrieved results page, and on the access image page.

On the county map page, participants remarked that spatial contextualization must be given at all stages of the search. The location of the flight lines must be shown clearly in the geographic landscape. During the requirements analysis, one participant suggested adding more town names along flight lines to help that orientation. Participants also wanted to know where the photographs were distributed over the flight line; one individual suggested placing reference thumbnails on the access page showing the photograph’s location along the flight line in order to provide more spatial context.

In the third task, participants were asked to locate a flight line in Boulder County and then find the continuation of the line in Larimer County. Participants completed the task, but noted that it would be easier if there were some visual indication, such as an arrow on the end of the flight line, to indicate that it continues into another county. Flight lines that span multiple counties are currently displayed in a way that creates a visual disconnect that interrupts spatial orientation.

Participants also had difficulty understanding spatial relationships on the retrieval results page. Currently, thumbnails in the result sets are displayed horizontally left to right. Several participants expressed confusion about how the photographs related spatially to each other and to the flight line, which is displayed vertically, north to south. This confirms one observation made during the heuristic analysis: “There is no explanation about how the photos are related to the flight lines (north to south).”

The access image page, a framed page with an approximately $600 \times 650$ jpeg of the aerial photograph and its complete metadata record, contains a navigational tool that allows users to view the next photograph to the north or south. This feature was intended to help users browse a flight line in a spatial context. User testing uncovered ways that this feature can be modified to more closely resemble spatial navigation features that our users frequently use on other sites. When asked to find the photograph that is south of a specified photograph, one participant rolled his cursor over the bottom region of the photograph and stated that he was looking for a navigational tool near the edge of the photo. When he finally saw the navigation tool actually provided, he said that he expected to see it closer to the photograph. The participant mentioned that he would prefer directional icons (i.e. arrows) on the edges of the access image of the photograph to indicate the option of viewing adjacent images, a feature that is available on Terraserver USA (www.terraserver-usa.com). Another participant in the user testing stated that when viewing the larger access image, he would like to have an additional frame showing that photograph’s spatial relationship to others in the flight line. This comment emphasizes the importance of matching the system to the real world (Nielsen, 2005). The photomosaic index is a common method of indexing print aerial photographs. This type of index displays thumbnails of all of the photographs, as they appear in the flight line. This preference was echoed in the evaluation of the Cypress digital library, which found that users wanted the ability to view and print the search results set as a contact sheet, a concept they were familiar with in viewing print images (Van House et al., 1996).
Navigation
The user testing also uncovered navigation problems. The primary navigational tool is a horizontal bar along the top of the screen with links to the three top-level pages: the site’s home page, map search interface, and the geographic keyword search interface. Each subsequent page, with the exception of the access image page, includes a link back to the next level up in the hierarchy. In the first task, the participants began on the home page, which contains the navigational bar, as well as text links to the map and keyword search tools in the page’s introduction. Two of the participants clicked on the link in the introductory text; one clicked on the navigational bar, but commented that he saw the text link first. This suggests that the navigational bar is not sufficiently eye-catching.

Labels
The card sorting activity provided some useful insights about what types of metadata users need, as well as how they want to see it labeled and displayed. Currently, the website provides the following metadata for each photograph: longitude, latitude, landmark, county, topographic quadrangle, state, scale, date, and photo identifier. Participants also asked for time of day, orientation, city, photographer, and collection name. Two participants asked for clarification on the “topo quad”, suggesting that the label needs to include “US Geological Survey topographic quadrangle (1:24,000)”. The label for “Photo ID” proved problematic for several participants in both the heuristic evaluation and the task analysis. Some did not know what it meant at all, and two participants initially considered it unnecessary metadata. When the interviewer explained after one task analysis session that the “Photo ID” metadata field provided a unique number used to identify and locate the analog photograph, however, one participant stated it was useful after all and should be retained.

After user testing, participants were asked what they would label this grouping of metadata. Two people suggested “metadata”, one suggested either “details” or “photograph details”, and another offered “location information”.

