Issues in User-Centered Design in LIS

Leanne Bowler, Sherry Koshman, Jung Sun Oh, Daqing He, Bernadette G. Callery, Geof Bowker, Richard J. Cox

Abstract

The purpose of this article is to survey the landscape of user-centered design in LIS. We begin the article by exploring the history of the "user-centered paradigm," looking first at the historical schism between behavioral science and computer science, and then surveying some of the methods of user-centered design. In the next section we present examples of technological artifacts that reflect the basic functions of information systems—artifacts designed to collect, organize, and retrieve information—as a way to present some of the difficulties and opportunities that surround the creations of user-centered design. Specifically, we look at how user-centered design relates to personal collections, social bookmarking, finding aids, Web interface design, information architecture, visualization systems, and personalization and adaptive search. The article then steps back and looks at design through the wider lens of values, asking the question, how are users represented (or misrepresented) through cultural, ethical, and political forces that influence information system design? The article concludes with a summary of the major issues to emerge from our survey of the current state of user-centered design and from this we extract some key lessons vis à vis research and teaching in LIS.

Introduction

Information professionals are designers. We build information systems, services, spaces, and objects that we hope will help users find, use, create, and share information. In this article we focus on the design of technology to support information and archival services and we do so from a

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user-centered point of view. Considering the needs of the user is a core competency of librarianship as reflected in documents produced by professional organizations such as the Reference and Users Services Association (RUSA, 2003). LIS has been playing with the principle of user-centered design for over two decades, and arguably, it is no longer necessary for us to defend it. Rather, we are now in a position to review user-centered design in a critical, reflective, and multilayered manner that reveals the rich array of experiences in LIS. The article takes such an approach, its purpose to survey the landscape of user-centered design in LIS. We try to answer the following questions: What is the state of user-centered design in LIS? What exactly do we mean when we speak of user-centered design? Where are the opportunities? What are the challenges? While the scope of the article is large, our intent is to highlight only the most pressing issues to provide a broad overview for readers who are at a starting point in their exploration of user-centered design. To investigate these issues in context, we provide concrete examples or case studies of artifacts designed to make information accessible and easy for the end user to find, choose, use, and share with others. While artifacts designed for the purpose of making information accessible to people are not necessarily technological (the design of physical spaces, library programs and policies, work practices, and community and social structures, for example), the emphasis of this article is on information technology.

Think of this article as unfolding in three concentric circles. The user and the user-centered paradigm lie at the core. Surrounding the inner circle of the user are the functions of information systems—the ways and means used to build collections, organize and eventually retrieve information objects. Over-arching all are the values embedded in the process. Reflecting this model of concentric circles, we begin this article by exploring the history of the "user-centered paradigm," looking first at the historical schism between behavioral science and computer science, and then surveying some of the methods of user-centered design. In the next section we present examples of technological artifacts that reflect the basic functions of information systems—artifacts designed to collect, organize, and retrieve information—as a way to present some of the difficulties and opportunities that surround the creations of user-centered design. Specifically, we look at how user-centered design relates to personal collections, social bookmarking, finding aids, Web interface design, information architecture, visualization systems, and personalization and adaptive search. The article then steps back and looks at design through the wider lens of values, asking the question, how are users represented (or misrepresented) through cultural, ethical, and political forces that influence information system design? The article concludes with a summary of the major issues to emerge from our survey of the current state of user-centered design and from this we extract some key lessons vis à vis research and teaching in LIS.

The User-Centered Paradigm

User-centered design, as its name suggests, reflects the user, typically from a cognitive, affective or behavioral point of view, as well as the social, organizational, and cultural contexts in which users function. The shift from a system-centered to user-centered perspective in LIS arose from the emergence of information retrieval systems that could be operated without the intermediation of experts and a need to understand how to better serve a new clientele of end users. In the age of disintermediation, where the users are the ones who actually search for information, understanding users' information behavior was a critical step to designing usable systems. This shift in thinking was articulated by Dervin and Nilan (1986), who identified a research gap in the practice and evaluation of information systems and appealed to the LIS community to place user-defined information needs and uses at the center of its endeavors. Nahl outlined this shift toward a user-centered paradigm in her article, *The User-Centered Revolution* (1997), and in an update in 2003, *The User-Centered Revolution: Complexity in Information Behavior.* Bishop and Star (1996), in their study of the then-emerging research area of social informatics, placed the user in the broader context of society, writing that the user "is thrown as never before into a collective or group mode, where the results of information seeking become information to be modified and passed" (p. 315).

Although the shift from a system to user point of view was indeed a revolution, it is now commonplace for information professionals to consider users (their clientele) in the design of systems, services, and spaces. Recent developments with the participatory Web make the user-driven perspective all the more compelling. Given the empowerment of users in the Web 2.0 world, information professionals may reasonably ask if they still have a role to play in designing information environments.

Historically, there has been a gap between information science (the "system/computer" people) and library and archival science (the "service/practice" people). This gap has often been seen in terms of the difference between research and practice. With the increased use of digital, networked information tools in daily practice and the emergence of the digital library and archive, it is impossible to separate the service from the system. In this context, understanding the user becomes more critical than ever.

Bishop and Star (1996) framed the problem differently. Instead of the research/practice divide, they saw the problem in terms of a schism between two research traditions—computer and information scientists on the one hand and social scientists on the other. The result was practices that led to the "exclusion of people and informal processes by computer and information scientists and exclusion of formal models and the properties of machines by social scientists" (p. 309).

In their exploration of design science in information systems research, Hevner et al. (2004) picked up on the theme of "schism." The conflict,

they write, is between behavioral science and design science. Behavioral science seeks to "develop and justify theories (i.e., principles and laws) that explain or predict organizational and human phenomena surrounding the analysis, design, implementation, management, and use of information systems." Design science (which has its roots in engineering) seeks to "create innovations that define the ideas, practices, technical capabilities, and products through which the analysis, design, implementation, management, and use of information systems can be effectively and efficiently accomplished" (p. 76). The creation in 1999 of the American Association of Information Science and Technology's SIGUSE, a special interest group concerned with "people's behavioral and cognitive activities as well as their affective states as they interact with information," marked a first step toward the bridging of this divide (ASIS&T, n.d.). Still, the behavioral/design gap has remained. Scholars of information behavior continue to study users using systems while scholars of computer science and engineering continue to experiment with new designs that, often only post-design, tell us anything about how users go about finding, seeking, and using information. The recent call for papers for the Information Seeking in Context 2010 conference highlights the urge to bring these two paradigms together, stating "we shall be particularly interested in papers in any of these areas *that address the connection between information research and information practice*" (emphasis added).

User-centered Design

To *design* is to "create, fashion, execute, construct according to a plan" (Merriam-Webster). User-centered design (UCD) focuses "*on users* through the planning, design and development of a product" (Usability Professionals Association). User-centered design is a repertoire of design methods *and* a philosophy. UCD places users at the center of the design so that the outcome of a design—the artifact—can be easily used by the people for whom it was created. The point of user-centered design is not just to create something that works but rather to create something that works for the intended user, something that is *usable.* Usable designs should "make it easy to determine what actions are possible at any moment; make things visible, including the conceptual model of the system, the alternative actions, and the results of actions; make it easy to evaluate the current state of the system; follow natural mappings between intentions and the required actions; between actions and the resulting effect; and between the information that is visible and the interpretation of the system state" (Norman, 1988, p. 188; see also Abras, Maloney-Krichmar, & Preece, 2004; Vredenburg et al., 2002). Usable designs created for the purpose of facilitating *information practices* have a specific purpose: they should make it easy for people (users) to find, choose, use, and share information.

