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Traditional IR for web users: a context for general audience digital libraries

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Abstract

The emergence of general audience digital libraries (GADLs) defines a context that represents a hybrid of both "traditional" IR, using primarily bibliographic resources provided by database vendors, and "popular" IR, exemplified by public search systems available on the World Wide Web. Findings of a study investigating end-user searching and response to a GADL are reported. Data collected from a Web-based end-user survey and data logs of resource usage for a Web-based GADL were analyzed for user characteristics, patterns of access and use, and user feedback. Cross-tabulations using respondent demographics revealed several key differences in how the system was used and valued by users of different age groups. Older users valued the service more than younger users and engaged in different searching and viewing behaviors. The GADL more closely resembles traditional retrieval systems in terms of content and purpose of use, but is more similar to popular IR systems in terms of user behavior and accessibility. A model that defines the dual context of the GADL environment is derived from the data analysis and existing IR models in general and other specific contexts. The authors demonstrate the distinguishing characteristics of this IR context, and discuss implications for the development and evaluation of future GADLs to accommodate a variety of user needs and expectations.

Keywords: Information retrieval context; Digital libraries; User studies; Internet searching

1. Introduction

Information retrieval (IR) systems have arguably now become a global tool for information access, largely due to the increased reach of the Internet, and more specifically, search tools that have been made available through the World Wide Web. Traditionally, the primary users of IR

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systems have been information professionals who have acted as intermediaries for clients with information needs. With the wider availability of online public access catalogs (OPACs), CD-ROM database products, and online databases, usage has expanded greatly to encompass a broad range of end-users. Until recently, much of this usage has still been limited to physical locations within information agencies such as libraries. Also, much of the content of these systems has related to published works in the form of document surrogates, such as bibliographic citations with abstracts or, increasingly, full text documents. This is the traditional context for and utilization of IR systems – information needs that are addressed by searching databases with selective content from published sources.

The Internet, and more specifically the Web, has introduced hundreds of millions of people to the concepts and capabilities of IR systems. Many search engines such as Google, Alta Vista, and Excite, now provide access to Internet-based documents, covering the breadth of human knowledge. Although primarily full text and increasingly multimedia, most documents in these environments do not contain the same level of structure and credibility as the contents of traditional IR systems, which include the selectively indexed documents of published and non-published works. The retrieval services of the Web generally lack the same level of search and display features found in traditional IR systems used to access bibliographic databases. Recent studies have shown that the search characteristics of these systems catering to general audiences are different than traditional IR (Jansen & Pooch, 2001; Spink, Wolfram, Jansen, & Saracevic, 2001). A different context for IR emerges from this environment, representing a more "popular" use of IR, characterized by a broader audience, different document collections, and different search models.

Access to Web-based resources may also take other forms. One form that has emerged as a means of facilitating access to electronic content is the digital library. Until recently, digital libraries have focused primarily on well-defined topic collections for specialized audiences, analogous to physical library special collections. However, we are now seeing the development of broader-based digital libraries with more generalized collections for a wider audience, occupying roles similar to that of public libraries. This is most evident in the recent rapid development of services sponsored by state agencies for residents of their respective states in the US. These services represent the core content for what are, in fact, emerging general audience digital libraries (GADLs), catering to a wide range of users with diverse information needs. With access to state-supported resources via the Web, residents can now connect to a variety of databases from home or recognized sites in the state. GADLs provide access to general and specific interest information resources such as full text content of magazines, newspapers, professional journals, selected monographic sources, and other published and unpublished information. A growing number of examples of these digital libraries are now available as state-supported services, including BadgerLink in Wisconsin, Washington State Library's Database Trials, the Inspire Service in Indiana, the Alabama Virtual Library, the Tennessee Electronic Library, the Michigan Electronic Library, DelAWARE – the Digital Library of the First State, and the Kentucky Commonwealth Virtual Library. Based on initial evaluations of the Washington and Wisconsin projects (Efthimiadis & Bruce, 2000; Wolfram & Xie, 2000), the positive impact of these services to residents of their respective states is clear.

Since GADL access is relatively new, there has been little research focus on the patterns of use of these services, and how they fit into the larger framework of the World Wide Web and its broad

resources and equally varied audience. Most research to date on GADLs has investigated database usage statistics or library responsiveness to these systems. However, it is also essential to investigate end-user attitudes to aid in service evaluation and improvement, and to provide recommendations for state wide digital library projects.

In this paper the authors investigate an example of a GADL, Wisconsin's BadgerLink. BadgerLink provides access to a range of databases from EBSCO (EBSCOhost) and Bell & Howell (ProQuest) to residents of Wisconsin via the Internet as a Web-based service, in addition to other state-developed and Web-accessible resources. Since becoming available in 1998, BadgerLink has been used by hundreds of libraries and countless users, generating millions of searches annually. EBSCOhost makes available more than a dozen databases with a range of topic coverage from disciplinary specialization (e.g. ERIC, Health Source Plus) to broad subject coverage (e.g. MasterFILE Premier, Academic Search Elite). Databases may include citation and indexing information, or may contain the full text of documents appearing in periodicals and monographs. The EBSCOhost web-based interface with its point and click approach to searching and browsing simplifies the database selection and search process. ProQuest provides access to a number of newspaper databases and ABI/Inform Global for business information. Its contents are more specialized in that each of the newspaper databases contains records of the full text of a single newspaper, or set of newspapers.