Viewing and using access images of the aerial photographs
Participants indicated a preference to view the entire access image in a single screen without scrolling, a sentiment that was also expressed in the heuristic evaluation. Three participants spontaneously suggested solutions: shrinking the metadata section of this web page; moving it to the side of the photographs as opposed to beneath it; or removing it entirely and adding an option near the photograph to link to the metadata, which, when clicked would appear in a separate pop-up box.

Participants in both the requirements analysis and user testing unanimously indicated a desire to zoom in (to see detail) and to zoom out (to see context for the detail) on the photographs. Since the requirements analysis indicated that printing and downloading photographs is important to the target audience, the team asked the participants to find the instructions for printing and downloading on the site. The testing indicated that the instructions should be on the same page as the access image.

Goals for redesign
The requirements analysis, heuristic analysis, and usability testing carried out on the Aerial Photographs of Colorado digital library have illuminated many problems and
possible enhancements for the digital library. The team analyzed these results and has developed a set of goals for the redesign of the digital library. The goals include functional requirements, navigational changes, and layout enhancements.

The most important and common finding throughout this evaluation was that the photographs must be presented within a geospatial context to allow for effective use. There are many options for providing this context, such as providing more detailed topographic base maps, and displaying the search results and the access image in their spatial setting by including reference maps on the page, and more. All will be considered in the redesign.

The redesign will address the searching and navigational issues found. In addition to providing more spatial context, as mentioned above, the map search will offer the ability to view the overlap of flight lines across county lines and to move smoothly between counties. It will be redesigned so that users do not need to choose a date before clicking on the map, reflecting participants' preferences. Navigational issues such as the provision of easy routes back to map search screens and search results will be resolved as suggested through the usability tests. The metadata display and access image page will be redesigned to eliminate scrolling in the photograph frame and to display the metadata in the optimal way, according to the input from the heuristic analysis and the user testing.

An important enhancement to be included in the redesign will be to provide completely georeferenced photographs to allow for easy import into GIS software.

In addition to redesigning the interface for the Aerial Photographs of Colorado digital library, the University of Colorado at Boulder Libraries will continue to develop the content of this collection. This research has corroborated the team's assumption that making digital copies of historical aerial photographs available online provides an important resource which fills a gap in the available historical geospatial materials for Colorado.

Conclusion
This evaluation has identified user requirements, specific problems, and desired enhancements for the interface of Aerial Photographs of Colorado digital collection. These findings will directly inform the redesign of the collection. It has also contributed to the larger understanding of how researchers use digital aerial photographs and their preferred methods of access and desired functionalities. These issues have not yet been fully explored in the literature. There is much opportunity for further research into the best methodologies to meet needs of researchers using digital libraries of geospatial materials.

Note
1. Georeferencing is defined as matching features on the aerial photograph with real-world features in a coordinate system, such as latitude and longitude. The team georeferenced the center point of each photograph for this project.

References


Appendix 1. Interview questions for requirements analysis

Knowledge and experience

Internet resources
1. How many hours a week do you spend on the internet doing general research, work-related, or school-related activities?
2. Do you use the library’s electronic resources?
3. If so, which ones do you use?
4. Have you ever searched for aerial photographs on the internet?

Aerial photographs
5. Do you consider yourself to be a novice, intermediate user, or expert in the field of aerial photographs?
6. Why?
7. What types of aerial photographs do you use?
8. What geographic region do you study?

Tasks

Establishing specific uses of aerial photographs
9. How do you use aerial photographs in your work, research, or study? Please be specific and provide examples, when possible.
10. When you are (fill in the blank with response from question 9), what do you need to do with the photographs to accomplish this task?
11. Is the scale of the aerial photograph important in completing this task?
12. If so, what scale do you need?
13. What other image characteristics are important?

