Digital Library Attributes: Framing Usability Research

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ABSTRACT

This paper presents a framework for evaluating the usability and effectiveness of digital libraries of various kinds. The framework consists of six attribute groupings (audience; institution; access; content; services; design and development). Each attribute grouping contains a number attributes expressed as continua, or dimensions. This framework allows us to think about digital libraries in a flexible and holistic manner and helps us compare digital libraries attribute by attribute. The utility of the framework as a means of organizing research is being tested in an evaluation of a commercial digital library.

Keywords: Digital libraries, user-centered design, user-centered evaluation

INTRODUCTION

Digital libraries are being built and operated by a wide variety of institutions for a wide variety of reasons. The framework presented here may help us understand and apply what has been learned from research on digital libraries to current and future digital library evaluation or development efforts. By understanding and clearly expressing how two or more digital libraries are similar or different, we should be able to better apply lessons learned from previous evaluation efforts. In addition, this analysis can highlight aspects of digital libraries that have been under- or un-examined in previous studies.

The framework may also prove valuable in helping focus digital library evaluation efforts by providing us with language to articulate the purpose and context of our work. For example, an evaluation project can be organized to examine the effectiveness of a particular digital library in terms of one or more of the attributes. Or, a digital library could be evaluated in terms of how variation in along one dimension (e.g., governance) affects another (e.g., content coherence). These are examples of evaluating a single digital library (*within-DL* evaluation). The framework can play a similar role in comparisons of multiple digital libraries. For example, a researcher might want to examine how different approaches to content sourcing affect content fit (*between-DL* evaluation).

The framework presented here is provisional and is based upon review of existing digital library literature. The utility of the framework as a means of organizing research is being tested in an evaluation of a commercial digital library.

WHAT KINDS OF DIGITAL LIBRARIES EXIST?

There are many DLs available on the Internet and on private networks or intranets. I assert that most of the DLs that have undergone careful evaluation have not been representative of the full range of existing DLs. If this assertion is accurate, how can we begin to understand what distinguishes DLs?

Borgman [3] makes a distinction between 'research' and 'practice' perspectives regarding DLs. Her examination of competing definitions of the term 'digital library' focuses on accommodating both perspectives. Lesk [6] examines a handful of early projects in detail, all of which are academic in nature and motivated by the interests of researchers. These two perspectives do not acknowledge other kinds of DLs that exist and continue to be developed.

Lynch [7] suggests that there are three types of digital libraries. Commercial systems targeted for specific professions or disciplines, like Westlaw, Lexis or Nexis; research systems (he cites, for example, the systems funded by the NSF/ARPA/NASA Phase I Digital Libraries Initiative as examples [4]); and systems embedded within existing research and academic libraries. He emphasizes distinguishing 'active' from 'passive' DLs. Passive DLs support locating and reviewing information and active DLs also include elements to support active work (analysis and collaboration).

Lynch also mentions retail systems like Amazon.com and, more generally, consumer health information systems and investment and stock trading systems as examples of active commercial DLs. They are important, he argues, precisely because they are *active* DLs that support decision making by their users and generally modify in some way individual and / or social behavior through their inclusion of analytic and collaborative tools. He also notes important differences

between commercial DLs and DLs arising out of the traditions of librarianship. Commercial, active DLs lack a commitment to preservation and continuity of access to content. They are also sensitive to marketplace dynamics because a commercial DL's audience may turn quickly to a competitor's DL if the competitor provides advantages in usability, content or cost.

ATTRIBUTES OF DIGITAL LIBRARIES

Rather than try to identify the three, four, five or whatever number of 'general kinds' of DLs that exist, it's more useful to think about the general attributes of any DL in order that we have a flexible vocabulary to use when examining DLs. Some researchers have already begun to address this issue. Saracevic and Covi present a framework for evaluating digital libraries consisting of these seven levels: (1) social, (2) institutional, (3) individual, (4) interface, (5) engineering, (6) processing and (7) content. The seven levels are grouped as 'user-centered' (levels 1-3) and 'system-centered' (levels 5-7), with level 4 as a boundary area between the user and the system. In either scheme, each level represents an aspect of the system that can be subjected to evaluation [9].

Another holistic description scheme, consisting of four major dimensions is presented by Fuhr et. al. Their dimensions are (1) data/collection, (2) system/technology, (3) users and (4) usage. Their scheme is an attempt to define a comprehensive set of evaluation criteria along with some suggestions for the metrics to be used in an evaluation [5].

