Making Digital Libraries Go: Comparing Use Across Genres

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ABSTRACT

A new federal initiative called Information Technology for the Twenty-First Century (IT2) recognizes the need to bridge research across domains in order to bring computing benefits to society at large. One implication for digital library (DL) research is that we should start looking at projects that span the spectrum from basic computer science to the implementation of working systems and consider links among findings on information system use from a variety of arenas in life. In this paper, I integrate findings from my research on people's encounters with DLs in two different arenas: academia and low-income neighborhoods. The point is to see how concepts and conclusions related to use do, in fact, cross these arenas. The paper also aims to help bring results from studies of local community information practices into the realm of DLs, since community networking represents one particular genre and audience that has not yet received a great deal of attention from those engaged in DL research. Beginning with a discussion of DL use as an "assemblage" of infrastructure, norms, knowledge, and practice, the paper explores a number of insights gleaned from user studies associated with two separate research projects: 1) the recently completed University of Illinois Digital Libraries Initiative (DLI) project; and 2) the Community Networking Initiative (CNI) currently in progress under the auspices of the University of Illinois, the Urban League of Champaign County and Prairienet, the community network serving East Central Illinois. Insights about DL use discussed in this paper include: the way in which trivial barriers are magnified until they effectively cut off use on a large scale; the difficulties faced by "outsiders" whose information worlds are impoverished; the primacy of comfort and relevant content in encouraging use; and the importance of informal social networks for providing help related to system use.

KEYWORDS: User studies, electronic journals, community networks, scientific and technical information, low income neighborhoods

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1. INTRODUCTION

A new federal initiative called Information Technology for the Twenty-First Century (IT2) recognizes the need to bridge research across domains in order to bring computing benefits to society at large [40]. The program will support research leading to improvements in "how we live" as well as how we work, learn, and conduct research. Technology applications targeted for funding include, for example, those geared to helping people with disabilities lead more independent lives, as well as those devoted to healthcare, electronic commerce, and accelerating the pace of scientific and technical discoveries. The new initiative also specifically calls for research on the social implications of the Information Revolution. Certainly one issue that must be dealt with if the benefits of computing are to accrue to all segments of society is the "digital divide" that currently bifurcates information technology use across socioeconomic fault lines [6, 21].

One implication for digital library (DL) research is that we should start looking at initiatives that span the spectrum from basic computer science to the implementation of working systems and consider links among findings on information system use from a variety of arenas in life. In addition to studying DL use in academic and corporate settings, we should include research into how DLs transform home life, the workings of local communities, and the activities of small community organizations, all of which are important in determining how we stitch together our days. At present, competing visions and agendas in both research and practice are hindering progress toward synthesizing and communicating DL research results [12]. Nonetheless, in looking at conceptions of DLs offered over the past several years--most of which define Dls as some combination of a collection, technology, and services--it is apparent that a range of system genres and intended audiences are candidates for inclusion. These include the web at large, online educational archives, digitized document collections mounted by libraries, virtual museums, and computer-based community information systems.

In order to gain a fuller understanding of the social implications of DL use, DL research should continue to explore how use is situated in social practices. In this paper, I integrate findings from my research on people's encounters with DLs in two different arenas: academia and low-income neighborhoods. The point is to see how concepts and conclusions related to use do,

in fact, cross these arenas. The paper also aims to help bring results from studies of local community information practices into the realm of DLs, since community networking [14, 24] represents one particular genre and audience that has not yet received a great deal of attention from those engaged in DL research.

Beginning with a discussion of DL use as an "assemblage" of infrastructure, norms, knowledge, and practice, the paper explores a number of insights gleaned from user studies associated with both the recently completed University of Illinois Digital Libraries Initiative (DLI) project and the Community Networking Initiative (CNI), which is currently in progress under the auspices of the University of Illinois, the Urban League of Champaign County and Prairienet [http://www.prairienet.org], the community network serving East Central Illinois. Insights about DL use discussed in this paper include:

- The way in which trivial barriers are magnified until they effectively cut off use on a large scale;
- The difficulties faced by "outsiders" whose information worlds are impoverished;
- The primacy of comfort and relevant content in encouraging use; and
- The importance of informal social networks for providing help related to system use.

2. COMPARING USE ACROSS GENRES: THE DIGITAL LIBRARY INITIATIVE (DLI) AND THE COMMUNITY NETWORKING INITIATIVE (CNI)

The goal of our NSF/DARPA/NASA Digital Libraries Initiative (DLI) project at the University of Illinois was to develop widely usable technology to effectively search technical documents on the Internet [33]. [For more information about the University of Illinois DLI project, visit the project homepage at http://dli.grainger.uiuc.edu/] DeLIver, the web-based DLI testbed at the University of Illinois, contains the fulltext of recent articles from over 50 science and engineering journals [http://dli.grainger.uiuc.edu/deliver.htm]. The University of Illinois DLI Social Science Team performed formative and summative user studies to improve testbed design, document use, and develop an understanding of faculty and student work and communication practices in the changing information infrastructure. Over the four years of the DLI project (1994-1998) we gathered data through:

- Observation of engineering work and learning activities (at four different academic sites);
- Interviews and focus groups with a range of potential and actual testbed users (about 50 faculty, students and staff in science and technology disciplines);
- Usability testing (about 40 subjects);
- User registration forms (collected from 1346 DeLIver users);
- System instrumentation (the creation of testbed transaction logs from about 3000 use sessions); and
- A final user survey (234 respondents).