Searching for aerial photographs
14. Describe how you find the aerial photographs you need, print or digital. Please be specific.
15. Why do you take this approach?
16. What are the disadvantages of searching in this manner?
17. Do you use more than one method to find aerial photographs?
18. If so, describe each method or approach.
19. How do you decide which method to try first?
20. Is there an advantage to finding and using aerial photographs online? Why or why not?
21. Are there limitations to finding and using aerial photographs online? Why or why not?
22. What level of quality do you look for in digitized aerial photographs?

Psychological characteristics
23. What is your general opinion of online aerial photograph resources?
24. (If participant already uses online aerial photos) What motivates you to use online aerial photographs before or instead of their print counterparts?
   OR
   (If participant does not use online aerial photos) What would motivate you to use online aerial photographs in lieu of print photos?

Physical characteristics
25. Are there any physical conditions – such as color-blindness or arthritis – that you think affects a person’s ability to search for and use aerial photographs online?
   (If participant already uses online aerial photos)
Earlier, you mentioned that you use online resources to find aerial photographs. Would you mind answering some questions about those resources? Please start with the resource you are most likely to use first.

26. Do you use any internet resources that provide access to aerial photographs?
   Resource name: __________
   URL: __________
   Participant ranks or uses this resource:
   first second third fourth fifth
   a. Why do you use this site?
   b. What do you like/dislike about it?
   c. What would you want to change?
   d. How do you search in this web site?
   e. Do you use keywords?
   f. If so, how do you choose keywords?
   g. If your search is unsuccessful, what do you do?

27. Before we conclude, do you have any questions or comments for us?

Appendix 2. User testing tasks

Task 1
A. Using the geographic keyword search, find one of the aerial photographs of Willow Creek in the Fall River Pass topographic quadrangle.
   B. Choose the second aerial photograph in the result set. What are the longitude and latitude of the center point of this photo?
   C. Find the photo in the results set that is south of this photo.

Task 2
A. Using the map search, find an aerial photograph in Eagle County from 1938.
   B. Return to the map of Eagle County. Find an aerial photograph in Eagle County from 1946.

Task 3
A. Using the map search, find the map of Boulder County 1938 that shows hyperlinked flight lines.
   B. The hyperlinked flight lines, which begin in Boulder County, continue north into Larimer County. Find the continuation of these flight lines on the map of Larimer County 1938.

Task 4
A. Return to the web site’s home page.
   B. Using either the map search or the geographic keyword search, locate one of the photographs that shows the town of Boulder in 1938.

Task 5
A. Find instructions for “printing and downloading an aerial photograph”.

Digital initiatives project, part 2
IUPUI image collection: a usability survey

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Abstract
Purpose – To measure functionality, content, and awareness of an online digital image collection by observing participants in a controlled search for a specific image and evaluating their responses to questions with the objective of improving the site.

Design/methodology/approach – Participants were recruited from among faculty, staff, and students based on interests stated in online profiles or indicated by type of professional work or academic major. Participants were timed while searching for a target photo and interviewed afterward about their search experience and their use of digital images.

Findings – Most potential users are not aware of the Indiana University-Purdue University Indianapolis image collection and have some difficulty locating it, but when introduced to it find the site attractive and navigable and its content interesting and useful for research, instruction, publication, or class work.

Research limitations/implications – There were only 5,100 images uploaded to the collection at the time of the study. The participant group was limited to 70.

Practical implications – User data and suggestions help the archives staff work with CONTENTdm to make improvements to the site’s function and metadata; choose photos to scan for the collection; and develop site-marketing plans.

Originality/value – This study provides quantitative measurements of user habits and concerns. Observation, sometimes rejected as an obtrusive methodology, is shown here as an important tool to evaluate human-computer interaction for improved understanding of user perspectives on navigability and functionality.