Logs of the GADL usage data, which are available through database providers, can shed light onto what is being searched and how frequently, but they cannot reveal user motivations, attitudes, or satisfaction with a GADL. By studying end-user responsiveness in conjunction with usage data, a more complete understanding of digital library usage, user information needs, and system effectiveness is gained.

The purpose of the present study is to gain a better understanding of end-user utilization and responsiveness to BadgerLink as an example of a GADL. Findings from a Web-based survey completed by end-users of BadgerLink are reported, along with resource usage figures of BadgerLink. Resource usage in BadgerLink is also compared to studies on popular Web searching to determine similarities and differences in patterns of information use in these two contexts. A model is developed that defines the GADL IR context and how it relates to traditional and popular IR contexts.

2. Related research

The present research builds on previous studies examining the areas of digital libraries and Web-based user studies.

2.1. Digital library studies

The concept of a digital library means different things to different people. Khalil and Jayatilleke (2000) attempted to survey end-users' understanding of digital libraries from a variety of Listservs around the world, and they found that digital libraries were defined in more than 35 different ways. Borgman (1999) identified two competing visions of digital libraries. The research community considers digital libraries as content driven while librarians share the conception that

digital libraries are institution or service-oriented. Researchers are more concerned with how to design systems for effective access, and librarians are more concerned about providing different services for users. Fox, Akscyn, Furuta, and Leggett (1995) summarized different perceptions of digital libraries by the key players in digital libraries: librarians, computer scientists, and users. To librarians, digital libraries carry out the functions of libraries in a new way; to computer scientists, a digital library is a distributed text-based information system – a collection of distributed information services, a distributed space of interlinked information or a networked multimedia information system; to end-users, digital libraries are regarded as being similar to the WWW with improvements in performance, organization, functionality and usability. This raises an interesting question whether users of digital libraries and the Web search systems have the same expectation of the services and share the same pattern of information use.

Digital library research has developed rapidly over the past decade. Key issues in digital library development have been the consideration of overall user needs and interface design. Several studies have examined usability of digital libraries. According to Mitchell (1999), it is important to define users and work within their domain of known needs, goals, behaviors, expectations, and traditions. User feedback was collected and applied in the design and implementation cycle of the Alexandria Digital Library (Hill et al., 2000). In terms of state digital library development, the State Library of Delaware has designed and developed DelAWARE: The Digital Library of the First State. One of the contributing factors in the success of the digital library as a useful service for the state and its citizens was addressing the needs and challenges of its users (Plummer & McNeeley, 1999). In designing interfaces and tools for the Library of Congress National Digital Library Program, interfaces were developed based on an assessment of user needs and designed to maximize interaction with primary resources (Marchionini, Plaisant, & Komlodi, 1998). In developing the New Zealand Digital Library, the main concerns were the real needs of library users and user interface aspects (Witten, Nevill-Manning, McNab, & Cunningham, 1998).

In addition to general user need, researchers have also acknowledged special aspects of user need in accessing digital libraries. For example, Borgman (2000) discussed a research problem of how to enable digital libraries to support the cycle of information seeking, use, and creation. By meeting three classes of user needs, Baldonado (2000) developed a user-centered interface for users' information exploration in a heterogeneous digital library. After comparing usability, user preference, effectiveness, and searching behaviors in systems that implement interaction with multiple databases through a common interface, Park (2000) suggested how to support effective interaction of users with heterogeneous and distributed information resources in digital libraries. In order to develop principles for the design of next generation digital libraries, Payette and Rieger (1998) studied the user research process to identify key tasks that involve interaction with a digital library, and they also assessed the effectiveness of the existing design in fulfilling information needs.

Although user need has been discussed in much of the research on the development of digital library interfaces or systems, there have been few empirical studies characterizing the pattern of information use in digital libraries, especially the GADL context. Research in digital libraries has concentrated on the design of better system features and architecture, and less research attention has been focused on how well digital libraries work for their users (Cool, 2000). With many GADLs now available, studies of information use are now appearing in the literature. In one of the few usage studies of a digital library, Jones, Cunningham, and McNab (1998) analyzed the

transaction logs for a large full text document collection on computer science, and discussed user acceptance of default settings, query complexity, query refinement, and result viewing.

2.2. Web-based user studies

Researchers realize the importance of information use in the Web environment, especially in a Web search engine context, which has created a new search environment for users. Researchers have recently conducted studies on Web searching behavior based on query log data from Excite, AltaVista, and Fireball (Hölscher & Strube, 2000; Jansen, Spink, & Saracevic, 2000; Ross & Wolfram, 2000; Silverstein, Henzinger, Marais, & Moricz, 1998; Spink et al., 2001). These studies have analyzed the use of terms, operators, number of queries per search, etc. One limitation of the log data is that researchers can only examine what users have done, but they have no knowledge of the purpose of users' behaviors and their intentions.

A series of Web surveys have been conducted to gain knowledge of how people use Internet (GVU's 10th WWW User Surveys (cf. GVU, 1998); Statistical Research's "How people use the Internet" Surveys (cf. Statistical Research, 2001)). These surveys are valued as an independent, objective view of developing Web demographics, culture, user attitudes, and usage patterns. A few researchers have further analyzed user surveys of Internet and Web use (Hoffman, Kalsbeek, & Novak, 1996; Pitkow & Kehoe, 1996). Spink, Bateman, and Jansen (1999) conducted their own survey, made available through the Excite homepage, and solicited information on user search topics, intended query terms, search frequency and demographic data. These studies provided valuable information to understand the pattern of information use in the popular Web context and reveal that Web searching has its own characteristics.