Our work represents an integrated research program for studying testbed users that combines broad study of use with deep study of social phenomena. [8, 9, 28] [Further information is also available at the Social Science Team's homepage at http://anshar.grainger.uiuc.edu/dlisoc/socsci_site/.]

The Community Networking Initiative (CNI) [http://www.prairienet.org/cni] is a research and development effort devoted to increasing participation in the "information age" among residents in low-income, predominantly African-American neighborhoods in Champaign-Urbana, Illinois. The project aims to analyze information needs and exchange at the local level, deliver computers and training to teens and adults, provide technical assistance to community-based organizations, and redesign Prairienet's information retrieval features. The community network serving as the basic infrastructure for the project is Prairienet, which provides residents with Internet tools (e.g., web browsing, email, and discussion groups) and a collection of digital information from about 500 local organizations.

During the first year of the CNI project (1998), our primary research goal has centered on conducting a community analysis in order to uncover problems facing low-income residents of the Champaign-Urbana area, learn what information is useful in addressing these problems and how it is currently obtained, and explore attitudes and practices related to computer use. Data have been collected through:

- Community application forms from about 700 people that collected information about potential participants' expectations and current computing knowledge;
- In-depth interviews with 26 parents and guardians of teens participating in Spring 1998 training, most of which were conducted in the teen households;
- Twelve focus groups with the 116 adults participating in CNI community training workshops held in Summer 1998;
- Focus groups with about 30 of the teens attending the CNI training program offered in Spring 1998;
- Training evaluation questionnaires collected from 20 of the teens completing training in Spring 1998 and from 109 of the community members who completed

CNI training workshops in Summer 1998;

- Written logs of CNI user support activities with trainees that record date, time, and mode (email, phone, in-person) of each user support interaction, as well as the nature of requestor's question or problem; and

- A follow-up telephone interview that surveyed adult trainees about their use of CNI training and equipment about six months after they had completed their training and received a computer for their household (about 40 interviews have been completed so far).

3. THE ASSEMBLAGE OF DL USE

Watson-Verran and Turnbull [43, p. 117] proposed the term "assemblage" to capture "the amalgam of places, bodies, voices, skills, practices, technical devices, theories, social strategies, and collective work that together constitute technoscientific knowledge/practices." The concept has been introduced into the digital library literature in several contexts [29, 41]. Extending this general view to the particular activity of information system use, we see actions, objects, and mental processes fit together like a tinker toy in motion... DL use can be described as the assemblage of infrastructure, knowledge, practice, and community norms that is functioning for an individual at any particular time. The interworking of the various components is always unstable, as the introduction of a change in any aspect of the user's situation necessarily demands adjustments throughout the entire assemblage.

Like recent frameworks that promote a general understanding of information system use as social practice--most notably "social informatics" [11, 23] and "information ecologies" [26, 35], the assemblage concept recognizes that DL use is a complex sociotechnical activity grounded in a particular moment in someone's life, and influenced by the collective set of circumstances that led up to that moment. It focuses on the person at the machine, without reducing students, librarians, firefighters, physicists, and moms to "users," and provides a metaphor that conveys "the ad hoc contingency of a collage in its capacity to embrace a wide variety of incompatible components" and "active and evolving practices rather than a passive and static structure" [43, p. 117].

Our analysis of how DeLIver's component search and viewing features were used resulted in insights about how new information systems disrupt the assemblage of existing work practices, knowledge, and infrastructure. In illustration of this point, when asked about his lack of use of DeLIver's extended citation screen, a participant in our situated usability study remarked: "I would go get the full article. Why not? Especially because it is just there; I have no incentive for stopping at the abstract. If I can just go and get the entire article, I can just skim it." In other words, the skimming of full text to focus selectively on the citation, abstract, figures and references is a familiar practice performed with paper documents. Learning to use a display which incorporates these same elements merely disrupts the familiar routine, adding a burden on users for which the payoff is not great enough to offset the initial effort of changing a set routine.

In the example provided above, a specific disruption of a person's information use assemblage is described. More general descriptions of the confluence of social worlds with information worlds depict the overall workings of the assemblage of information system use. Such studies have spanned academic and community resident domains. In order to incorporate a multimedia DL of classics material into the curriculum, teachers were forced to make substantial adjustments in their entrenched classroom tools and practices [27]. An understanding of the use of new electronic media in Scottish households was formulated though the investigation of family members' power relationships, personal goals, and attitudes toward technology [18]. The lack of interest in community networking technology expressed by residents of a women's shelter, compared to its enthusiastic adoption by those frequenting a senior center, was explained as a result of observing and discussing the lifeworlds (including characteristics, perceptions, and needs) of these two groups of potential users [42].