Keywords Archives management, Digital storage, Computers, Photographs

Paper type Research paper

Introduction
Digital image collections accessible via the internet are still a relatively new library resource, most created no more than 15 years ago and many in just the last few years. Books and journal articles proliferate on technical aspects of the digitization process and image quality assessment. Until recently, however, comparatively little research had been undertaken with respect to the access needs of targeted users, and which factors influenced their use of digital image delivery systems. But as consumer expectation of web-accessible images has grown exponentially along with technological advances in their delivery, libraries have hurried to take advantage of a new way to increase use of their photographic holdings while simultaneously identifying and preserving them – and perhaps also protecting them from repeated hands-on use. A decade ago librarians might have asked if they should digitize photo collections and why the task might be important. Today librarians are trying to decide which images to digitize first and where to get the money to fund the projects. Just a few years ago photographs might have been scanned only as low-resolution JPEG files in acknowledgement of long download times for patrons using 56K dialup modems.
Now, high-resolution TIFF files are increasingly desired and available as more users have high-speed online service and demand top-quality images. The role of catalogers in collection access used to be hidden from public view. Now, in an era when most computer users understand the importance of Google keyword searches, the primary issue facing managers of cutting-edge digital image collections is how to provide bibliographic access of equally high quality that is also portable enough to accommodate the inevitable changes in technology and likely need for future collaborative interoperability (Plate 1).

The IUPUI image collection
Indiana University-Purdue University Indianapolis (IUPUI) was created in 1969 as a partnership between Indiana and Purdue universities. IUPUI is a campus of Indiana University that offers degrees in more than 180 programs from both IU and Purdue. The IUPUI University Library’s Ruth Lilly special collections and archives include the manuscript collections, university archives, and rare books. The university archives preserves the official records of IUPUI and its various predecessor institutions, including materials related to the history and unique structure of the institution. The archives includes approximately 250,000 photographic images (Plate 2).

In an effort to increase use of photographs in the archives, improve preservation of the materials by reducing the amount of manual contact with them, and reduce the number of staff-assisted photo searches, Archivist Brenda L. Burk created the IUPUI image collection, an online resource launched in October 2002 (http://indiamond6.ulib.iupui.edu/IUPUIphotos/).
The author observed and timed 70 test subjects while they searched for a target photo, and interviewed them afterward about their search experience and their use of digital images. Based on results from a pilot test of the survey conducted in July 2004, questions were posed that were designed to elicit information needed to improve the site.

Baseline data
At the time of the survey there were approximately 5,100 images uploaded to the IUPUI image collection. All photos – people, buildings, and events – pertain in some way to the IUPUI campus or the development of the urban area it occupies in downtown Indianapolis. According to statistics kept by the archives, faculty and staff are the most frequent users of IUPUI's archived images. Since the launch of the online resource, requests for printed copies of photographs have declined from a high of 232 in 1998-1999 to a low of six in 2003-2004. Requests for printed images are leveling off as users learn to retrieve or request digital images through the web site. (Source: University Photograph Collection Reprint Statistics, Ruth Lilly special collections and archives, IUPUI University Library, 1997-2004, provided by Brenda L. Burk, Archivist.)

Web trends data are available only as an aggregate for the entire period of site operation and not by month. Because the images reside within CONTENTdm™ proprietary software, it is not possible to link directly to specific IUPUI image collection photos from a search engine such as Google. Users must first locate the IUPUI image collection site in order to perform a specific photo search. Also because of the software, it is not possible to display a feedback button or other survey mechanism when users complete their searches. These limitations prompted the archives’ request for a usability study with locally collected statistics.
Protocol
The author conducted interviews with selected users and potential users about their online experience with the IUPUI image collection after observing them while they conducted a controlled search. Participants were recruited from among IUPUI faculty, staff, and students based on interests stated in their online profiles, type of professional work, or academic major.

The author gathered data in October and November 2004 to evaluate the functionality of, content satisfaction with, and awareness of the online resource through observation interviews of current, past, and potential users from within the IUPUI community. The author provided each participant with written instructions to complete an online search for a designated photo, recorded their search path, and noted the time required to reach the target. After the participants completed the search, simple questions were asked about their experience to obtain descriptive answers and constructive criticism.