Researchers have begun to compare the similarities and differences between Web-searching and traditional information retrieval. These studies have found that while Web search engines follow the basic principles of IR systems, Web users show very different patterns of searching from those found in traditional information retrieval systems such as online databases. For example, most users did not have many queries per search session, and each query tended to be short. Boolean operators were seldom used. Many users submitted only one query and did not follow with successive queries (Silverstein et al., 1998; Spink et al., 2001).

After comparing searches performed in traditional IR systems, OPACs and Web search engines, Jansen and Pooch (2001) reported that there are noticeable differences in terms of session length, query length, use of Boolean operators, and failure rates of these three types of searches, despite their similarities in the use of advanced features and the number of documents viewed. These comparisons, however, were limited to the query formulations and document display, and did not go further to compare the purpose and content of users' information uses.

Although a few studies have touched on the issue of differences in searching and usage in the popular and traditional environments, there have been no direct comparisons as to whether there are differences in patterns of information use in popular Web search and digital library contexts, and more specifically GADLs. In developing a model of GADL usage, the investigators explore several key questions in public usage of a GADL and their relationship to traditional and popular IR. Central to the study is the question "What are the characteristics that define the use of the studied GADL and how does it differ from "popular" IR systems?" More specifically, the study investigates

- What characteristics define the GADL user population?
- How is the GADL content used and for what purpose?
- How do users access and interact with the GADL?

3. Research design

Data were collected from two primary sources to permit investigation of how the studied GADL was used and how end-users responded to the service.

3.1. Database usage logs

GADL usage data, represented by EBSCOhost logs within BadgerLink, were accessed from the vendor's Web site for the period January–June 1999. The vendor-collected data included specific library usage, title usage across databases, database usage, and format of the requested documents (abstract, full text). Since the ProQuest databases dealt primarily with news sources and did not represent a broad range of subjects, they were not included as part of this study. Database usage findings not directly related to the present research are reported in Wolfram and Xie (2000).

EBSCOhost databases provide access to thousands of periodicals covering a broad range of subject areas and are available as document surrogates (bibliographic citations and abstracts) or full text. Data collected from EBSCOhost on journal abstract requests by users across databases were tabulated and analyzed for the 6-month study period. The investigators did not have access to specific query data; however, counts of periodical abstract requests and their subject categorization were available. Abstract counts were selected instead of full text requests because they represented the majority of requests made to EBSCOhost.

By examining the subject distribution of abstracts requested, a snapshot of users' general information needs may be revealed. The investigators also compared the use of BadgerLink resources, categorized by subject, with at the query subject classification for general Web queries found by Spink et al. (2001). Where available studies exist, the investigators also compared the present findings to other Web and Internet usage study findings. Differences in the questions asked, categorizations and summaries of data presented in these other studies make it difficult to compare findings beyond a general level.

3.2. End-user responses

A Web-based end-user survey was developed and made available as a hypertext link from the BadgerLink Web site to elicit direct end-user input regarding the service. The Web survey consisted of closed- and open-ended questions concerning how users access the service, purpose of usage, search and browse habits, and satisfaction with the resources available. Basic demographic data were also elicited (gender, age range, occupation, location in state). To adhere to ethical research practices, participation in the study was made completely voluntary and targeted to users of at least 18 years of age. Completed surveys were e-mailed to the investigators. The sample derived from the user population consisted of BadgerLink users who volunteered to complete the

survey during the window of survey availability of the Web site over the course of several weeks in September 1999.

Responses to closed-ended questions were tallied and analyzed in Microsoft Excel and SPSS. Cross-tabulations and χ^2-analysis were used, where appropriate, to discover relationships and differences between response questions. Responses to open-ended questions were categorized and tallied to determine the most frequently held attitudes towards the service. Samples of these responses are reported below to provide a better sense of user attitudes. The findings of the end-user survey were compared to findings from log data to obtain a more complete picture of user information use and responsiveness to the GADL.

4. Results

Results of the BadgerLink log data analysis and survey responses are reported by themes related to each research question. Since not all respondents for the Web survey answered every question, sample sizes varied from one question to another. Where necessary and appropriate, data categories were collapsed to permit statistical analysis using χ^2-tests. χ^2-values and d.o.f. are only reported for significant outcomes.

4.1. User characteristics

Resource usage data collected from EBSCOhost represented more than 3.6 million requests for abstracts and one million requests for full text articles from over 7200 titles indexed by the service. Location data revealed that the majority of known sites (i.e. known Internet Protocol addresses) were affiliated with educational institutions (K-12 and post-secondary). Dial-up users to the service, whose affiliation could not be determined, performed approximately half of all searches (Table 1).

Eighty-one valid responses were received electronically over the course of the availability of the survey. The sample size ended up being smaller than anticipated due to several factors including duplicate responses and sporadic technical difficulties during the electronic submission process.

Responses to the Web survey were received from users from all regions of Wisconsin, with a roughly proportional representation based on population density within the state. Respondents represented adults of wide-ranging ages with diverse occupational backgrounds. Occupations of

Table 1
EBSCOhost usage by organization type

Institution/user type	Number of identifiable institutions	Searches conducted
Dial-up users	N/A	2,165,359
K-12 schools	242	766,806
Colleges/universities	35	689,047
Public libraries	75	433,602
Junior/technical colleges	27	222,366
Corporate	21	34,469

respondents included teachers, information professionals, other types of professionals, and students. The typical respondent can be described as a mature, Internet-literate, working professional. Relevant demographic data for Web survey respondents are summarized in Table 2. The survey sample appears to be older than that reported by Spink et al. (1999) in their survey of users of the Excite search service. In that study the investigators found that 60% of respondents to their Web survey were over 30 years of age – not the typical portrait of an Internet user who is assumed to be a member of generations-X or -Y. It is conceivable that younger users may have been less likely to complete the survey in both studies.