In both DLI and CNI, descriptions of a range of circumstances associated with the overall assemblage of information system use were generated. In a DLI focus group with undergraduates, we were confronted with just how hard it is to negotiate the brittle information environment represented by the current distributed library, a hybrid of formal and informal, online and offline resources. Students reported that they have to stand in line waiting to use the computers in the library to find citations for a few articles. Once they get a list of potentially relevant articles, they have to run all over campus looking for the items on their list. And once they have finally located the journal volumes on the shelves, they often find that the articles they want have been ripped out. The plight of undergraduates can be understood as that of people who, in part because they are newcomers to the academic social system, experience an information world that is "confusing, chaotic, insurmountable, unusable" [36].

Teens participating in CNI training programs were faced with a similarly ragged information world. They were not bereft of electronic media in their homes, though computer ownership in their households falls below the national average [30]. In the households interviewed, all had telephones (about half had cordless phones and answering machines) and TVs, and the vast majority had cable access and a VCR. Just over one third owned at least one computer, although only about half of these were networked.

Teens depicted their current access to computing resources as scattered and superficial. Although they have access to and use computers in a range of locations, their focus group comments suggested that use is fragmented by location and does not reflect their own goals or interests. Teens reported that while they may have computer labs in their schools, the labs are only open a few hours and only for use on class assignments for students taking certain courses. Teens who had taken computer courses

depicted their content as primarily learning the names of computer parts and typing. They may have looked over the shoulder of a friend doing email a few times, but that did not mean they learned either the conceptual basics of email or how to really use email themselves. Further, without ready access to computers on which email was permitted, they had little means to practice anything they may have picked up from friends.

Teens also presented a somewhat less rosy view of home access than that suggested by our basic statistics on home computer ownership. A number of teens said that while their households did own a computer, that computer was actually unusable because it was broken, too old, or only temporarily placed in the home (i.e., rented or borrowed). The heads of households in which the teens lived were fairly evenly split in their degree of computer use, from daily to never to somewhere in between. Of our household interview sample, 39% said they used computers daily while, at the other end of the spectrum, 31% reported that they had never used computers. Those who used computers were more likely to gain access at a public site (school, work) than at home or at a friend or relative's house. Their use, like that of the teens, was guided by external forces rather than personal goals. They were familiar with one or two applications, perhaps each on a different technology platform, and had little opportunity to gain a more fundamental understanding of computer applications.

4. IMPOVERISHED INFORMATION WORLDS

Both the typical undergraduate and the typical teenager from a low-income neighborhood face a restricted information world. In such cases, as is evident above, the assemblage of information system use is particularly tenuous. Chatman characterizes the urban poor as "outsiders" who face an impoverished information world [16, 17], in that they are barred from full and easy participation in an information system through lack of physical access, technical proficiency, awareness and, often, motivation. Her characterization has much in common with the description of the undergrads who, as described above, were faced with a narrow and brittle information world, one in which they experienced few of the benefits of "information convergence" [36].

Information convergence deals with the "larger implications of the changing information infrastructure: how communities of practice converge with information artifacts and information infrastructure to produce the ready-to-handness of particular resources" [10]. Academic insiders, typically well-established faculty members, have the financial and technical resources, embeddedness within a research specialty, understanding of how information is organized in the field and how to use specific information resources, and membership in an invisible college that all interact in such a manner that information flows easily to them.

This lack of convergence clearly plagues teens participating in the CNI project. In an information world characterized by superficial knowledge about information resources and practices related to their interests, intermittent and unpredictable access to technology, and a network of family and friends whose information worlds are unfortunately similar to their own in these characteristics, few of the intellectual and physical resources needed to support information seeking and use are ready-to-hand for low-income teens.

5. INSURMOUNTABLE MOLEHILLS

In implementing DeLIver, we were struck by number of occasions on which a small, seemingly trivial, primarily technical, barrier thwarted access and use on a grand scale. Successfully negotiating authentication and registration procedures presented potential users, for example, with a problem that was far greater than system developers expected. [9] Web log data on attempted DeLIver accesses for the first several weeks following our full public roll-out across campus revealed that the vast majority of attempted accesses were abandoned when users reached the point of filling in their campus network ID numbers. Of those who managed this hurdle, only half continued on to successfully complete our user registration form.

Data on subsequent access attempts suggest that simple remedies--such as providing basic information about a digital library's characteristics (i.e., its cost and contents) and clarifying access instructions (e.g., explaining where to find the "netID" required to enter the system)--paid off: over the course of about nine months, the rate of successful access attempts rose from 17% to 62%, and the rate of successful registration completions rose from 51% to 72%. Even with these gains, however, it is obvious that routine registration and log-in procedures are still major bottlenecks for users of DeLIver and, presumably, other systems.

In another example of the potentially large effect of a small technical problem, some situated usability subjects reported that difficulties in loading figures limited the utility of DeLIver's extended citation screen. Although the ability to download the required viewing software was only a "few clicks" away, lack of already installed applications presented a seemingly insurmountable roadblock for faculty and students unfamiliar with downloading free software from websites, uncertain about whether their machines could support the required application, and uneasy about "messing around" with their computers.