The author provided the search scenario to each participant on a printed card, stopped participants who had not reached the target photo within 4 minutes, and helped them find the IUPUI image collection home page, http://indiamond6.ulib.iupui.edu/IUPUIphotos/, to try the search again.

The scenario was:

Please search the IUPUI Image Collection to find a 1938 photo of Franklin D. Roosevelt talking with hydrotherapy patients at the Union Building. I will take notes while you search but cannot answer questions until you have finished.

The scenario was constructed so that the most important keywords, “IUPUI Image Collection”, were provided first, followed by terms to narrow the search, including two intentionally incorrect terms, “patients” and “Union Building”, to see what participants who tried to narrow their searches too early would do when confronted with no results. Several photographs in the collection met the search criteria; any of them was considered a target (Plates 3 and 4).

The author took step-by-step notes regarding where participants began the search, what search terms they used, what path they took to the site, and how long it took them to find the target photograph. Search engines used were also recorded, if any, and which search option on the site itself was chosen.

Demographic data and interview questions
Participants were asked their age (noted in spans that correspond with US census age groups) and university affiliation (undergraduate or graduate student and school;
Faculty and staff were also asked if they had ever used or seen the IUPUI image collection previously; if so, how they found out about the site and if they had found what they were looking for; and whether they would use this resource in the future. They were then asked to describe changes that could be made to the site that would encourage them to use it again.

While discussing possible changes, participants were asked if they found the site visually appealing and easy to navigate, using follow-up queries to elicit details. Their personal and professional uses of digital images were also queried, and the types of images they would like to see included on the site.

With the goal of understanding how the site might best be marketed to potential users, participants were asked about their reading habits, with a focus on publications of local interest.

Results (Table I)

Of those who said they had used the site previously, ten heard about it from someone in special collections; six from a student or faculty member; and two came across it by chance while searching other IUPUI web sites. One person had it bookmarked on her computer.

Of those who had used the site previously, nine were faculty, four were staff, two were graduate students, and four were undergrads.

Of the 52 who had not or might have used the site prior to the survey, four were at least aware of it (Table II).

Of those who had not used the site prior to this survey, 36 said they will use it in the future, 12 might, two will recommend it to students, and one will not use it (Table III).
<table>
<thead>
<tr>
<th>Total participants: 70</th>
<th>Number of participants</th>
<th>Percentage of total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-24</td>
<td>13</td>
<td>18.6</td>
</tr>
<tr>
<td>25-34</td>
<td>14</td>
<td>20.0</td>
</tr>
<tr>
<td>35-44</td>
<td>12</td>
<td>17.1</td>
</tr>
<tr>
<td>45-54</td>
<td>21</td>
<td>30.0</td>
</tr>
<tr>
<td>55-64</td>
<td>10</td>
<td>14.3</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>32</td>
<td>45.7</td>
</tr>
<tr>
<td>Males</td>
<td>38</td>
<td>54.3</td>
</tr>
<tr>
<td><strong>Position</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faculty</td>
<td>20</td>
<td>28.6</td>
</tr>
<tr>
<td>Staff</td>
<td>16</td>
<td>22.9</td>
</tr>
<tr>
<td>Graduate students</td>
<td>17</td>
<td>24.3</td>
</tr>
<tr>
<td>Undergraduate students</td>
<td>17</td>
<td>24.3</td>
</tr>
<tr>
<td><strong>Departmental affiliation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alumni office</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Anthropology</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Communications</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Computer science</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>French</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Geology</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Herron School of Art</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>History</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Informatics/news media</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Information technology</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>IU foundation</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Journalism</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Law</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Library and information science</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Marketing administration</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Medicine</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Nursing</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Psychology</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Tourism</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Used the site previously</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Maybe</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>

Table I.