The defining characteristic of UCD is that users are involved in the design of a functioning artifact. The degree to which they are involved

can vary, from a onetime, usability test *after* the artifact has been built to projects where users work alongside designers from inception to creation. In the next sections, we look more closely at the user and then at methods of UCD.

The User

In keeping with best practices in UCD, we begin by asking, who exactly *is* the user? Taking the position that the voice of the user should be heard is admirable (and, we argue, an essential position for today's designers of information systems, services, and objects). However, one might reasonably ask, whose voice is to be heard? Users approach designs with different intents, varying degrees of engagement, and unique backgrounds of personal experience, beliefs, knowledge, and abilities. When we design, are we designing for a universal user—an "everyman" of information practice? Or are we designing for special segments of the population? The answers are not simple. According to Easun (1987), users can be divided into three broad, overlapping categories: (1) the *primary user*, the person or people who will actually regularly use the artifact; (2) the *secondary user*, the person or people who will only occasionally use the artifact or who will use it through an intermediary like an archivist or librarian, and; (3) the *tertiary user*, the person or people who will be affected by the user of the artifact and typically make decisions about its purchase. Larger populations contain multiple user communities and within each of these three categories there may be multitudes of subgroups.

Friedman, Kahn, and Borning (2006) in their study into Value Sensitive Design, work with the concept of stakeholder, rather than user, and say that designers of technology must consider both direct and indirect stakeholders. The direct stakeholder is the group of users who will interact directly with the design or its outputs. Indirect stakeholders are the people who will be impacted by the design even though they may never interact with it directly (people who purchase books from an online book vendor, for example, are the direct stakeholders in e-commerce and may find the experience convenient and efficient, but the local bookstore in the community, an indirect stakeholder, may suffer from the loss of customers). While direct stakeholders should have priority in the conceptualization of a design, the interests of indirect stakeholders should also be considered.

Given the potential layers of use, one solution may be to design for the broadest possible end-user population, aiming for designs that can address a wide range of abilities, skills, and preferences. *Universal design,* an approach from the field of user interface design, has attempted to address user differences by proposing that successful design is design that is usable by all (Stephanidis, 2001). This approach raises the issue of the "canonical user," which assumes that users as a group have, on some level, shared properties that can be reflected in design (Kay, 2001, p. 285).

Some question the validity of the concept of the universal user. Perhaps successful information technology works, not because of a "big picture" approach, but because of the technology's ability to meet local needs in individual ways.

Methods of User-Centered Design

Two decades of user studies have left a considerable repertoire of methods and techniques for involving users in the design process. This section begins with a review of user-centered design methods all of which are meant to discover what the user needs, wants, and is capable of using (Rosenbaum, Rohn, & Humburg, 2000; Mao et al., 2005, Vredenburg et al., 2002). The methods range from large scale data gathering, like surveys, to intimate, face-to-face interactions. UCD is typically iterative in that the design is modified throughout the process so that it increasingly matches the user's requirements. UCD is also often multidisciplinary and includes people from different domains of knowledge. Vredenburg et al. (2002) surveyed UCD practitioners to identify the most widely used methods and processes. Thirteen methods were identified: participatory design, field studies (including contextual inquiry), user requirements analysis (needs assessment), iterative design, usability evaluation, task analysis, focus groups, formal heuristic evaluation, user interviews, prototype without user testing, surveys, information expert review, and card sorting. Interestingly, the practitioners in the Vredenburg et al. study did not identify methods involving role playing, simulations, and storytelling, although these techniques may have been embedded in the methods they list. Participatory design was the least used of all user-centered design methods identified in this survey, the most used being usability testing followed by task analysis and focus groups.

User-Centered Design in Practice

Libraries and archives bring order to chaos through systems—collections of procedures, methods, and logic-driven tools used for selecting and acquiring materials and organizing and retrieving information. In the next section through the lens of user-centered design, we look at the information life cycle: selection, organization, dissemination, and preservation. In the first section, we explain the implications of social tagging in terms of collections and organizational systems that rise up from the user, rather than trickle down from the information professional. The second section picks up the theme of user-generated metadata and discusses the descriptive work of archivists (a value-added task traditionally owned by the archivist). In the third section, we look at participatory design in terms of how children informed the layout, design, and architecture of Web portals. The fourth section explores two important facets of information organization and retrieval: information architecture or the design of informa-

tion structures and the visual representation of such structures. The final section presents the notion of the intelligent search engine (a retrieval system) that adapts to user behavior rather than expecting the user to adapt to the system.

Social Tagging and Personal Collections

Social tagging refers to a phenomenon that takes place in an open space on the Web, where people can store and annotate information resources. It took off in 2004 with a social bookmarking site called *del.icio.us* (currently *delicious.com*) and a photo sharing site called *Flickr*. These sites introduced a new approach to finding and organizing information based on user-created free-text keywords called *tags*. Social tagging has two broad implications for user-centered design: it provides users with a flexible and personalized organization/access tool and it offers a venue for collecting empirical data on how users categorize and name information resources.

Social Tagging as a Flexible Mechanism for Organizing Information for Users

A central problem of library and information science is to provide subject access for effective retrieval. The library catalog has two basic functions: finding known items and gathering similar items (Cutter, 1876). It is the gathering function that is traditionally provided through subject access. While the notion of similarity is the basis of this gathering function, it is assumed that determining similarities among documents relies on a universally applicable vocabulary, which controls subjectivities and diversities of language (Olson, 2002). Library classification schemes and subject headings provide such language.

With the growing recognition of the subjectivity and variability of human conceptions of information, as well as the significant effect of contextual factors, many researchers have pointed out the shortcomings of traditional approaches to organizing and accessing information that is based on the objectivist view (Bates, 1986; Chalmers, 1999). The question is whether cognitive structures constructed by individuals in organizing/accessing information accord with the formal organization imposed by a controlled vocabulary (classification or subject headings) within an information system. Catalog use studies have repeatedly shown that people experience difficulties interacting with cataloging systems and often fail to access items due to the mismatch of terms (Borgman, 1986; Cochrane & Markey, 1983; Krikelas, 1972). Indexer consistency studies have further demonstrated that individual differences and variability cannot be controlled by the use of a controlled vocabulary. Not only can ordinary system users not find the "right" terms, but highly trained indexers using the same vocabulary do not agree on indexing terms for a given document in a great number of cases. Even the same indexer indexes the same document differently at different times (Cooper, 1969; Jacoby & Slamecka, 1962; Markey, 1984; Zunde & Dexter, 1969).

Another line of empirical evidence of individual variability is found in studies on search term overlap. The agreement between searchers on search terms for the same question is shown to be relatively low regardless of the complexity of the question, of the level of search experience of the searchers, or of specific measures of overlap (Bates, 1977; Fidel, 1985; Saracevic & Kantor, 1988a, 1988b). Based on these studies, researchers have questioned existing approaches to subject representation and information organization. Bates (1986) has stressed that the current design of subject access does not accommodate the complexity and diversity inevitably involved in the processes of indexing and searching, and advocated the need for a new model.

Social tagging allows users to organize information the way that is most useful for them by tagging items with the terms that make sense to them. Unlike traditional information organization systems, social tagging does not impose any structure (either hierarchical or analytical) on the users. There is no controlled vocabulary and there need not be any declared relationship between tags. When people tag an item, they choose any terms in any order that they think will be useful for their own purpose. In addition, users are not expected to follow any established standards or guidelines. The way tags are used and associated with items is solely determined by the individual. Not surprisingly, this free tagging feature with its simplicity contributes to the rapid adoption and growing popularity of social tagging.