Guided search usability studies (developed and conducted by Michael Twidale, who offered to help students use DeLIver to find articles for a current course assignment) presented other examples of the consequences of small technical problems. One of the primary barriers to use identified in that study was the effect of data errors that seemed quite trivial and may not even have been widespread. One such data error was that no abstract was available when the student clicked on that link. The DLI researcher conducting this set of usability tests noted that after one failed attempt, students often did not bother to click on abstract links again. Thus, one thwarted attempt caused complete abandonment of use of that feature.

In the CNI project, attempts to shore up information technology access and use among residents of low-income neighborhoods were also all but jettisoned in a number of cases by seemingly slight problems. Several of those who attended technology training workshops, for example, commented it was exceedingly difficult for them to arrange a means for getting to their required classes because city buses did not operate at the required times. With childcare schedules to juggle, and few available and affordable alternative options for transportation, training was almost missed.

In order to chart the number and nature of problems experienced by CNI participants after they had completed their training and received computers to take home, technical support staff are maintaining a log of the user queries they field. In addition, a follow-up telephone survey of project participants conducted about six months after they acquired their computers included questions about extent of, and factors relating to, use of their machines. These sources of data revealed that a number of people were not able to use their CNI computers for any communications applications, such as sending email, browsing the web, or logging onto Prairienet.

Reasons offered for the inability to get online were, on the surface, surprisingly minor: people could not remember completely how to configure their communications software, did not receive a needed modem power cord, or forgot their login name. It appears that available remedies--such as calling the Prairienet office for instructions, consulting a knowledgeable friend or published software manual, or purchasing small supplies--were beyond CNI participants. Based on interviews and observations associated with CNI research, it also seems possible that lack of trust in CNI staff or lack of motivation may underlie some of the explicitly stated barriers. A key point is that if CNI training and support staff had had better knowledge of the social and information worlds of project participants, some of these barriers could possibly have been anticipated and worked around.

6. PRIMACY OF CONTENT AND COMFORT

Faculty and students who participated in needs assessment focus groups for our DLI project emphasized the importance of convenient, comfortable, easy, and inviting access to online journal collections, a finding consonant with similar studies [4, 37]. When asked to describe the ideal electronic journal collection, undergraduates noted such features as "comfortable chairs" and a "homey" feeling, in addition to such standard visions as access to the world's store of knowledge, from your own computer, at the touch of a button.

In the user survey distributed at the end of the DLI project, the vast majority of respondents (83%) said they would use DeLIver again, with full-text, desktop access cited about twice as often as either ease of use or new search abilities as motivating factors. In our user survey, respondents were also asked to rate the importance of specific DeLIver features to their work. Their responses confirm that the ability to find and view articles from one's desktop was apparently more important to users than enhanced search and display features, such as the ability to search individual sections of journal articles.

Relevance of DeLIver's content was overwhelmingly cited in the user survey as the primary reason for not using the system again, as opposed to factors related to the DeLIver's reliability or ease of use. The system contained a handful of journal titles in each of the fields it covered, and only recent journal issues. Those titles included were not necessarily the ones most often used by researchers. Interviews with potential and actual users revealed that DeLIver's collection was unlikely to be suitable for responding to many needs. People described many situations in which access to older material was crucial to their work. In identifying the sources they consulted most frequently, it was clear that DeLIver's collection offered far from a perfect match for most individuals.

Adult participants in the CNI project also provided a clear picture of the importance of convenient and comfortable access to computer resources. Household interviewees were asked for their opinion about "what computers are good for" and in response they identified a wide range of positive uses for computers. Familiar phrases like "access to the world in a click" and "accessing information at the touch of a button" were offered by study participants.
In household interviews and focus group discussions, we also gained a number of insights into why low-income community members believed that the comfort of home access was critical to becoming an active computer user. With busy schedules and limited transportation opportunities--especially in single parent households where the parent was juggling work, education, childcare, and home upkeep responsibilities--public access sites might be difficult for some low-income community members to take advantage of. A single mother with a young daughter stated simply that when not at work "home is where we're usually at." Fear of criminal activity in the immediate proximity of the home may also lead to reluctance to venture out to visit public access sites. One household member stated: "I hang out [in my own apartment], where I know it's safe."

Perhaps more importantly, home ownership and access provide a familiar environment with the myriad resources related to the computing task (including people) close to hand. Many parents stressed their desire to engage in computer activities with their children and seemed to feel that the home setting was most conducive for this. Most of the simple day-to-day activities that CNI participants wanted to use their computers for--like paying bills, writing to friends, finding a recipe, or browsing the net like they might leaf through a magazine or flip through television channels--are activities traditionally done at home.

Some of these pursuits require the at-handness of things you have at home, like previous bills, a calculator and calendar, the ability to check what cooking ingredients you have on hand, old letters, and friends' addresses or phone numbers. In addition, these are the kind of activities that just take a few minutes, often at odd, unpredictable moments of the day,

whenever a few spare moments are found.