4.2. GADL usage and purpose of use

4.2.1. User awareness

Users were asked how they became aware of BadgerLink and how they learned to use the system. Libraries and educational institutions were the primary means by which respondents learned about BadgerLink, accounting for 68% (54 of 79) of responses. Although users reported that they had become aware of BadgerLink through libraries and educational institutions to learn about the existence of the service, a majority (65%, or 53 of 81) reported that they learned to use the service on their own (Table 3). A significantly larger proportion of female respondents reported having learned to use BadgerLink by attending a training session ($\chi^2 = 5.25$, d.o.f. $= 1$, $p < 0.05$).

Table 2
Summary of user demographics

Factor	Groups	Number	Percent
Gender	Female	51	65.4
	Male	27	34.6
Age	Under 30	11	13.9
	30–49	33	41.8
	50 and above	35	44.3
Location in State	Northwest	5	6.2
	North central	12	14.8
	Northeast	17	21.0
	Southwest	7	8.6
	South central	15	18.5
	Southeast	25	30.9
Internet usage frequency	A few times a month or less	4	5.0
	A few times a week	13	16.3
	Daily	63	78.7
BadgerLink usage frequency	Rarely	16	20.3
	A few times a year	9	11.4
	A few times a month	25	31.6
	A few times a week	18	22.8
	Daily	11	13.9

Table 3
How end-users learned to use BadgerLink

Purpose	Overall	Gender		Age		
		Female	Male	<30	30–49	>49
	$n = 81$	$n = 51$	$n = 27$	$n = 11$	$n = 33$	$n = 35$
On own	53 (65.4%)	33 (64.7%)	19 (70.4%)	5 (45.5%)	22 (66.6%)	25 (71.4%)
Training session	23 (28.4%)	18 (35.3%)	3 (11.1%)	5 (45.5%)	10 (30.3%)	8 (22.9%)
Friend/relative	3 (3.7%)	1 (2.0%)	2 (7.4%)	0 (0.0%)	1 (3.0%)	2 (5.7%)
Written instructions	2 (2.5%)	1 (2.0%)	1 (3.7%)	1 (9.1%)	0 (0.0%)	1 (2.9%)
Other way	4 (4.9%)	2 (3.9%)	2 (7.4%)	0 (0.0%)	1 (3.0%)	2 (5.7%)

4.2.2. Purpose of use

Respondents reported that they used BadgerLink for a variety of purposes (Table 4), primarily related to research, education, work, and personal information. A smaller number of respondents reported that they used the service for personal or recreational information. Usage also varied by age. Not surprisingly, a higher percentage of respondents in the youngest age category (under 30 years of age) reported educational usage of the service ($\chi^2 = 9.91,\ \text{d.o.f.} = 2,\ p < 0.01$), while respondents in the highest age category (50 and over) reported work-related and personal needs as the primary usage ($\chi^2 = 9.66,\ \text{d.o.f.} = 2,\ p < 0.01$). No significant differences were evident based on gender.

When compared to a general Web usage study, the findings reflect differences in the overall purpose of use. The Graphics, Visualization, and Usability Center of Georgia Institute of

Table 4
Purpose of BadgerLink usage

Purpose	Overall	Gender		Age		
		Female	Male	<30	30–49	>49
	$n = 81$ max.	$n = 51$	$n = 27$	$n = 11$	$n = 33$	$n = 33$
Research	58 (71.6%)	36 (70.6%)	20 (74.1%)	7 (63.6%)	23 (69.7%)	27 (81.8%)
Education	36 (44.4%)	26 (51.0%)	9 (33.3%)	8 (72.7%)	18 (54.5%)	9 (27.3%)
Work-related	34 (42.0%)	23 (45.1%)	10 (37.0%)	2 (18.2%)	11 (33.3%)	21 (63.6%)
Personal needs	33 (40.7%)	17 (33.3%)	15 (55.6%)	1 (9.1%)	15 (45.5%)	17 (51.5%)
Recreation	15 (18.5%)	9 (17.6%)	6 (22.2%)	1 (9.1%)	8 (24.2%)	6 (18.2%)
Other	2 (2.5%)	0 (0.0%)	2 (7.4%)	1 (9.1%)	1 (3.0%)	0 (0.0%)

Technology's 10th WWW User Survey (October 1998) found that users primarily accessed personal information, followed by work-related sources, education, and shopping/entertainment sources. The study also revealed that there were no significant differences in general usage based on gender. Differences in primary usage were more evident based on age, with the most noticeable difference occurring in the entertainment and work usage categories.

4.2.3. System content and its use

Investigations of end-user search behavior using Internet search tools have recently begun to appear in the research literature. Spink et al. (2001) analyzed a data set consisting of one million queries submitted to the Excite search engine. In addition to quantitative query and user session characteristics, the authors examined the subject distribution of a sample of more than 2000 queries from the query set. The most popular query categories entered included entertainment/recreation, followed by sex/pornography, commerce/economy, and computer/Internet.