<table>
<thead>
<tr>
<th>Will use in the future</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>55</td>
</tr>
<tr>
<td>Maybe</td>
<td>12</td>
</tr>
<tr>
<td>No, but will recommend to others</td>
<td>2</td>
</tr>
<tr>
<td>No</td>
<td>1</td>
</tr>
</tbody>
</table>

Table II.
Of those who said the site was easy to navigate, five commented that it was easy to navigate once it had been located. Those who did not find the site easy to navigate made suggestions for improving the search functions and metadata (Table IV).

Of those who liked the site design, several specifically approved of its “minimalist” or “uncluttered” layout and the size of the thumbnail images. Of those who did not like the design, several specifically mentioned the gray background as detracting from its appeal. Many of those who said the site design was acceptable also criticized the gray background color and simple design.

**Images of interest**
Participants indicated their desire to see the following photographs (in order of frequency mentioned): anything historical; people; events; aerial views; buildings; landscapes; parks; neighborhoods; building interiors; classrooms; teacher-student interaction; professional-patient interaction; technological innovations; Indianapolis; art; athletics; extracurricular activities; medical- and nursing-related; African Americans and other minorities; close-ups of structures, especially pre-IUPUI; disability access; computer labs; internet-related; women; anything unusual (Table V).

**Remember seeing a photo from the site used somewhere**
After the survey, 48 participants did not recall seeing a photo from the site in print or electronic use, one might have, and 21 were able to name a specific place they had seen an image from the collection published (Table VI).

Of the 19 participants who said they had or maybe had used the site previously, 13 (68.4 percent) reached the target in 1 minute or less, and all (100 percent) reached it 3 minutes or less. Of the 51 participants who had not previously used the site, 14 (27.5 percent) reached it in 1 minute or less, and 32 (62.8 percent) reached it in 3 minutes or less. Of all 70 participants, 51 (73 percent) reached the target photo in 3 minutes or less.

The two most direct paths to the site are:

1. From Google > search “IUPUI Image Collection” > click on first link.
2. From any IUPUI home page > search “IUPUI Image Collection” (or “image collection”) > click on first link.

<table>
<thead>
<tr>
<th>Ease of navigation</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy</td>
<td>45</td>
</tr>
<tr>
<td>OK</td>
<td>13</td>
</tr>
<tr>
<td>Not easy</td>
<td>12</td>
</tr>
</tbody>
</table>

Table III.

<table>
<thead>
<tr>
<th>Attractiveness of the site</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thought it was OK</td>
<td>35</td>
</tr>
<tr>
<td>Liked it</td>
<td>25</td>
</tr>
<tr>
<td>Did not like it</td>
<td>10</td>
</tr>
</tbody>
</table>

Table IV.
Of the 70 participants, six took the most direct path from Google and 16 took the most direct path from IUPUI. They were able to reach the target photograph in less than 1 minute. Others also started at these points but followed paths through additional links (sometimes many) before reaching the target photo (Plates 5-8).

Table V.

<table>
<thead>
<tr>
<th>Use of digital images</th>
<th>Number of participants (multiple responses)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal or professional work</td>
<td>21</td>
</tr>
<tr>
<td>Publications</td>
<td>19</td>
</tr>
<tr>
<td>Instruction (faculty)</td>
<td>18</td>
</tr>
<tr>
<td>Web site</td>
<td>18</td>
</tr>
<tr>
<td>Class projects (students)</td>
<td>17</td>
</tr>
<tr>
<td>Research</td>
<td>11</td>
</tr>
<tr>
<td>Do not use</td>
<td>11</td>
</tr>
</tbody>
</table>

Table VI.