At the opposite end of the spectrum, several study participants expressed the desire to use their computers to start home-based businesses or engage in home-based educational programs. These activities require that a much greater range of supporting resources be ready-to-hand, in addition to demanding sustained and reliable computer access for, perhaps, many hours each day... certainly not the type of use typically fostered by public access sites.

Discussions with CNI participants also highlighted the importance of determining and improving the relevance of Prairienet's content to the lives of low-income community members. Community information needs most often cited by adult CNI participants were related to health, parenting, education, leisure activities, and employment opportunities. Interview respondents also wanted more easily accessible information about available and affordable services of all kinds.

While substantive content related to a number of these areas currently exists on Prairienet, a closer look reveals that it may not truly reflect (or make easily retrievable) information most pertinent to those living in low-income neighborhoods. For example, although the local park district has an extensive website on Prairienet, complete information about events at the neighborhood parks most often frequented by CNI participants is either not posted or not easily found.

A key insight from our CNI community analysis is that people are not just consumers of community information, anxious to identify sources of help to meet their needs. Through their jobs, volunteer work, and informal support of friends and neighbors, participants are contributors to the community and the community's store of information. CNI participants were eager for their interests, views, and capabilities to be represented on Prairienet. Adult participants in focus groups expressed significant interest in seeing more information created by African American organizations and individuals added to Prairienet's content. Without such information, Prairienet will not be truly relevant to their lives.

A number of people suggested posting information that emphasized their potential role in contributing valuable and relevant information to the community at large. A few noted their desire to announce community events, such as picnics or meetings, in which they were participating. One woman said she would like to post facts about local schools so that parents could make informed decisions regarding where to enroll their children. Another woman expressed the desire to provide a link to the website promoting the million women's march or other information, such as the availability of a university program to teach seniors about computing, that would "pique people's interest to learn something." And one said simply that she would like to create a personal webpage that would help to encourage other single moms.

Clearly, DLs must provide an environment that is perceived as hospitable by intended users. Content must reflect needs and interests. The setting of use must be convenient and comfortable, and offer ready access to resources used in conjunction with the DL's collection. Further, for the assemblage to function smoothly, access to the technology must fit naturally into the rhythm and circumstances of daily activities in which it is embedded. While these points may seem obvious, our research revealed the massive degree to which use is determined by content and convenience, as well as the importance of digging deeper into the circumstances of use in order to determine what would, indeed, make sense from the user's point of view.

7. ROLE OF SOCIAL NETS IN HELPGIVING

The importance of social networks for the exchange of information, ideas and support has long been recognized in the sphere of scientific and technical communication [3, 20, 32, 44] and in the provision of material and intangible social support for everyday needs [5, 15, 19, 34, 39]. It is also recognized that informal collaboration and social exchange with others helps in learning how to use new technologies [1, 2, 22 25, 31, 38]. Findings from our user studies in the DLI and CNI projects provide a direct link between what is known about informal communication exchanges in these two domains. Some of the key contributions of social networking evident from our research in scientific and low-income communities are:

- Its role in mediating among formal and informal systems;
- The natural crossover between intangible (affective, informational) and material support that attends it;
- The relationship between personal acquaintance and important information use factors such as proximity, familiarity, and relevance; and
- Its importance for the exchange of tacit and private knowledge, for maintaining a private communication space and for building trust.

While extended discussion of study results related to these features is beyond the scope of this paper, several examples of the nature, role, and function of information communication via interpersonal channels are presented below.

In a DLI interview, one student described how turning to a professor for help assisted in mediating between personal and formal knowledge structures and building a bridge from "outsider" to "insider" knowledge. The student reported that he first consulted his professor before conducting a literature search, because the professor would know "what words to use," i.e., had better knowledge of not only the subject domain, but of the controlled vocabulary terms that should be used in a particular library search system.

Another student's experience points out how formal and

informal information channels, private and public domains, are interrelated in typical information seeking situations. In an attempt to re-locate a particular website of interest, this student first tried using her favorite web search engine, but was unsuccessful. She had originally heard about the website through a newsgroup; so she then tried accessing that group's archive to see if the posting that gave her the URL was still there. She couldn't find it there, and was finally successful when she went back to the sent-mail log in her email account to find a message in which she had given a friend the URL of a frequently asked questions page that contained a link to the desired website.

DLI study participants also provided significant evidence of the role of friends and colleagues in providing both direct and indirect access to information. From our final survey of DeLIver users, we learned that respondents were most (and about equally) likely to have heard about the system from someone they knew, from a link to it from the university library's website, or from a poster or flier.

Further, graduate students interviewed about their information seeking practices described a number of situations in which their peers were instrumental in providing information, from getting a needed article from an office mate's personal collection, to asking a workgroup colleague for advice on the best way to approach a problem, to borrowing a computer manual. Consulting colleagues was described as convenient and productive because colleagues were nearby, would understand the context of your information need, and offered a familiar and trusted route of exchange. One graduate student explicitly commented on his reliance on "others in my group" to "tell me when something [posted in an electronic pre-print archive] was not as good as it should be."