The investigators of the present study classified a subset of the EBSCOhost data by applying the same scheme used in the Spink et al. (2001) study to determine if a similar pattern of resource requests existed within the BadgerLink environment. The resulting distribution of requests is highly skewed, with the majority of the requests being made from a small percentage of titles available (Fig. 1). In fact, 52% of all abstract requests came from 200 journal titles, representing only 2.8% of all titles. The EBSCO subject classification for these 200 journals was used to map the subject distribution to the scheme developed by Spink et al. (2001). Subject terms used by EBSCO fit readily into the scheme used for the Excite study. Two categories within the initial scheme for Excite queries ("entertainment, recreation" and "performing & fine arts") were merged into one category. The "unknown" category was removed, and percentage distributions for each of the other categories in the Excite study were re-tabulated to exclude the "unknown" number. The EBSCOhost journal title data were classified into the remaining nine categories, weighted by the total number of abstracts requested from each title. A comparison of the resulting distributions for the Excite data and EBSCOhost data appears in Fig. 2. The subject distribution of information requests is clearly different. The most frequently requested subject area from

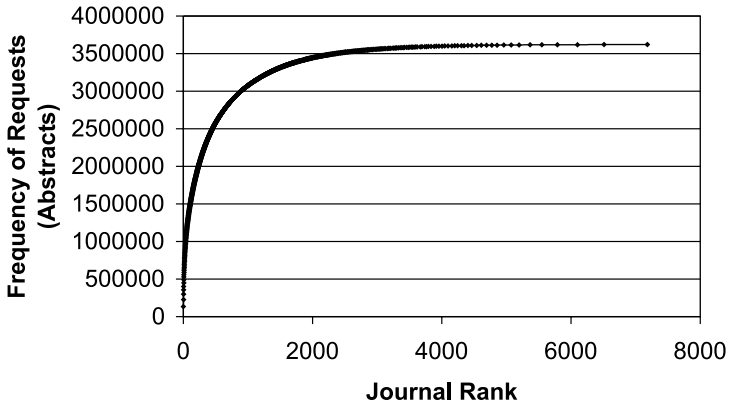

Fig. 1. Cumulative requests for EBSCOhost journal abstracts by journal rank.

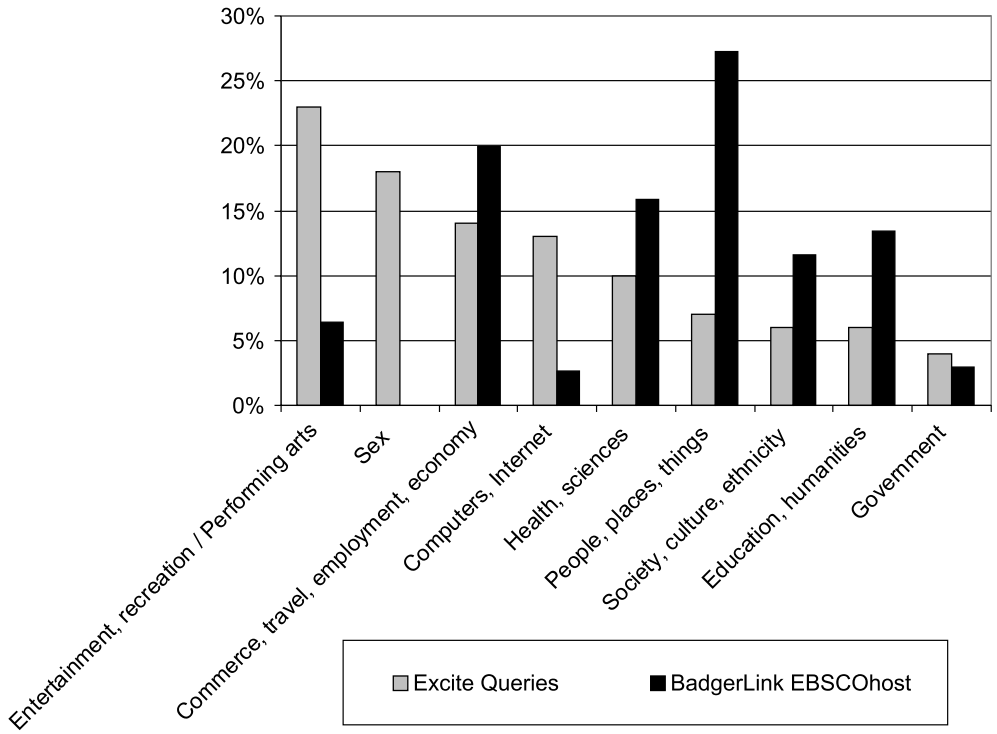

Fig. 2. Information request subject distribution for Excite study and BadgerLink EBSCOhost.

EBSCOhost, "People, places, things" corresponded to largely news and current event journal requests. This was followed by commerce/economy-oriented titles. None of the top 200 journal titles could be classified under the category of "sex/pornography". There were approximately two-dozen titles indexed by EBSCOhost dealing with sex and sexuality, representing approximately 0.1% of all abstract requests. This demonstrates one key difference between the public environment of Web search engines and public access to the studied GADL.

The BadgerLink service offers not only broad coverage of databases but also high quality resources. Users appreciate the service for the currency of its resources. One user commented: "I don't have the excuse that I can't find current information". It is also considered to be a great addition to library services. One big advantage is "it has helped me find information not available in the regular library", one user claimed. Another one declared: "We no longer rely on ILL as much as we did before; what a difference in doing research".