It should be noted that social tagging has dual characteristics as a personal information tool and as social software. By allowing users to put tags on information resources, it serves as a personal information management tool. The "social" part of the term *social tagging*, however, indicates that there is something beyond the personal use. For example, a "folksonomy" (a portmanteau of "folk" and "taxonomy"), is a taxonomy built from the bottom up. The aggregation of simple tags individually created by a number of users can be a useful tool for organizing large collections of information.

Arguments for social tagging as an information organization mechanism are fundamentally based on the concept of self-organization and emergence (Johnson, 2001). It has been suggested that a certain pattern will appear among individual tags created in the uncontrolled way if there is enough participation (when a lot of people tag the same item); that is, eventually some kind of structure will emerge in a bottom-up fashion. As Campbell (2006) puts it, the notion is, "if you let users tag their own resources in their own ways, with their own words, patterns of order will emerge; these patterns will be truer, more convincing, more user-centered, and more useful than the pattern imposed by formal classification schemes. What's more, they will acquire greater accuracy and greater sophistication as more and more people use them" (p. 4).

Social Tagging as a Way to Understand Users

As a step toward developing a flexible organization/access mechanism, attention has been drawn to user-centered cognitive approaches. This involves understanding the ways in which individuals categorize information objects as the basis of improving the design of information architectures and systems (e.g., Carlyle 1999, 2001). Such studies have typically been conducted either in a laboratory setting or with a small-scale qualitative design. In the next section, we present concrete examples of ways that users can participate in the creation and organization of personal collections through the use of social tagging.

Social Tagging to Create Personal Collections from Online Museum Catalogs

Many of the online catalogs of today's virtual collections, such as museum catalogs, include options for users to select and organize personal collections from the museum collection. An example is the "My scrapbook" feature in the Ohio Memory Online Scrapbook, which encourages users to make their own museum exhibition catalogs using social tagging tools. The developers of this feature in the Ohio Memory project reported that people immediately responded to it, noting that it has "always been very popular and represented an early form of social media/web.20 in that folks could actually interact with the materials, not just view them" (L. Gemmill, personal communication, January 21, 2010).

Creative Spaces is a federated search tool providing access to the catalog records of such museums as the British Museum, the V&A, and Sir John Sloane's Museum. The Creative Spaces website "connects you with nine UK national museums and galleries, allowing you to explore and comment on collections, upload your own content, and build and share collections with others. (Creative Spaces, 2010). Welcoming, and even soliciting user comment on museum collections, in this way is a substantial change from the mediated access that museums have traditionally provided and acknowledges the rising interest in user-centered design in the presentation of museum collection information. Another current project is the Steve Project. Steve

> is a collaboration of museum professionals and others who believe that social tagging may provide profound new ways to describe and access cultural heritage collections and encourage visitor engagement with collection objects. Our activities include researching social tagging and museum collections; developing open source software tools for tagging collections and managing tags; and engaging in discussion and outreach with members of the community who are interested in implementing social tagging for their own collections. (http://www.steve.museum/)

Projects such as these that give the user the opportunity to interact with the collections, even to the level of creating exhibits, the most public of museum management activities, allow a level of involvement otherwise

unattainable. Paleontologist Chris Norris notes that online catalog users should be "encouraged to participate in the collections by providing and sharing information and by bringing the cool things that they discover to the attention of their friends and the wider public" (2010). Building on the familiarity with online shopping, the user is encouraged to decide what to take home from their museum experience, by adding individual items to their "cart." Just how much freedom the user may actually have may be limited, particularly in in-gallery kiosk installations that purport to provide access to the museum's collection catalog. In the Newseum, for example, the museum visitor functioning as an editor may select individual newspaper stories, although this may provide only the illusion of choice in that there is a predetermined set of options (Barry, 1998).

The value of story as an access method has been discussed as an element in the design of Web interfaces to museum collection.

> The stories may begin by being generated "by hand" as static pages, but the database could be used at any time to pull further information on objects or areas of interest. The database can be used to create dynamic stories where the "who, where, why and how" is important to the user, rather than obtaining information on an isolated object record. . . . People can learn from contextual information, provided in the form of engaging stories. Objects can be woven into stories, rather than having a focus on the objects. (Dyson & Moran, 2000)

As Callery notes, "Perhaps all these efforts at the personalization of the online museum catalogs are the electronic extension of the human urge to accumulate and organize objects to give them additional meaning" (2004). The invitation to the user to participate in selection and description of museum collections recognizes the value of the user's contribution to the process of curation.

Finding Aids in Archives

Archival description has long been thought to be at the heart of the archivist's responsibilities. It has been rather matter-of-factly defined as "the process of creating a finding aid or other access tools that allow individuals to browse a surrogate of the collection to facilitate access and that improve security by creating a record of the collection and by minimizing the amount of handling of the original materials" (Pearce-Moses, 2005). The creation of the finding aid has always been the focus of the archival descriptive function. The finding aid is "tool that facilitates discovery of information within a collection of records." It provides a "description of records that gives the repository physical and intellectual control over the materials and that assists users to gain access to and understand the materials" (Pearce-Moses, 2005). Finding aids have been described as both the scholarly contributions to knowledge and the utilitarian tools that archivists provide for their users.

Archivists have always assumed that their descriptive work incorporated an understanding of users. Their history of generating finding aids suggests a different story. Historically, archivists mostly prepared finding aids according to their local tradition and needs, producing everything from single volume published guides to unpublished lists and card catalog systems found only in their reading rooms. Nearly forty years ago, archivists began to standardize their findings primarily by building on the inventories and registers that had been used by the National Archives and the Library of Congress since the 1940s. In the early 1980s archivists adopted library bibliographic approaches that only required a tweaking of well-developed and supported library standards (Spindler & Pearce-Moses, 1993). By the mid-1990s the development of Encoded Archival Description (EAD) allowed finding aids to be standardized for use on the World Wide Web. These had the potential for aiding researchers to move beyond generalized discoveries of pertinent records to connect to specific sources (Pitti, 1998; Redding, 2002).

Even as the introduction of automated cataloging systems picked up pace, forcing the development and use of standardized indexes and thesauri, most archivists assumed they would stand between themselves and the researcher. Indeed, from the earliest archival inventories and manuscript registers in the 1940s until a half-century later, through each iteration of archival descriptive practices, archivists mostly assumed a knowledge of their users and rarely studied them. (Cox, 2007).Yet David Bearman (1989) more than two decades ago stated that, "Information delivery begins with the reexamination of finding tools and access points, but it doesn't end until the information itself is provided directly to patrons, in their own intellectual framework, on their own terms, and wherever they may be" (p. 39). Even a decade ago, the problem that finding aids had to solve was explicitly identified:

> It is in finding aids that users' representations of archives meet archivists' representations of collections. If these two cognitive representations intersect enough, the user is able to locate and utilize the archives and to identify primary sources that may hold the answer to his or her inquiry. If these representations diverge, the access tools are useless for the researcher. Creating finding aids that are true boundary objects is key. (Yakel, 2002, p. 122; see also Duff & Stoyanova, 1998; Piché, 1998; Yakel & Torres, 1993)

Now we are realizing that user expectations are changing, especially as archives go online (Conway, 1986; Prom, 2004) and will continue to change as new tools appear (Cox, 2007, November). As we begin to have a growing knowledge of users, we have recognized the need to develop descriptive systems that circumvent accepted standards. For example, some archival constituencies, such as genealogists, have proved to be particularly adept at working online and to be receptive to working with archivists (Duff & Johnson, 2003; Lemieux, 1995).