In interviews with residents of low-income neighborhoods participating in the CNI project, we also learned of the importance of social networks for getting help in accessing needed information and finding support related to both community services and the use of computers. Low-income neighborhood residents rely on a full suite of channels to acquire and exchange community information. These include informal, word-of-mouth contacts with people in one's intimate social circle; contacts with community institutions through print, telephone and in-person visits; library use; and use of mass media channels such as newspapers and television.

In our household interviews, we learned that contacts with community organizations and word-of-mouth exchanges with people in one's close social circle appear most important for accessing and exchanging information about community activities and resources. Interview participants were asked to name those with whom they had recently discussed something of importance. Friends and relatives were most often (and about equally) mentioned. Professionals and work colleagues were cited equally, but only about one-third as often as friends and family members. In fact, however, these two sources overlap as friends, relatives, colleagues and neighbors pass along news from the institutions with which they are affiliated. Household interviewees noted that they got information about institutional resources from, for example, friends representing "girls who work at the university," a relative working in a local recreational institution, kids who report on upcoming events at school, and an outreach worker at one's place of employment.

Formal, institutional sources were also activated through one's own affiliations with community organizations. About 90% of our household interviewees belonged to some kind of local organization, primarily religious and social groups. Many of our study participants were active church-goers, and a substantial number participated in various volunteer programs. People frequently noted that they rely on exchanges of information at meetings and other events associated with the organizations to which they belonged.

Other household interviewees described their everyday interpersonal encounters as the primary way they found out about things going on in the community. One person commented "I ask questions... someone I know knows someone somewhere who has the information I need." Another said "I ask around, talk to people at the grocery store." And a third person commented with a grin: "I talk with my neighbors in the summer. That's what I call 'voice mail.'"

Study participants often indicated a wish for recommendations or advice, which helps explain the importance of interpersonal information exchange. The community analysis focus group interview process was itself a model of informal exchange of information about available resources and services accompanied by experiential advice. When one individual responded to the moderator's question about needed information by expressing the desire to find, for example, affordable daycare or free checking, others not only named possible organizations, but chimed in with evaluative comments and tips on how best to get the desired service. Their comments frequently addressed the accuracy of public information about the service or the perceived hospitability of those providing the service to people of limited income.

Further evidence of the important role of social circles was uncovered by determining that information and support related to the CNI project itself often reached people through informal social contacts. In their CNI application forms, about half of community trainees said they heard about the CNI project through family and friends, about a third heard of it through the Urban League, and only about 10% learned of the program through mass media, such as radio, television, or newspapers.

We also conducted a follow-up telephone survey with adult trainees about six months after they received training and a computer from the CNI project. Preliminary results, based on responses from about one-third (N=35) of all potential respondents, indicate that project participants have been active in informally extending or getting help with CNI resources through their social networks.

The majority of respondents said that someone besides themselves had used their CNI computer (80%) and that they had used their CNI computer to show someone else how to do something (65%). About half of the survey respondents said that someone other than a project staff member had helped them in some way with their computer. The types of people most often mentioned in these relationships were primarily family members (including those living in or outside the household) or friends, as opposed to neighbors, work colleagues or community professionals, such as teachers or ministers.

Community trainees also suggested means for providing follow-up training and support using existing social networks. Several requested that future training sessions allow family members to attend as a group. Community trainees participating in one focus group spontaneously created their own support group by collecting each others' names and contact information and noting what kinds of help they could offer each other. Some focus group participants immediately offered direct help to their fellow participants. For example, one person asked how to do something on the computer and another person in the group volunteered to lend her a manual she had at home.

In addition, CNI staff fielding user support calls have reported that a number of callers remarked that they would pass on the answers they received to their friends from the summer training sessions. A grandmother raising her teenage grandson alone provided another example of the importance of social intimates for supplying technical assistance: "Even if [my grandson] got one, I doubt I'd use it much because I'm not used to it. I use the phone and write letters. But if we had one, maybe I'd get interested and learn about it. I want my grandson to learn real good so he can teach me. We'll be emailing in a while!"

8. CONCLUSIONS

If we accept the validity of insights stemming from the "assemblage" view of DL use, what do we do about it as DL designers, implementers, and researchers? First, to really understand use, we need to articulate and investigate each aspect of the assemblage--social practice, beliefs and goals, community norms, knowledge, technology access and proficiency, and resource constraints--and the interplay among them. This holds whether our intended audience is academic researchers or low-income neighborhood residents, whether the DL collection in question is comprised of scientific journals or webpages mounted by community residents and organizations.

In fact, viewing DL use as an assemblage of infrastructure, norms, knowledge, and practice yields insights about use that carry across system genres and knowledge domains. Those highlighted in this paper are the magnification of trivial barriers until they effectively cut off use on a large scale, the difficulties faced by "outsiders" whose information worlds are impoverished, the primacy of comfort and relevant content in encouraging use, and the importance of informal social networks for providing help related to information system use.