<table>
<thead>
<tr>
<th>Approach to the search</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>From the IUPUI homepage</td>
<td>44</td>
</tr>
<tr>
<td>From the university library homepage</td>
<td>12</td>
</tr>
<tr>
<td>From Google</td>
<td>12</td>
</tr>
<tr>
<td>From IUPUI’s philanthropy library site</td>
<td>1</td>
</tr>
<tr>
<td>From a bookmark for the collection</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Elapsed time for the target search</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 minute</td>
<td>27</td>
</tr>
<tr>
<td>1 minute</td>
<td>1</td>
</tr>
<tr>
<td>1.5 minutes</td>
<td>6</td>
</tr>
<tr>
<td>2 minutes</td>
<td>7</td>
</tr>
<tr>
<td>2.5 minutes</td>
<td>7</td>
</tr>
<tr>
<td>3 minutes</td>
<td>3</td>
</tr>
<tr>
<td>3.5 minutes</td>
<td>3</td>
</tr>
<tr>
<td>4 minutes</td>
<td>2</td>
</tr>
<tr>
<td>5 minutes</td>
<td>8</td>
</tr>
</tbody>
</table>
Conclusions

Analysis of the responses suggests that most potential users are not aware of the IUPUI image collection but when introduced to it find the site attractive and navigable and its content interesting and useful. They appreciate the prominent inclusion of information about image copyrights and how to obtain permissions. Problems
identified are more related to site design than content. Users are grateful for the site and enthusiastic about its potential.

Use of the site will continue to increase as more photos and features are added and the URL is publicized to potential users. Users will find the site more quickly and navigate it more easily as enhancements are made to the CONTENTdm software.
Recommendations

When updates to the CONTENTdm software make it possible, online user surveys will be an important additional tool for evaluation of the IUPUI image collection. A feedback mechanism given to visitors as they exit the site can take them to such a survey and provide perspectives from a wide variety of users.

Including digital image web site designers in a larger study would invite valuable feedback on functionality and content. Subjects with expertise in search syntax could provide suggestions for improvements in metadata.

A more intuitive and easy-to-remember URL consistent in syntax with other IUPUI URLs might help to increase repeat use of the site. Adding the simple search link (or a “search again” link) at the top of each results page will increase navigability. Adding the word “or” between the simple search and browse search boxes will eliminate some confusion. Ease of searching will increase the number of return visitors to the site.

While the image collection is logically catalogued using controlled language (Library of Congress subject headings so that records can be exported to OCLC and IUCAT), searches might be made simpler – especially for those with poor computer literacy skills – by extending the natural language search capability used in the descriptive metadata to the subject headings. (The National Library of Medicine’s medical subject headings have been added for some images in order to facilitate searches (Plate 9).)

Routine publicity of the site and its updates through intra-university and print and electronic communications will increase faculty awareness. Faculty should be encouraged to introduce students to the site at the beginning of each semester and to include mention of it in every class syllabus, if possible. Alumni and other specialized university audience publications also can be targeted for promotion of the site. The student newspaper could collaborate on projects that promote use of the site and
student journalists can use historical images from the collection to illustrate feature articles.

Local publications that focus on or sometimes feature the history of downtown Indianapolis also should be targeted for promotion of the site and its updates. As more users become aware of the site, an automated mechanism for downloading and purchasing high-resolution photos could further reduce the need for Archives staff assistance.

The author believes that the rapid development of digital libraries has dramatically outpaced the average user’s navigation and information literacy skills. Although the site search for this survey was not designed to test individual online research skills, most participants who became lost in the effort appeared to have poor understanding of the basics of search syntax. That lack of understanding, moreover, was not statistically more significant in any one group over another. The ongoing collaboration between academic librarians and others in the university community to promote information literacy and teach mastery of online research skills will undoubtedly go as far as any software update or design change in increasing use of and user satisfaction with digital resources.

Recommended reading
The following articles can be helpful in constructing a framework for measuring user evaluations of a digital image collection; identifying delivery, content, quality, and support variables that affect user satisfaction and frequency of use; and setting benchmarks for measuring the success of changes after they are implemented.

Rieger and Gay’s (1999) article in RLG DigiNews is especially helpful in understanding how much more meaningful evaluation of an electronic resource can be when investigators use data collection and analysis tools that take into account human-computer interaction. Instead of assessing a technological resource in isolation, which often leads to emphasis on simple measurements alone, a framework for evaluation based on a “social construction of technology” model allows for a richer assessment that combines statistics with expert evaluation of resource design and investigators’ observation of human use of the electronic resource.