Perhaps the future of archival description and the way in which user-centric design is being incorporated can be seen in tests developed by archival faculty and their students. The University of Michigan's Polar Bear Expeditions Digital Collections includes both EAD finding aids allowing users to annotate the finding aids in a variety of ways allowing the work of the archivist to be evident along with the knowledge researchers bring with them (see Krause & Yakel, 2007; Yakel, Shaw, & Reynolds, 2007). Such approaches allow both archivists and the users of archivists to identify and release the stories found in archives. Wendy M. Duff and Verne Harris have written of the importance of story in the archives, arguing that archivists "should come to terms with the reality of storytelling in their descriptive work. Attempting to deny it, by insisting that they merely marshal facts rather than construct a narrative with a selection of the facts, or by insisting that they are merely a conduit for a story that tells itself, leads to sterility" (Duff & Harris, 2007, p.143).

With the emergence of the Web and new means of social computing, and perhaps a growing postmodern appreciation of the social dynamics of the archive (the social construction of records and the power implications of how records are both generated and managed), there is a growing recognition that archival descriptive systems should be opened to include the knowledge of archival researchers. Now archivists have an opportunity to correct decades of not incorporating user perspectives into their finding aids by placing finding aids online where researchers can tag and provide other commentary on the nature of the archival materials. This recognizes that archivists, even with their understanding of records and record-keeping systems, cannot possibly be experts on every topic represented by the materials they hold. With such approaches, archivists may be skipping more quickly into the realm of user-centered design than they imagine.

Participatory Web Interface Design with Children

This section describes participatory design projects in which children have worked alongside adults to design Web-based interfaces to reflect the ways in which children seek, organize, and use information. Allison Druin (1999, 2002) worked with seven children (ages seven to eleven) and an interdisciplinary team of researchers from information studies, computer science, education, art, and psychology to create the International Children's Digital Library (ICDL), a digital library for children. From this design partnership, researchers were able to gain a new understanding of how children went about collecting, organizing, searching for, and using information. The children's contributions demonstrated the value of bringing the user (even young children) into the design process. For example, the children wanted to search by feelings (books that make you scared or happy) and not just by topic. This led the design team to explore new forms of metadata that represent the emotions of children.

Large and his colleagues set out to build two Web portal prototypes for children, HistoryTrek and KidSearch Canada, using two intergenerational teams. One team consisted of adults and sixth grade students, the other was a mix of adults and third grade students (Large et al., 2004, 2005). Both portals were to be used in the context of learning about Canadian history. The common task of each team was to design a low-tech portal prototype that would enable elementary school students to search for Web-based information dealing with Canadian history. The team members—child and adult—worked side by side over several weeks exploring, negotiating, questioning, brainstorming, and sometimes heatedly debating as a community of designers. The methodology used has been called *bonded design* because members of the design team, irrespective of their age, must rely on each other and "bond" their wisdom and knowledge in order to achieve a usable design.

Druin et al.'s use of *cooperative inquiry* and Large et al.'s *bonded design* demonstrate two ways to include users as co-designers. In each case, the design teams used an array of techniques to open a window on children's thinking and children were an integral part of the design process. The techniques included brainstorming and contextual inquiry in which the researchers were participant observers of the children as they worked with technology. Another technique was the creation of low-tech prototypes by sketching designs or modeling with materials like clay and yarn. The models were shared and reflected on in written journals or in group discussions. The bonded design work of Large positions itself between Druin's cooperative inquiry and informant design. Like cooperative inquiry, bonded design accepts children as co-designers. However, bonded design "has reservations about the extent to which full and equal cooperation can occur across the generational divide" (Large et al., 2005, p. 90). In this respect, bonded design accepts the assumptions of informant design, in that it accepts that some form of scaffolding for the users is required—something that bridges what the users wish to see and what the designers know is possible. Bonded design occurred in a school, not a lab and, owing to the constraints of the school environment, has a much shorter implementation timeframe than Druin's cooperative inquiry.

While the work of Large and Druin demonstrate that information professionals can work alongside children, *participatory design* remains the least used of all user-design methods in LIS, despite the fact that it has been practiced in other contexts for almost three decades. It has its roots in Scandinavian cooperative projects of the 1970s, the goal of which was to increase workplace democracy (Bødker, 1996; Druin, 1999; Torpel, 2005). Accepting the user as co-designer, it is assumed, brings equity to the design process, gives voice to those who are not normally heard, uncovers their tacit knowledge and uncommunicated values, and provides a way to bridge the gap between what is known and what can actually be

expressed. This latter goal is particularly important when it comes to children's use of technology because they may not yet have the verbal skills to articulate their reasons for what they are doing.

As with all user-centered design of technology, participatory design recognizes that users are the experts in how *they* will use technology in the real world and that they should, therefore, be part of the design process. The single-most important characteristic of participatory design and one that distinguishes it from other methods which incorporate a face-to-face interaction with users, is that users are "in essence co-designers" throughout an iterative, circular process of design (Abras et al., 2004, p. 765). From conception to design, users work alongside designers to "*design by doing*," using "interactive experimentation, modeling and testing, hands-on designing, and learning by doing" (Large et al., 2005, p.75).

In participatory design, the dialogue between user and designer is constant. We use the word dialogue loosely here: dialogue can occur over many channels of communication and has multiple forms of expression. Children, for example, may communicate their needs and ideas physically through storytelling and playing with toys that represent computer functions (Montemayor & Druin, 2002). Unlike many usability studies, where users are asked to test a product after a prototype has been developed, participatory design begins at the beginning, before the product is even on the drawing board. It begins with concepts and ideas that have been generated by the *user*.

An inescapable element of participatory design is that it is highly contextual. This means that the method must match the situation and more specifically, the user. As an evolving methodology, the definition of participatory design has shifted as new approaches have been added to the collage. Participatory design, therefore, is not a prescribed set of techniques and approaches but rather, any tool or method that facilitates the role of "user as co-designer."

Information Architecture and Visualization

"Your web site needs to work for *somebody* if it's going to work for *anybody*," state Brinck, Gergle, and Wood (2002, p. 39) in accordance with the user-centered design rationale prevalent in Information Architecture (IA) for Web interfaces. IA principles are primarily devoted to front end design that concentrates on user activity within the Web browser. The application of IA principles has extended to collaborative tools, social structures such as wikis and blogs, and mobile websites (Vossen & Hagemann, 2007). Deliverables in IA include site maps, page designs, content outlines, and basic prototypes that demonstrate information structure and navigation. Since content classification and categorization are required to organize diverse malleable information, the field emerged from LIS theory. Related areas include graphic design, content management, and human-computer in-

teraction. The classic text for teaching IA is *Information Architecture for the World Wide Web* now in its third edition (Morville & Rosenfeld, 2007).

IA is concerned with building a visual framework for information presentation that balances the relative value of textual and iconic labels to convey information on a Web page to the end user. Being able easily to find links, headings, and navigation pointers increases the user's confidence in site exploration. Index term labeling, taxonomies and other controlled vocabularies have traditionally supplied the formal structure of labeling practices but there is now a shift toward incorporating social tags to represent the user's perspective on site content and access (Governor, Nickull, & Hinchcliffe, 2009). This participatory approach expands the user's role from user-centered design to *user-designed* in some instances. A tag cloud visualization feature for informational and navigational purposes consolidates social tags and is frequently used on library websites.