Although BadgerLink provides access to a broad range of information, some users found they were unable to locate material on specific topics such as specialized publications of regional interest. Approximately 87% of users (66 of 76) indicated that they were unable to find information of interest to them at some point. Analysis of the specific reasons indicates that respondents viewed BadgerLink as a one-stop search environment, instead of as a supplementary resource to print-based published resources, and expected to find everything they needed online.

4.3. Access to and interaction with the GADL

4.3.1. GADL access

Respondents were asked from where they primarily accessed BadgerLink (Fig. 3). The most frequently cited location was the respondent's home, accounting for almost half of the responses. Other recent surveys on user Internet access confirm that most respondents to these surveys are now accessing the Internet from home (GVU's 10th WWW User Survey: General Demographics (cf. GVU, 1998); Lieb, 1999).

Responses to the open-ended questions regarding access to BadgerLink and the problems encountered resulted in largely uniform responses. Users reported convenience and flexibility as the primary advantages for accessing BadgerLink. The availability of the system provides residents an opportunity to access information resources at any time and from a variety of places. Although some users touted ease of access to online materials, others felt the connectivity to the resources was sometimes problematic. It was unavailable at times and slow response times during peak hours were frustrating for some. This is typical of the Web, where users of the Web environment report slow response times as the primary barrier to effective use (GVU's 10th WWW User Survey: Problems Using the Web (cf. GVU, 1998)). It should be noted that these connectivity issues are largely beyond the control of GADL developers, having more to do with Internet traffic and Internet Service Provider access.

Of particular note is how users selected databases available through BadgerLink (Table 5). Familiarity with databases was the most frequently cited reason (54.3%). Users also relied on content, publication coverage, format, description and reputation. A small percentage of respondents (9.9%, or 8 of 81) indicated they were unaware that they were able to select different databases, while 6.2% (5 of 81) indicated that they just relied on the default database presented. This provides some evidence that more end-user training may be needed to allow users to more effectively use BadgerLink resources. No significant differences in the selection of databases were observed based on demographic factors.

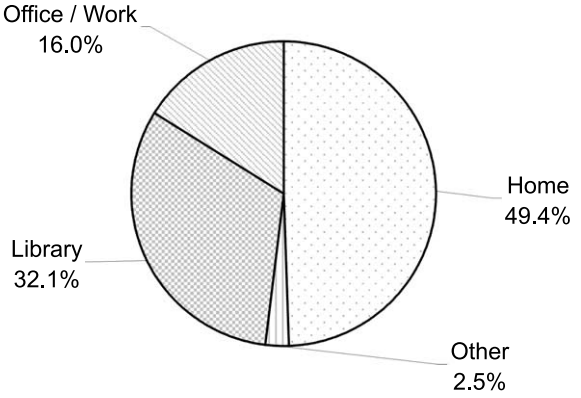

Fig. 3. Primary BadgerLink access site.

Table 5
BadgerLink database selection criteria

Selection criterion	Overall	Gender		Age		
		Female	Male	<30	30–49	>49
	$n = 81$ max.	$n = 51$	$n = 27$	$n = 11$	$n = 33$	$n = 35$
Familiarity	44 (54.3%)	27 (52.9%)	17 (63.0%)	4 (36.4%)	19 (57.6%)	21 (60.0%)
Content	31 (38.3%)	21 (41.2%)	9 (33.3%)	2 (18.2%)	14 (42.4%)	15 (42.9%)
Publication coverage	29 (35.8%)	20 (39.2%)	9 (33.3%)	1 (9.1%)	14 (42.4%)	14 (40.0%)
Format	27 (33.3%)	15 (29.4%)	11 (40.7%)	2 (18.2%)	9 (27.3%)	16 (45.7%)
Descriptions	20 (24.7%)	11 (21.6%)	7 (25.9%)	2 (18.2%)	7 (21.2%)	11 (31.4%)
Reputation	16 (19.8%)	7 (13.7%)	8 (29.6%)	0 (0.0%)	9 (27.3%)	7 (20.0%)
Did not know others could be selected	8 (9.9%)	4 (7.8%)	4 (14.8%)	2 (18.2%)	1 (3.0%)	4 (11.4%)
Default	5 (6.2%)	2 (3.9%)	2 (7.4%)	1 (9.1%)	2 (6.1%)	2 (5.7%)
Other criteria used	3 (3.7%)	1 (2.0%)	2 (7.4%)	1 (9.1%)	1 (3.0%)	1 (2.9%)

4.3.2. User searching and viewing behavior

The broad coverage of databases, high quality of resources, and currency of information attract many residents to use the service, and many of them have become regular users. More than two-thirds of survey respondents (54 of 79) reported using BadgerLink at least a few times a month.

Respondents were engaged in a variety of searching and viewing behaviors (Table 6). Most respondents reported that they used the service to search for specific information as opposed to "surfing". Close to half of the respondents (37 of 81) indicated that they browsed for specific subject areas. Survey participants stated they were more likely to browse abstracts instead of full text articles. This is supported by the log data, where full text and citation abstracts from journals represented for the majority of requests. Fig. 4 plots the number of abstract versus full text requests for each source indexed in EBSCOhost. Observations appearing below the diagonal line indicate that more abstracts were viewed than full text documents. Only 31% of respondents (25 of 81) indicated that they searched for full text articles only. For those categories with sufficiently large sample sizes to conduct statistical analysis, there were no significant differences observed in search habits either by gender or age group.