The framework proposed here is different from those presented in the work described above in three ways. First, this framework seeks to make the technical, the social and the organizational attributes of digital libraries visible without giving any of these areas primacy. Second, the conceptualizations of the attributes contained here are purposely inclusive. For example, in contrast to Fuhr et.

al., access here includes issues influenced by DL policies, such as the persistence of the content contained in the DL. This is consistent with how others have conceptualized access. Borgman, for example, defines access broadly: "…as connectivity to a computer network and to available content, such that the technology is usable, the user has the requisite skills and knowledge, and the content itself is in a usable and useful form [3]." Rice et.al. present a multi-dimensional framework of access that takes physical, cognitive, affective, economic, social, political and mediative aspects into account [8]. Finally, this framework, in contrast to the emphasis on layers presented by Saracevic and Covi [9], leaves open the possibility of considering how varying certain attributes may affect other DL attributes. This is similar to the 'cascades of interactions' model proposed by Bates [1].

I have developed a list of attributes, expressed as continua or dimensions, to help identify similarities, differences and patterns among different DLs. This system of attributes contains six attribute groupings:

- *Audience:* attributes of the targeted and actual users of a particular DL
- *Institution*: the library, university, company or other entity that sponsors the creation of a DL
- *Access:* who can use the DL, under what conditions; also the features the DL provides to support access to content
- *Content:* the information (e.g., documents) contained in the DL
- *Services:* human or technology-based capabilities that link 'collections to those using them and link people to one another' [2]
- *Design and development:* the process of building and maintaining a DL

The groupings and their associated dimensions are summarized in Table 1. The labels anchoring each dimension are shown in **bold** text.

Digital Library Attributes	
Audience	**attributes of the targeted and actual users of a particular DL**
Scope	Is the target user community **constrained** or **unconstrained**? For example, only the employees of one company can use an internal DL in a constrained setting, or only the students, faculty and staff of one university can use certain DL services provided by a campus library. Other DLs may require fees and others may be free and available on the open Internet (subsidized by advertising or government funding).
Coherence	Does the main user community consist of people who have a set of similar interests or is the user community the general public? A **coherent** audience consists of intended or actual users who have key attributes in common relative to the DL. A DL designed to support researchers in astrophysics has a coherent audience. A **diffuse** audience has few attributes in common (or only by chance). A DL intended for the general public has a diffuse target audience.
Fit	Are the actual users of the DL the same as the target users? A DL with **mis-fit** has actual users who are not members of the target audience. A DL with **close fit** has users who are members of the target audience.
Institution	**the library, university, company or other entity that sponsors the creation of a DL**
Governance and control	Who and what drives decision-making with regard to the DL's design, its operations and its ongoing development [7]? A competitive, commercial DL has **closed** governance and control in order to minimize leakage of plans and proprietary information to competitors. A government supported DL typically has **open** governance and control.
Type	Is the sponsoring institution **public** (government, university) or **private** (a corporation)?