A navigational problem for IA is the user being "lost" on a site or not knowing where to go next. Morville (2005) examines the notion of *findability*, or the extent to which an object is easily located. While Morville dismisses information visualization as a viable option for enhancing the findability of websites, information visualization techniques can be applied to abstract nonspatial information that offers the user context and options to manipulate information displays (Koshman, 2006). In order to help users navigate a website the information architect can manipulate site structure to operationalize Web page features (Brinck et al., 2002). One practical implementation of user-centered navigation is the provision of textual or visual breadcrumbs that leave a semantic trail of the site's sections the user has visited. Another is to provide visual clues by making some sections of the Web page prominent by means of font size and type and logos or landmarks.

Methods used in IA to understand the intended user include developing user profiles or personas of who will use the site (Brinck et al. 2002). This requires direct observation of the end user in their Web-use context. *Card sorting research* requires the user to organize a set of index cards into meaningful categories to build an appropriate user-based labeling system on the website (Morville & Rosenfeld, 2007). *Standard user research* methods such as surveys, focus groups, interviews and field studies are also used, though there is a paucity of research studies that utilize these methods in an operational context to develop a robust research agenda in information architecture.

This may be in part related to the nature of website design which is strongly based in pragmatic projects implemented in specific organizations in government, industry, and academia. The exponential growth of the Web and its volatility make for a user testing environment that is unstable and not replicable. Moreover the metamorphosis of the user from a viewer to a Web content creator, evaluator, and contributor has mark-

edly changed approaches to user-centered design that go beyond basic IA design for functional user interaction and navigation. Including social elements in a site's Web presence involves cyberspace adaptation of real-world human social behavior of writing, chatting, collaborating, and sharing (Porter, 2008). IA principles must not only relate to the structure of a site's basic information, but also to how the site is to facilitate the communication of informal information among its users. Sign-ins, ratings, comments, and social tagging are features of IA Web design that can help merge structure and presentation for the user with user creation activities in information design.

LIS website design now features flexible architectural approaches that reflect the fact that Web information access has gone beyond desktop and laptop machines to handheld mobile devices.[1] Mobile devices free the user from a fixed location and require a new approach to website design (Rabin & McCathieNevile, 2008). In the growing context of social information, mobile websites, and information visualization, the term *user-centered design* has reached a new zenith in IA. However, the user studies that go beyond the identification of a primary audience is difficult because of the dispersion and diversity of Web users. In IA the trend toward more usability research that focuses on site functionality, efficiency, and memorability in the social web context offers many challenges. However, if this research is conducted in the context of new social, collaborative, visual, and mobile user-centered IA design principles, then it has the potential of offering assurance that a website site will work for *somebody*.

Information Visualization

Information visualization (InfoVis) refers to the depiction of abstract entities devoid of inherent spatial properties, such as Web or digital library search results. Users are paramount in the information visualization system experience and their role evolves from being a model to an evaluator to a learner. User-centered system design is not novel to this field and has formed the foundation on which many visualization design principles have been developed to overcome the limitations of current text-based interface designs for information retrieval. Most commonly this approach is referred to as human-centered design. One of its major aims is to create a visualization tool to *amplify cognition*. Cognitive amplification for visual representations offloads work from cognitive to perceptual mechanisms, expands working memory, and facilitates parallel perceptual processing (Card, Mackinlay, & Shneiderman, 1999).

Human perception provides a conceptual design model for visualization systems that is largely based on pre-attentive processing. This refers to perceiving or seeing an entity before cognition or conscious thought is applied (Ware, 2004). Pop-out designs utilize this theory and offer a powerful visual mechanism to identify a target object from a group of

distracters in a visualization screen display. Figure 1 shows a pop-out example using size and it is quite easy to quickly select the largest object in the display. Other pop-outs using color, orientation, and enclosure offer interface design options to bring objects on a computer screen to the user's attention.

Specific features in information visualization operationalize the user's tasks. Shneiderman's infamous visual information seeking mantra summarizes this effort: "Overview first, zoom and filter, then details on demand" (2003). Several visualization task taxonomies have been proposed to provide a structure for user such as aggregating, clustering, and highlighting so that systems can be designed to accommodate the user's perspective (Morse, Lewis, & Olsen, 2000; Shneiderman, 2003; Zhou & Feiner, 1998).

One major challenge associated with user-centered design in visualization systems is evaluation. Visualization system prototypes are typically evaluated by users. These evaluations determine the designer's success in building a robust prototype and in rendering the visualization usable and understandable. Usability testing methodology varies from an expert walkthrough to task-based system evaluations. Novice and domain expert participants are generally recruited from academic settings for quasi-experimental testing in laboratories (Rivadneira & Bederson, 2003; Plaisant, 2004; Koshman, 2005; Carpendale, 2008). Librarians have participated in some visualization studies to solicit their feedback from an information retrieval perspective.

Mainstream visualization technology is increasingly evident in the library context. The AquaBrowser Library system for the online public access catalog (OPAC) offers a component visualization that features a word constellation in the left corner (see fig. 2). As query terms are entered by the user, they are positioned at the center of the constellation and a visual breadcrumb trail is established as the search progresses. Different colors are used to indicate synonyms, translated words, and terms may be selected from the visual display to retrieve additional items.

Visualization-based Web search engines such as Kart00 (http://www.kartoo.com) or TouchGraph (http://www.touchgraph.com) employ selected visualization techniques in combination with textual descriptions to graph Web search results for users. The availability of Web-based visualization tools for a general audience indicates a growing movement toward augmenting the user's visual learning experience in a user-centered context. Future developments include the emergence of information visualization for retrieving information in the mobile environment where many of design concepts will be adapted for small screen devices. An initial proof of concept project for mobile visualization adapted the established visualization-based information retrieval tool VIBE (Visual Information Browsing Environment) for use with mobile devices (Koshman & Ahn,

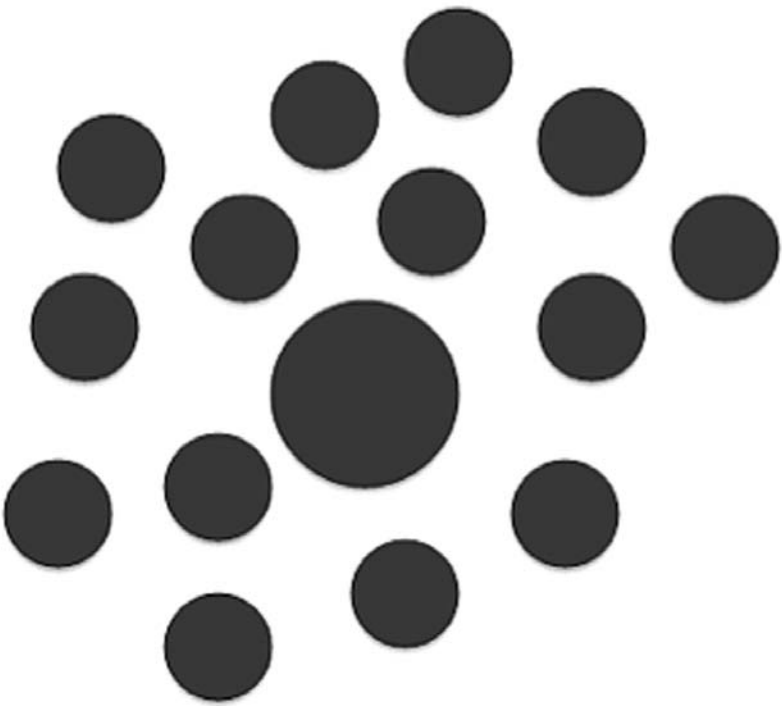

Figure 1. Pop-out Display Using Size

2009). As the LIS field progresses, the user-centered design orientation of information visualization will impact this environment by enriching the end user's experience of information seeking through novel technologies and advancing the librarian's role as a visual intermediary.