Another insight derived from the two studies of use reported here is that we need to come up with ways to support users as they tinker with the assemblage, making adjustments to a wide range of activities in order to accommodate the intrusion of new DL tools and resources. This is part of the process by which technology "disappears" as it becomes so embedded in one's life that it slips from consciousness and view, becoming an unnoticed part of the fabric of daily activities. [13] New users are not simply faced with the task of learning how to make an information system function. They are figuring out how to make the new system fade into the masquerade of naturalness.

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REFERENCES

[1] Agre, P. E. New Roles for User Groups. *The Network Observer*. 1994. http://communication.ucsd.edu/pagre/tno/november-1994.html#roles.

[2] Agre, P. E. Computing as Social Practice. In Agre, P. E., & Schuler, D. (Eds.). *Reinventing Technology, Rediscovering Community*. Ablex, Greenwich, CT, 1997, pp. 1-17.

[3] Allen, T. J. *Managing the Flow of Technology: Technology Transfer and the Dissemination of Technological Information within the R&D Organization*. MIT Press, Cambridge, MA, 1984.

[4] Baldwin, C. (1998). SuperJournal Update. Ariadne, 14, 4 (March). http://www.ariadne.ac.uk/issue14/superjournal

[5] Barker, J. C., Morrow, J., & Mitteness, L. S. Gender, Informal Social Support Networks, and Elderly Urban African Americans. *Journal of Aging Studies*, 12, 2, 1998, pp. 199-222.

[6] Benton Foundation. *Losing Ground Bit By Bit: Low-income Communities in the Information Age*. Benton Foundation, Washington, DC, 1998. http://www.benton.org/Library/Low-Income/

[7] Bishop, A. P. Document Structure And Digital Libraries: How Researchers Mobilize Information In Journal Articles. *Information Processing & Management*, Feb.

1999, in press.

[8] Bishop, A. P. Digital Libraries and Knowledge Disaggregation: The Use of Journal Article Components. In I. Witten, R. Akscyn, & F. M. Shipman, III (Eds.). *DL '98: Proceedings of the 3rd ACM Conference on Digital Libraries*, Pittsburgh, PA. ACM Press, New York, 1998, pp. 29-39.

[9] Bishop, A. P. Logins and Bailouts: Measuring Access, Use, and Success in Digital Libraries. *The Journal of Electronic Publishing*, 4, 2, 1998. http://www.press.umich.edu/jep/ 04-02/bishop.html.

[10] Bishop, A. P., Neumann, L. J., Star, S. L., Merkel, C., Ignacio, E., & Sandusky, R. J. Digital Libraries: Situating Use in Changing Information Infrastructure. Submitted to the *Journal of the American Society for Information Science*, 1998.

[11] Bishop, A. P. & Star, S. L. Social Informatics of Digital Library Use and Infrastructure. In M. Williams (Ed.). Annual Review of Information Science and Technology (ARIST), 31, Information Today, Medford, NJ., 1996, pp. 301-401.

[12] Borgman, C. L. What are Digital Libraries? Competing Visions. *Information Processing and Management*, Feb. 1999, in press.

[13] Bruce, B. C., & Hogan, M. P. (1998). The Disappearance of Technology: Toward an Epistemological Model of Literacy. In D. Reinking, M. McKenna, L. Labbo, & R. Kieffer (Eds.), *Handbook of Literacy and Technology: Transformations in a Post-Typographic World*. Erlbaum, Hillsdale, NJ, pp. 269-281. http://www.ed.uiuc.edu/facstaff/chip/Publications/Disappearance.html.

[14] Chapman, G. & Rhodes, L. Nurturing Neighborhood Nets, Technology Review, Oct. 1997. http://web.mit.edu/techreview/www/articles/oct97/chapman.html.

[15] Chaskin, R. J. Perspectives on Neighborhood and Community: A Review of the Literature. *Social Service Review*, 1997, pp. 521-547.

[16] Chatman, E. A. Life in a Small World: Applicability of Gratification Theory to Information-Seeking Behavior. *Journal of the American Society for Information Science*, 42, 6, 1991, pp. 438-449.

[17] Chatman, E. A. The Impoverished Life-World of Outsiders. *Journal of the American Society for Information Science*, 47 3, 1996, pp. 193-206.

[18] Davenport, E., Higgens, M., & Sommerville, I. The Appropriation of Home Information Systems in Scottish Households. In *Proceedings of the International Conference on Research in Information Needs, Seeking and Use in Different Contexts* (14-16 August, 1996, Tampere, Finland), 1997, pp. 386-411.

[19] Dervin, B. The Everyday Needs of the Average Citizen: A Taxonomy for Analysis. In M. Kochen & J. C. Donohue (Eds.), *Information for the Community* (pp. 19-38). Chicago: American Library Association, Chicago, 1976, pp. 19-38.

[20] Garvey, W. D. *Communication: The Essence of Science*. Pergamon Press,Oxford, England, 1979.

[21] Hoffman, D. L. &. Novak, T. P. Bridging the Racial Divide on the Internet. *Science*, 280, 1998, pp. 390-391.