Economic model	How is the DL funded and sustained? A DL supported only by **grants** supplied by a foundation or similar agency would be placed on one end of the dimension. A DL supported only by the direct (pay for use) or indirect (advertising) generation of revenue based on use would be placed at the **sales** end of the dimension.
Purpose	What is the stated purpose of the DL? An **experimental** DL is developed primarily to examine the feasibility of new techniques. A **production** DL is developed to provide a needed information service to a community of users.
Access	**who can use the DL, under what conditions; also the features the DL provides to support access to content**
Payment Model	Do DL users pay directly or indirectly to use the DL? **Fee** based DLs might implement 'pay per view' or monthly subscriptions. In either case, the correlation between payment and access is direct and obvious. Less direct payment models include access to a DL as a side effect of paying tuition. This DL would belong near the **free** end of the dimension. In this case, the connection between payment and use is less obvious.
Visibility	Is the DL visible on the Internet (whether or not the materials are available for free) or is the DL hidden from view (by firewall or other security technology)? Private DLs hosted on carefully controlled intranets are **hidden** unless specific privileges are granted. Commercial and governments DLs accessible through the public network are **visible**.
Persistence	Are the DLs contents guaranteed or implied to be available in the future? A DL containing academic papers is expected by its audience to be **preserved** forever in some format (for decades or centuries). A commercial DL's contents are unlikely to be preserved by its provider: continuity of access is not implied: the content is **ephemeral**.
Coherence	Is access to the DL content enhanced through the application of principles of information organization? A minimally organized (or **unorganized**) DL might only provide a full-text search or a single-level topic navigation structure. An **organized** DL might provide multiple types of search access and multiple complex topic structures. See also 'organization' within the grouping 'Content'.
Content	**the information (e.g., documents) contained within the DL**
Scope	How extensive is the topical coverage of the content included in the DL? A DL with **limited** content scope would have only information about a single topic. A **comprehensive** DL would contain information pertaining to any branch of human knowledge.
Fit (to audience needs)	Does the content suit the intended or actual audience? A science DL intended for grade school children would emphasize introductory, easily read information and would have **close fit** with the audience. The same collection would not be a good fit for scientists conducting basic research (**mis-fit**).
Coherence	Is the content of the DL collected in a way to provide coherent coverage of any included topic? A **coherent** DL might provide a range of introductory and specialized information in a variety of media, treatments and languages. A **non-coherent** DL would provide some, but not all, parts of these ranges. Significant gaps might be found in a non-coherent DL.
Organization	Is the DL content organized to facilitate information finding and access? A minimally organized (or **unorganized**) DL might only provide a full-text search or a single-level topic navigation structure. An **organized** DL might provide multiple types of search access and multiple complex topic structures. See also 'coherence' within the grouping 'Access'.
Specialization	Is the DL content **specialized** for a specific audience, like astrophysicists, or is the content **general** or wide ranging in nature?
Digitized content	Is the content in the DL digitized from existing, non-digital material or is the content created as digital information? A DL of current scientific information would likely contain **original digital** content. A DL of nineteenth century newspapers would contain **digitized** versions of content originally produced in another medium.
Sourcing	Is the DL content from a single or multiple sources? **Single-sourced** DLs would present content created by a single entity or a single, controlled process (e.g., a journal or periodical with a defined editorial process). **Multiple-sourced** DLs would present content created by many entities.
Restricted	Is the content in the DL in the **public domain** (not subject to copyright restrictions) or **restricted** by copyright or similar restrictions on intellectual content (implying that rights management is an important concern)?
Services	**human or technology-based capabilities that link 'collections to those using them and link people to one another' [2]**
Nature of Interaction	This dimension represents the manner in which the DL does or does not provide support for active work[7]. Those DLs that support simple access to information (similar to the basic model of a physical library) are **passive**. DLs that provide analytical tools or user-to-user (or user-to-expert) collaboration are **active**. See specific types of interaction 'Analytic', 'Collaborative' and 'Reference', below.
Analytic	Does the DL provide support for evaluation or assimilation of information? **Analytic** DLs include interactive tools to support data analysis or ability to store user-generated data in the context of the DL. **Non-analytic** DLs do not include these facilities.
Collaborative	Does the DL provide support for communication between DL users? **Collaborative** DLs often include embedded chat or message board systems; defined interest groups; user-to-user awareness facilities; etc. **Non-collaborative** DLs would not include these facilities.
Collection	Does the DL provide content selection and organization services? A DL with clear collection development and indexing policies would be **controlled**. A DL allowing the addition of content without an evaluative process would be **uncontrolled**. A simple example is to contrast moderated with un-moderated mailing lists or message boards.

Reference	Does the DL give users the ability to interact with domain and / or DL experts? Can users contact someone via email? In real-time (e.g., technical support via chat interface)? This is a specific type of collaboration service. DLs either **include** or **lack** this service.
Design and Development	**the process of building and maintaining the DL**
Design approach	Is the DL designed with the issues of audience, institution, access and content in mind? An **experimental** approach is often employed with systems driven by technical ideas interesting to the DL developers. **Socially grounded** approaches take some or all of the issues of audience, institution, access and content into account from the outset.
Design cycle	A **non-iterative** DL would be one that was developed and left unchanged after one design iteration (e.g., a DL built with funding by a single grant). An iteratively designed DL undergoes multiple, regular revisions based upon a methodical approach that includes feedback from the analysis of DL use (**iterative**).
Consulted users	Who stands in for / speaks for the intended DL users during DL design and development? Many DLs are conceived and developed without direct input from users or their proxies despite the higher risk of mis-fit (**none**). In other cases, some kind of proxy user may be consulted by the designers and developers because the actual users are not easily contacted. The other extreme is represented by a project where **actual users** are included as full members of the design and development group (e.g., participatory design).

Table 1 - Digital Library Attributes

The attributes in Table 1 can be used to identify the kinds of DLs that exist and the kinds of DLs that have and have not been subject to evaluation. There are, however, limitations to how these attributes can be used to analyze DLs. It may be impossible to learn about the details of the collection development policies or the kind of systems development methods employed in the construction and maintenance of a particular DL. The placement of any particular DL along any of these continua is also subject to debate. These continua may be helpful in comparing a small number of DLs on a small number of dimensions. So it might be possible and useful to rank three DLs as 'passive', 'somewhat active' and 'active' without assigning absolute values to their positions on the continuum.

CONCLUSION

Examination of the research record indicates that most user research is conducted on experimental, public DLs supported by research grants and managed by researchers. Future research into digital libraries of all kinds, including commercial digital libraries, will help us refine the framework of attributes presented here. Work will also continue to integrate the different conceptualizations developed by other researchers [1, 3, 5, 9]. Future work will also help us determine the utility of this framework as a tool for articulating digital library evaluation goals, objectives and results for both within-DL and between-DL evaluation projects.

NOTES

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