Adaptive and Personalized Search

Information seeking is a process that "humans purposefully engage in order to change their state of knowledge" (Marchionini, 1995, p. 5). One manifestation of it occurs when an information retrieval system is asked to match and display information objects in response to a given gap or need (Marchionini, 1995). Here the retrieval system can be a human being such as a reference librarian or more often a computer system such as a Web search engine. Adaptive and personalized search for information (APS) is a type of intelligent search that provides individualized collections of search results to users based on some form of model representing the users' needs and the context of their activities (Micarelli, Gasparetti, Sciarrone, & Gauch, 2007).

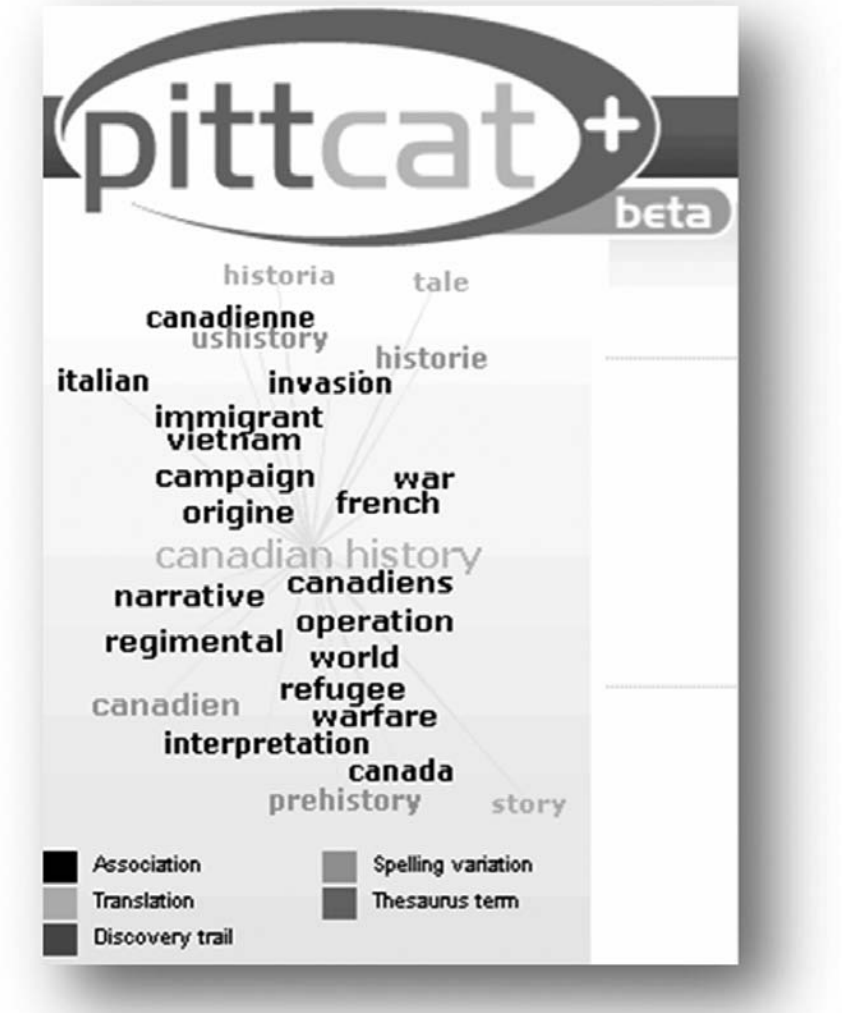

Figure 2. University of Pittsburgh's AquaBrowser Display

Library reference service has traditionally been adaptive and personalized. This is true in face-to-face reference services or reference services using phone, fax, mails, etc., and it is also true in virtual reference services on the Web (Kovacs, 2007). However, as the 2005 OCLC report (De Rosa et al., 2005) points out, an overwhelming majority of people (84 percent) now start their search for information with an online search engine outside of library services and of course without a reference librarian acts as the intermediary.

Although search engines have their genesis in library-based systems for searching bibliographic records, over the years they have provided the basis for the field called information retrieval (IR). This now involves library science researchers and practitioners, computer scientists, information scientists, and Web companies. "System-oriented" information retrieval has a strong emphasis on effectiveness and efficiency in its development of search algorithms that best match queries against documents. There is no explicit representation of users in this approach; it is not user centered. The frameworks for evaluating search algorithms, first developed in the 1967 Cranfield II project (Cleverdon, 1967), utilize test collections consisting of documents, static search requests, and judgments identifying relevant documents for a given request. The continuing Text REtrieval Conference (TREC; see the TREC website at http://trec.nist.gov) and its related approaches have inherited the spirit of Cranfield and have been a strong force in the development of the IR field since 1990 (Voorhees & Harman, 2005).

Increasingly, however, the system oriented information retrieval paradigm has been criticized for omitting the information needs of users in the modeling of the search problems. Search is, above all, a human activity—it is the users who initiate the search process and who ultimately judge the relevance of search results. Taylor, as early as in 1968, pointed out that the queries that search engines rely on for retrieval are not identical to the users' information needs (Taylor, 1968). It has also been pointed out that the notion of relevance is not static as is assumed in system oriented IR research, but is subjective, situational, and non-binary (Ingwersen & Javelin, 2005, p. 1). All of this suggests that further development of the IR field should take the route of user-centered design (Kekalainen & Jarvelin, 2002).

Studying users has been an important area in information seeking literature and library and information science (He & Xu, 2007, p. 211). Since Dervin and Nilan's (1986) article on information need and use, user-centered information seeking research has developed many important theories and models. Among them are Dervin's (1998) Sense Making theory, Belkin's (1980) ASK Model, and Ellis' (1989) information seeking patterns (for overviews see Case 2002; Ingwersen & Jarvelin, 2005).

Adaptive and personalized search (APS) focuses on providing individualized results and presentations. It puts the emphasis on the user (Micarelli et al., 2007). APS systems build, manage, and represent information about individual users so their information searches can be customized. This customization may "take the form of filtering out irrelevant information and/or identifying additional information of likely interest for the user" (Gauch, Speretta, Chandramouli, & Micarelli, 2007, p. 54). The information that the APS systems collect about user is stored in a model called a user profile. The information collected may include demographic infor-

mation, for example, name, age, country, education level, etc., and the interests or preferences of either a group of users or a single person (Gauch et al., 2007). A profile can be constructed using information collected explicitly by directly interacting with the user, or implicitly but observing the user's activities. Explicitly collected information is often accurate, but it costs the user's time and requires the user's willingness to participate. Implicit information, on the other hand, does not require any additional intervention by the user during the process of constructing profiles. A number of studies have examined the effectiveness of the profiles constructed explicitly and implicitly (Quiroga & Mostafa, 2000, White, Jose, & Ruthven, 2001, Teevan, Dumais, & Horritz, 2005). Increasingly research shows that implicitly created profiles are as good or better than explicitly created profiles (Gauch et al., 2007, p. 63).

User profiles can take several forms of representation. The simplest and most commonly used representation in APS is keyword-based profiles. They capture words from the documents or information items provided by the user and the user's profile is created through a combination of terms and their associated weights. The construction of this type of profile requires a large amount of user feedback. Semantic network-based profiles and concept profiles contain more semantic related information in the profiles, making them robust to variations in terminology with less user feedback.