Reference

Further reading


Visual Image User Study (2003), Pennsylvania State University, December, available at: www.libraries.psu.edu/vius/reports.html


Awards for Excellence

Trevor James Bond
Washington State University Libraries, Pullman, Washington, USA

is the recipient of the Journal’s Outstanding Paper Award for Excellence for his paper

“Streaming audio from African-American oral history collections”

which appeared in OCLC Systems & Services: International digital library perspectives, Vol.20 No.1, 2004

Abstract

Through the use of OCLC/DiMeMa’s CONTENTdm software and a RealSystems Server 8, this article outlines the process of converting two collections of African-American oral histories recorded on cassette tapes to digital streaming files at the Washington State University Libraries.
Outstanding doctoral research awards

As part of Emerald Group Publishing’s commitment to supporting excellence in research, we are pleased to announce that the 1st annual outstanding doctoral research awards have been decided. Details about the winners are shown below. The year 2005 was the first year in which the awards were presented and, due to the success of the initiative, the programme is to be continued in future years. The idea for the awards, which are jointly sponsored by Emerald Group Publishing and the European Foundation for Management Development (EFMD), came about through exploring how we can encourage, celebrate and reward excellence in international management research. Each winner has received €1,500 and a number have had the opportunity to meet and discuss their research with a relevant journal editor. Increased knowledge-sharing opportunities and the exchange and development of ideas that extend beyond the peer review of the journals have resulted from this process. The awards have specifically encouraged research and publication by new academics: evidence of how their research has impacted upon future study or practice was taken into account when making the award selections and we feel confident that the winners will go on to have further success in their research work.

- The winners for 2005 are as follows:
  - Category: Business-to-business marketing management
    Winner: Victoria Little, University of Auckland, New Zealand
    Understanding customer value: an action research-based study of contemporary marketing practice
  - Category: Enterprise applications of internet technology
    Winner: Mamata Jenamani, Indian Institute of Technology
    Design benchmarking, user behaviour analysis and link-structure personalization in commercial web sites
  - Category: Human resource management
    Winner: Leanne Cutcher, University of Sydney, Australia
    Banking on the customer: customer relations, employment relations and worker identity in the Australian retail banking industry
  - Category: Information science
    Winner: Theresa Anderson, University of Technology, Sydney, Australia
    Understandings of relevance and topic as they evolve in the scholarly research process
  - Category: Interdisciplinary accounting research
    Winner: Christian Nielsen, Copenhagen Business School, Denmark
    Essays on business reporting: production and consumption of strategic information in the market for information
  - Category: International service management
    Winner: Tracey Dagger, University of Western Australia
    Perceived service quality: proximal antecedents and outcomes in the context of a high involvement, high contact, ongoing service
• Category: Leadership and organizational development
  Winner: Richard Adams, Cranfield University, UK
  *Perceptions of innovations: exploring and developing innovation classification*

• Category: Management and governance
  Winner: Anna Dempster, Judge Institute of Management, University of Cambridge, UK
  *Strategic use of announcement options*

• Category: Operations and supply chain management
  Winner: Bin Jiang, DePaul University, USA
  *Empirical evidence of outsourcing effects on firm’s performance and value in the short term*

• Category: Organizational change and development
  Winner: Sally Riad, Victoria University of Wellington, New Zealand
  *Managing merger integration: a social constructionist perspective*

• Category: Public sector management
  Winner: John Mullins, National University of Ireland, Cork
  *Perceptions of leadership in the public library: a transnational study*

Submissions for the second annual Emerald/EFMD outstanding doctoral research awards are now being received and we would encourage you to recommend the awards to doctoral candidates who you believe to have undertaken excellent research. The deadline by which we require all applications is 1 March 2006. For further details about the subject categories, eligibility and submission requirements, please visit the web site: www.emeraldinsight.com/info/researchers/funding/doctoralawards/2006awards.html