Overall, 88% of users (67 of 76) felt they had benefited from using BadgerLink, however, this varied by age of the respondents. Fifty percent of respondents under 30 years of age (5 of 10) felt they did not benefit from using BadgerLink. Conversely, 94% (62 of 66) of respondents at least 30 years of age felt they had benefited from the service (Table 7).

Table 6
BadgerLink searching and viewing habits

Search habit	Overall	Gender		Age		
		Female	Male	<30	30–49	>49
	$n = 81$ max.	$n = 51$	$n = 27$	$n = 11$	$n = 33$	$n = 35$
Search behavior						
Search specific information	49 (60.5%)	32 (62.7%)	16 (59.3%)	4 (36.4%)	24 (72.7%)	21 (60.%)
Browse specific subject area	37 (45.7%)	22 (43.1%)	13 (48.1%)	2 (18.2%)	18 (54.5%)	17 (48.6%)
Search only for full text articles	25 (30.9%)	5 (29.4%)	8 (29.6%)	4 (36.4%)	9 (27.3%)	11 (31.4%)
Other searching/browsing habits	3 (3.7%)	3 (5.9%)	0 (0.0%)	0 (0.0%)	3 (9.1%)	0 (0.0%)
Viewing behavior						
Browse abstracts of full text articles	44 (54.3%)	30 (58.5%)	14 (51.9%)	4 (36.4%)	19 (57.6%)	21 (60.0%)
Browse abstracts of citations	17 (21.0%)	11 (21.6%)	6 (22.2%)	1 (9.1%)	4 (12.1%)	12 (34.3%)

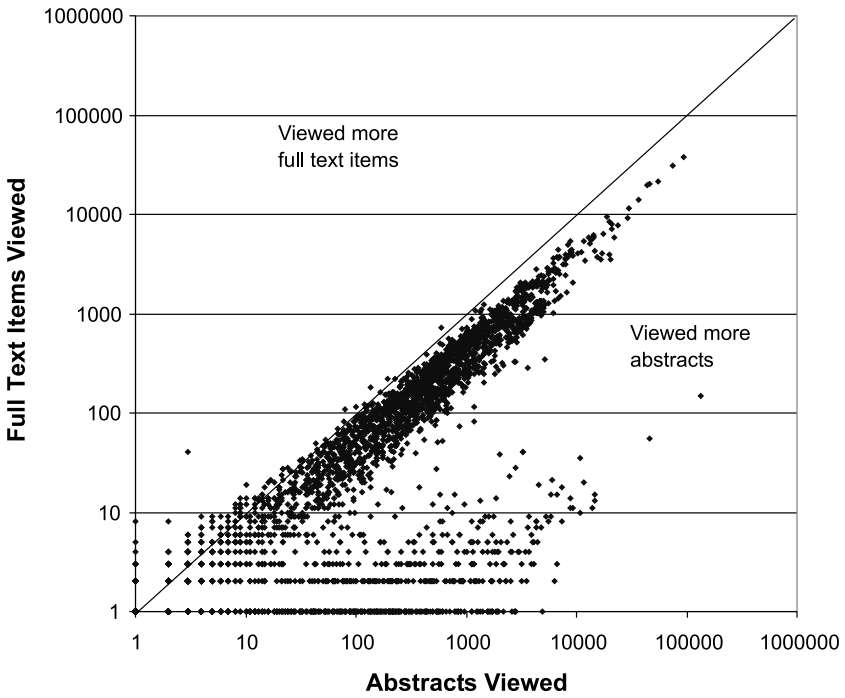

Fig. 4. Abstract vs. full text items viewed per title in BadgerLink EBSCOhost.

Table 7
Response to whether users benefited from the BadgerLink service

Response	Overall	Gender		Age		
		Female	Male	<30	30–49	>49
	$n = 76$	$n = 48$	$n = 25$	$n = 10$	$n = 32$	$n = 33$
Yes	67 (88.2%)	42 (87.5%)	23 (92.0%)	5 (50.0%)	30 (93.8%)	32 (97.0%)
No	9 (11.8%)	6 (12.5%)	2 (8.0%)	5 (50.0%)	2 (6.2%)	1 (3.0%)

5. Discussion

This study has intended to define and explore the context of the GADL. Although "context" is a term that has variety of definitions, it generally can refer to any factors that affect information seeking behavior (Dervin, 1997; Talja, Keso, & Pietilainen, 1999). The users themselves, the IR systems, and the environment defined by the user interactions with the IR systems are the major components of an information seeking context.

5.1. IR models

Most user-centered IR research to date has focused on the problematic situation context of information seeking. Anomalous states of knowledge (Belkin, 1980), problematic situation (Wersig, 1979), sense-making (Dervin, 1992), and uncertainty reduction (Kuhlthau, 1993; Wilson, 1999) are different illustrations of this type of context. Within the problematic situation context, users must identify the problem, define the problem, and try different approaches to solve the problem (Vakkari, 1999; Wilson, 1999). In order to solve problems, users have to interact with systems, information, and the environment; therefore information seeking can be considered an interactive process. Some researchers further developed models to define the interactive information seeking process, for example, Ellis and Haugan's behavior model, (Ellis, 1989; Ellis & Haugan, 1997) Kuhlthau's information process model (Kuhlthau, 1991), Ingwersen's cognitive model (Ingwersen, 1992), Belkin's episode model (Belkin, 1996), Saracevic's stratified model (Saracevic, 1996), and Xie's model of interactive information retrieval (Xie, 2000).