From the traditional adaptive and personalized searches conducted by reference librarians to one-results-fit-all Web search engines and back to the customization of search results and presentations based on information about individual users, we have seen a re-centering of search processes around the user. APS is just one important development in the user-centered movement.

Reflecting the Social and Cultural Values of the User

In their exploration of value sensitive design and information systems, Friedman et al. (2006) distinguish between usability and human values. Usability refers to systems, services, and tools that work in a functional sense, but usability can come at the expense of social, cultural, political, and ethical values. For example, Web pages are ranked by popularity (as determined by the number of inlinks from other sites) to create a listing that presents what is assumed to be the most relevant information first. From the designer point of view, these rankings make the search engine more usable because it connects the user to pertinent information in the most efficient manner. But from a value sensitive point of view one might ask why popularity is correlated with worthiness. Is the most-used information necessarily valuable to all? This trade-off between usability and values is but one example of the complex relationship between the de-

sign of information technology and the human context in which it functions.

In this section we look at user involvement from the broad perspective of value sensitive design. We revisit the problematic question of "the user," but specifically through the lens of social, cultural, political, and ethical contexts. Values provide an over-arching framework for designers of information technology. Technical decisions about the selection, organization, preservation, and retrieval of information are social decisions that have social consequences—they reflect human values and have outcomes that affect human society (Bowker & Star, 1999; Friedman, 1997; Lessig, 1999; Nissenbaum, 1998; Star & Bowker, 2007). Most troubling is the effect that such decisions can have on the individual and his or her quality of life. In the section below, we look more closely at one case in particular—One Laptop per Child's XO Box—to investigate how values embedded in a design project can reflect problematic assumptions about the intended user that may conflict with local customs.

One Laptop per Child's XO Box

The concept of the "user" or the "end user" is highly complex. In canonical, slightly stereotypical design process, a given application is first tested by engineers and their friends and then "thrown over the wall" to see if anyone will adopt it. The problem with this approach is crystallized by the One Laptop per Child initiative's (OLPC) XO Box. This ambitious venture has sought—with limited success—to convince governments of developing countries around the world to buy large quantities of their computers (to keep prices down) and to use them as a basis for their educational systems. There are several kinds of problems with this program: for the purposes of this paper we shall restrict ourselves to design issues and the end user.

First is the design assumption that the end user is an individual. In fact, studies both in the developed and developing world (Twidale, Nichols, & Paice, 1997) suggest that users typically work collaboratively on their machines. Thus the concept of one computer per child enforces a culturally inflected value of individual ownership that arises from a particular configuration of the social—late capitalism. Further, the design of the XO Box is such that its small keyboard is suitable to children much more than to adults. Here is an additional assumption, then, being smuggled in through the physical design of the product: that children are the gateway to the future for the developing world. This is possibly true; but it is an ill-supported hypothesis and not a fact about the world.

However, let us take one step back from the physical design. The whole process of producing XO boxes involves the use of cheap labor by manufacturing companies with no guarantee of fair wages. There is no worked-through plan for maintenance. Although maintenance is "made easy" by

making the box easy to open, it is by no means clear that users or their community will be able to keep the product going over the long term. It seems more likely that piles of used XO boxes will grow in the developing world, as have many of the other machines donated/dumped by large manufacturers in the third world. Further, one effect of the XO Box, should it succeed, might be to stifle any nascent IT industry in the countries that produced it. Designs have political consequences, whether or not this is intrinsic to the thinking of the design community (Winner, 1980).

Finally, let us consider the programming itself. Nicholas Negroponte, the originator of the project, has stated that with the XO Box up and running it is not so important to have educators present. Learning will happen through interaction between child and machine, mediated by the user interface. However, the interface is only "intuitive" to those who have spent a lot of time around computers.

Figure 3 is a representation of visible computers in One Laptop per Child range within a given radius; it is given in a highly formalized language that assumes a culturally specific awareness of a certain kind of symbolism—"native" perhaps to Western readers, but surely not to all. Similarly, the educational modules provided (it is difficult for users to generate content) all assume a culturally specific model of education with all the problems recognized by educational theorists over the past half century; it is only with locally relevant content—and gender diverse content—that the educational process can be democratized (Lave & Wenger, 1991).
In conclusion, then, the One Laptop per Child initiative is tied to an inapplicable educational model, supports nonoptimal outcomes for the user community and is embedded in a highly problematic policy context.

We are not particularly concerned with the OLPC initiative per se. Rather, it stands as synechdoche for the wider problem that user-centered design is not about better relationships between individual users and their machines: it is about full awareness of the cultural context of use and the development of educational and other theories consonant with that context.

Conclusion

Following are some of the key issues related to the involvement of users in the co-construction of knowledge in libraries, archives, and museums.

- *Relinquishing control*: some information professionals may be reluctant to allow the users' voice(s) to emerge because opening design to the user implies a loss of control. Information professionals have expertise in the provision of information systems and services, expertise that is often gained after years of study and training. Relinquishing control without loss of quality and functionality may be difficult. Examples from

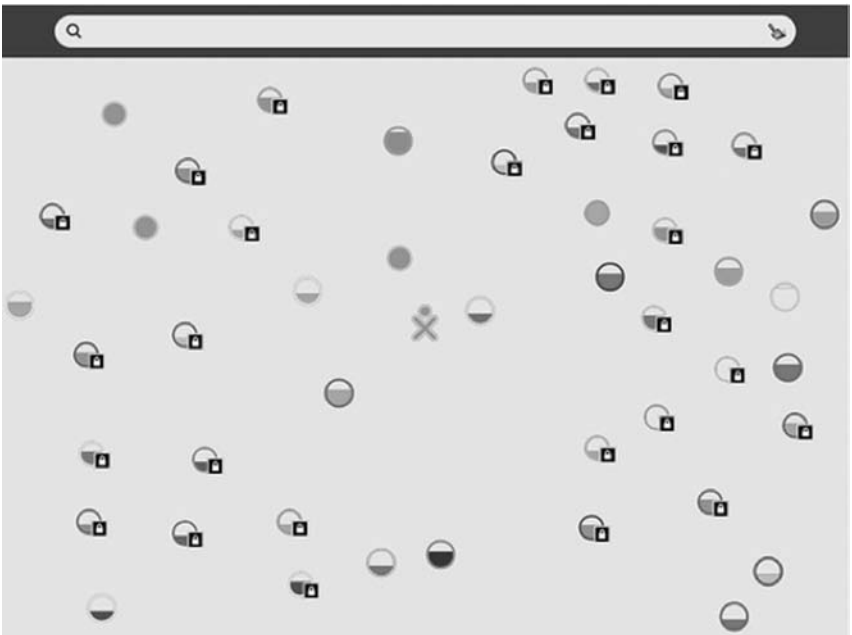

Figure 3. Visible computer in OLPC range within a given radius

this paper, however, have shown that involving the user in design does not necessarily lead to a loss of power. Rather, user-centered design may reveal aspects of the user hitherto never before explored. Furthermore, allowing the user to participate in the process may actually promote the services we work so hard to build and manage. A good illustration of is the example of Creative Spaces, a system that connects users to multiple museum sites and collections that have been prebuilt by museum curators. If it is in fact difficult for information professionals to relinquish control (and there is some evidence that this is the case, as the section on finding aids points out), the difficulty may be related less to attitude—a state of mind toward the user—and more to a lack of knowledge related to methods of user-centered design. Negotiating the space between user and expert is a skill and one that information professionals need to be taught.