[22] Kling, R. Behind the Terminal: The Critical Role of Computing Infrastructure and Use. In Cotterman, W. and Senn, J. (Eds.). *Challenges and Strategies for Research in Systems Development*, ch. 10. John Wiley, London, 1992, pp. 153-201. http://php.ucs.indiana.edu/~kling/pubs/webinfra.html.

[23] Kling, R. What is Social Informatics and Why Does it Matter? *D-Lib Magazine*, 5, 1, Jan. 1999. http://www.dlib.org:80/dlib/january99/kling/01kling.html.

[24] Lillie, J. *Possible Roles for Electronic Community Networks and Participatory Development Strategies in Access Programs for Poor Neighborhoods*. 1998. http://www.unc.edu/~jlillie/310.html.

[25] Nardi, B. A., & Miller, J. R. Twinkling Lights and Nested Loops: Distributed Problem Solving and Spreadsheet Development. *International Journal of Man-Machine Studies*, 34, 1991, pp. 161-184.

[26] Nardi, B. A., & O'Day, V. *Information Ecologies*. MIT Press, Cambridge, MA, 1999.

[27] Neuman, D. Evaluating Evolution: Naturalistic Inquiry and the Perseus Project. *Computers and the Humanities*, 25, 4, 1991, pp. 239-246.

[28] Neumann, L. J., & Bishop, A. P. From Usability to Use: Measuring Success of Testbeds in the Real World. In *The 1998 Clinic on Library Applications of Data Processing: Collected papers*. University of Illinois, Graduate School of Library and Information Science, Champaign, IL, in press. [June 15, 1998 draft available at: http://anshar.grainger.uiuc.edu/dlisoc/socsci_site/dpc-paper-98.html]

[29] Neumann, L. J., & Star, S. L. Making Infrastructure: The Dream of a Common Language. In *PDC '96: Proceedings of the Participatory Design Conference*. Computer Professionals for Social Responsibility/ACM, Cambridge, MA, 1996, pp. 231-240.

[30] National Telecommunications and Information Administration [NTIA]. *Falling Through the Net II: New Data on the Digital Divide*. National Telecommunications and Information Administration Washington, DC, 1998. http://www.ntia.doc.gov/ntiahome/net2/falling.html.

[31] Orr, J. *Talking About Machines: An Ethnography of a Modern Job*. IRL Press, Ithaca, NY, 1996.

[32] Ravetz, J. *Scientific Knowledge and Its Social Problems*. Oxford University Press, Oxford, England, 1971.

[33] Schatz, B. R., Mischo, W. H., Cole, T. W., Bishop, A. P., Harum, S., Johnson, E., & Neumann, L. J. Federated Search of Scientific Literature: A Retrospective on the Illinois Digital Library Project. *Computer*, 32, 2, 1999, pp. 51-59.

[34] Stack, C. B. *All Our Kin*. Harper & Row, New York, 1974.

[35] Star, S. L. (Ed.). *Ecologies of Knowledge*. State University of New York Press, Albany, NY, 1995.

[36] Star, S. L., Bowker, G. C., & Neumann, L. J. Transparency Beyond the Individual Level of Scale: Convergence Between Information Artifacts and Communities of Practice. In Ann P. Bishop, Nancy A. Van House, and Barbara P. Buttenfield (Eds.), *Digital Library Use: Social Practice in Design and Evaluation*. MIT Press, Cambridge, MA, in press.

[37] Stewart L. User Acceptance of Electronic Journals: Interviews with Chemists at Cornell University. *College and Research Libraries*, 57, 4, 1996, pp. 339-349.

[38] Twidale, M., Nichols, D. M., & Paice, C. D. Browsing is a Collaborative Process. *Information Processing & Management*, 33, 6, 1997, pp. 761-83.

[39] Uehara, E. Dual Exchange Theory, Social Networks, and Informal Social Support. *American Journal of Sociology*, 96, 3, 1990, pp. 521-527.

[40] United States. Office of the Vice President. *Information Technology for the Twenty-First Century: A Bold Investment in America's Future*. [Press Release]. Jan. 24, 1999. http://www.pub.whitehouse.gov/uri-res/I2R?urn:pdi://oma.eop.gov.us/1999/1/25/12.text.1

[41] Van House, N. A., Butler, M. H., & Schiff, L. Cooperative Knowledge Work and Practices of Trust: Sharing Environmental Planning Data Sets. In *Proceedings of CSCW '98: The ACM Conference on Computer Supported Cooperative Work*, Seattle, WA, November 14-18, 1998, pp. 335-343.

[42] Virnoche, M. The Seamless Web and Communications Equity: The Social Shaping of a Community Network. *Science, Technology and Human Values*, 23, 2, 1998, 199-220.

[43] Watson-Verran, H. & Turnbull, D. Science and Other Indigenous Knowledge Systems. In S. Jasanoff, G. E. Markle, J. C. Peterson, & T. Pinch (Eds.), *Handbook of Science and Technology Studies*. Sage, Thousand Oaks, CA, 1995, pp. 115-139.

[44] Ziman, J. *Public Knowledge: An Essay Concerning the Social Dimensions of Science*. Cambridge University Press, Cambridge, England, 1968.