- *Generalizability:* Is user-centered design generalizable? That is, can it support broad laws of human behavior? Perhaps more importantly, should it? This article emphasized the point that values are embedded in design. The problem is this: Can values be generalized? To a certain degree, social tagging can tell us much about the values of the "user" writ large.

With its ability to aggregate large quantities of data, social tagging offers a way to paint a "big picture" of the user.

The article also highlights an alternative approach to generalizability—one that deliberately leads to specificity and contextuality. In the section on participatory design of Web interfaces, for example, the sample user population involved in design was small and highly specific—small groups of children—and their work led to Web interfaces that in no way made claims to being a "universal design" (see Bowler and Large, 2008, for a discussion about validity and generalizability in design-based research). In the section on adaptive and personalized searches, we learned of search engines designed to reflect the needs and behavior of each individual user, rather than a global population of users. It may be that generalizability is not the point of user-centered design.

- *Practicality:* Is it practical for information professionals to approach design from a user-centered perspective? One of the most direct methods of eliciting the user point of view is through participatory design, but, as the article points out, this is one of the least used methods because of a concern for cost effectiveness. Is it worth the time, effort, and cost for information professionals to build information products from the ground up, alongside the user? In many cases, the answer will be no. Social tagging, which allows for the aggregation of large scale data from and about users, and interactive search engines that individualize the search process, are two alternate solutions to the "do-ability" problem of participatory design. But for those instances where face-to-face interaction is the best choice, the difficulties that information professionals may have in running such types of user studies may negate their actual usefulness.
- *The ethics of user-centered design:* Beyond the practical, there are ethical issues attached to UCD. User studies gather data about users and as such, should be approached with care. A user study is more than a "marketing study." Are information professionals trained in the ethics that underlie UCD, particularly in the issues related to data-gathering from vulnerable populations such as the elderly, young, and disabled? Do information professionals understand the meaning of informed consent? How do information professionals retain the data they gather about users? To what extent is the user's anonymity guaranteed? Are we training information professionals to manage the ethical issues related to the practice of gathering data about users? Where can information professionals turn for guidance in this area?

> The values embedded in design also present important concerns for information professionals. The guiding mantra of information professionals has often been "access, access, access," but at what cost and for whom? While information profession-

als need training in the actual methods of user-centered design, this training needs to emphasize the need for critical thinking so that design just for the sake of design is not the result. A driving theme that runs through all professional education is the notion that the true professional is one who assumes a critical, reflective stance with regard to his or her own practice. In the context of the twenty-first-century information professional, this must surely include the design of information technologies that are used to build collections and organize and retrieve information objects. Calls for a "reflective designer" is an idea explored more fully by Sengers, Boehner, David, and Kaye (2005). The "reflective designer" is one who questions the limits of current design practice and understands the values, biases, and assumptions that the designer brings to the design process. Do information professionals-in-training learn to think reflectively about their design practices?

User-Centered Education in LIS

It has long been recognized that we live in an age based on information, even if there are wildly divergent notions of what constitutes information. Eventually we recognized that we could bypass the difficult (and sometimes unanswerable) philosophical issues by attempting to understand the artifacts (documents of all sorts) conveying information and those who used the artifacts and the information they contained—all of this made possible by an array of new social computing technologies.

These technologies not only have contributed to breaking down the boundaries between libraries, archives, and museums. The storming of the barricades has occurred in part because users increasingly do not think in such organizationally restricted terms; they seek information from whatever source they can get it from. This has consequences for our programs of professional education. UCD as a partnership or collaboration between users, designers, and disciplinary experts may bring profound changes in these programs and do research about the information users with whom these professionals work.

It may be that academics (the authors of this essay) may need to focus on collaborating with, rather than training, our students. Students are now bringing with them a tremendous breadth, if not always depth, of experience with information systems. They may well be more adept at the use of the tools than we are. As educators our role may be more in helping them to building knowledge of the concepts underlying the development of these tools and an awareness of the implications of their use. We may learn from our students by analyzing what they know and how they work while we educate them about the larger picture in which they are placed, once called the information age but now really a knowledge era.

Just as no one of the authors of this essay could have brought together intelligently all the experiences and research reflected in it, so too we should transform our classrooms into transdisciplinary workshops where we allow students to critique our knowledge and to take it to the next level. This would be to create a user-centered education that transcends the hackneyed and not very satisfactory notions of students as customers in the present corporate university model, something far more profound and useful for both student and professor (Haythornthwaite et al., 2007). If we attest to the positive potential of participatory design, why not play with the possibilities of participatory education?

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Note

Koshman's Information Architecture course features an IA for Library Mobile Web Sites Lab.

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Leanne Bowler is an assistant professor at the Graduate Program of Library and Information Science, School of Information Sciences, University of Pittsburgh, where she is responsible for the specialization in children and youth. Her research interests lie in the area of youth information-seeking and the use of design-based research as a means of revealing the ways that young people make sense of information. She teaches graduate courses about technology and resources for children and youth.

Sherry Koshman is an assistant professor at the School of Information Sciences, University of Pittsburgh. Her research interests include investigating user interaction with information visualization tools, mobile devices, and Web collections. Her published articles have appeared in journals such as the *Journal of the American Society for Information Science and Technology*, *Journal of Documentation*, and *Information Processing & Management*. She is involved with testing mobile access to an academic library system and teaches graduate courses at the School of Information Sciences at the University of Pittsburgh.

Jung Sun Oh is an assistant professor in the School of Information Sciences, University of Pittsburgh. Her research interests are centered on understanding people's information behavior as manifested in their use of the Web, especially in the context of social networking, social bookmarking, and social Q&A.

Daqing He is an associate professor of information sciences and intelligent systems at the University of Pittsburgh. His main research interests are in information retrieval (monolingual and multilingual), Web adaptive systems and user modeling, interactive retrieval interface design, and Web log mining and analysis.

Bernadette G. Callery is an assistant professor in the School of Information Sciences, University of Pittsburgh. She teaches Museum Archives and other courses in the Archives, Records Management and Preservation specialization. She is particularly interested in museum recordkeeping systems in transition from paper to digital formats and edited *Collaborative Access to Virtual Museum Collection Information: Seeing Through the Walls* in 2004, co-published as the *Journal of Internet Cataloging*, 7(1).

Geoffrey C. Bowker is professor of and senior scholar in cyberscholarship at the University of Pittsburgh iSchool. For the past five years, he has been serving as executive director, Regis and Dianne McKenna Professor Center for Science, Technology and Society, Santa Clara University – a center whose mission is to research and promote the use of science and technology for the common good. He was previously professor in and chair of the Department of Communication, University of California, San Diego. He has written with Leigh Star a book on the history and sociology of medical classifications (*Sorting Things Out: Classification and Practice*, published by MIT Press in September 1999). His book, entitled *Memory Practices in the Sciences* (MIT Press, 2006) is about formal and informal recordkeeping in science over the past two hundred years. It won the ASIST prize for best book in Information Science as well as the Fleck Prize for best book in Social Studies of Science. He is currently working on a book about how to recognize the social, cultural, and moral values that are embedded in the construction of databases.

Richard J. Cox is professor, archival studies in library and information science at the University of Pittsburgh, School of Information Sciences. He served as editor of the *American Archivist* from 1991 through 1995 and editor of the *Records & Information Management Report* from 2001 through 2007. He has written extensively on archival and records management topics and his books have won the Waldo Gifford Leland Award of the Society of American Archivists in 1991, 2002, and 2005. He was elected a fellow of the Society of American Archivists in 1989.