At present, there is a lack of theoretical research on information seeking in the context of the Web/Internet. Instead of creating a new conceptual framework, researchers have adapted IR models to this new context. For example, Wang, Hawk, and Tenopir (2000) constructed a multi-dimensional model of user-Web interaction in IR, where the user, interface, and the Web are dimension factors that affect the interaction. Belhassen, Ben Abdallah, and Ben Ghezala (2000) proposed a cognitive approach for building a user model in the online context, which is based on identification how users process information and what constitutes an appropriate model to represent the process. Savolainen (1999) developed a model of the selection and use of Internet services in information seeking that focuses on the major factors (purpose of information seeking, situational factors, accessibility of services, experiences of use, etc.) associated with the selection and use of Internet services among alternative sources and channels of information seeking.

Based on the existing IR models, several key attributes that define IR contexts emerge. These can be divided into attributes related to the system, the users, and the interaction environment. The system is identified by its contents, document formats, and search features. The users are characterized by their knowledge structure and purpose of use. The environment is defined by the interaction between the user and the system, which includes information seeking behaviors, user accessibility, and system usability.

5.2. The GADL context

What emerges from the study of BadgerLink usage and the user survey findings is a GADL IR context that encompasses traditional IR in terms of content and purpose of use, but for a general audience accustomed to the convenience of access and ease of use of popular Web IR tools. This dual context defines the pattern of information use in GADLs. Furthermore, this context has implications for the design and evaluation of GADL services. A model that summarizes the GADL context is developed using the results of this study in conjunction with research findings from the traditional IR context and the emerging popular IR context (Fig. 5). Major entities of the model include the tangible entities (rectangles) representing the user and the system, the two influencing conceptual contexts (circles) represented by traditional and popular IR, and the GADL context represented by the overlap between the traditional and popular IR contexts.

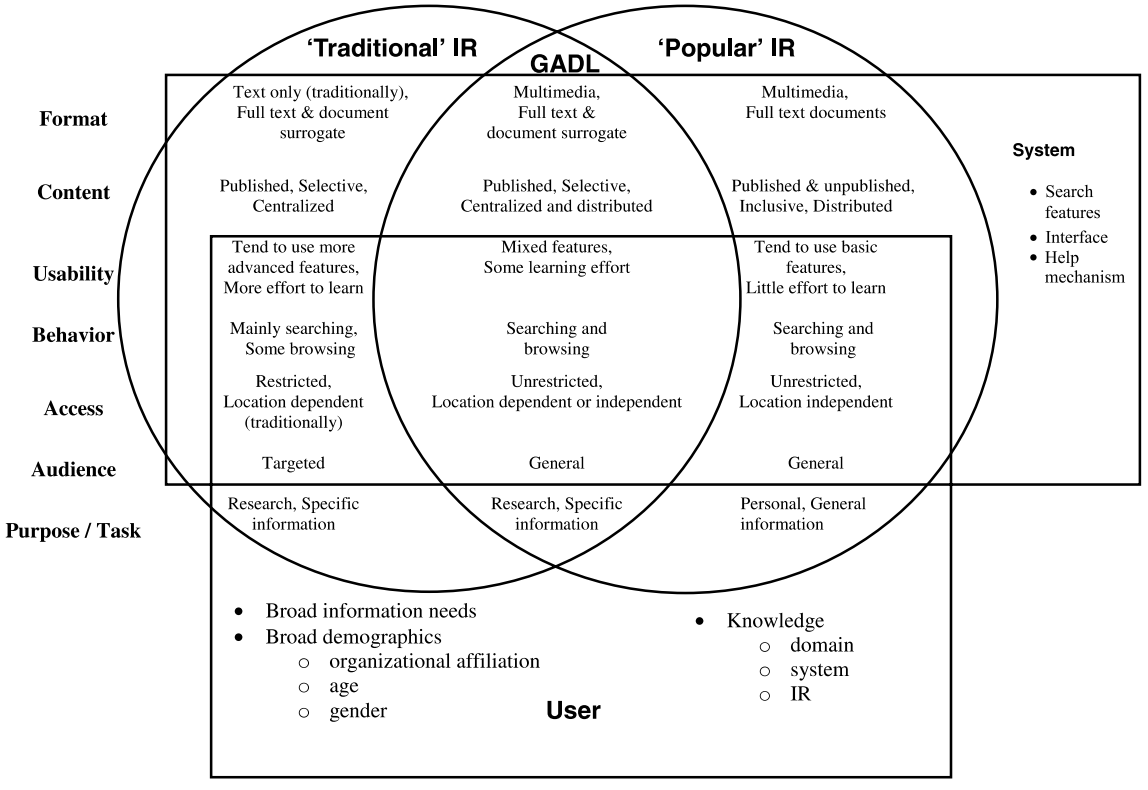

Fig. 5. Model of the general audience digital library (GADL) context.

From the system perspective, GADL content and document formats most closely resemble traditional IR environments. Traditional IR is characterized by selective content inclusion from published and unpublished sources, more sophisticated search features, and is generally used for search topics of a non-personal nature. Users also rely on the GADL environment for similar reasons as for traditional IR. However, from a user interaction perspective, GADLs differ from the traditional IR environment in the way they are accessed and in the more limited range of search features, which are designed to accommodate a broader audience.

The increased availability of the Internet and the growth of resources to which it provides access have led to the emergence of popular IR. It has created a context that permits easy user access to a variety of full text information resources. More importantly, it allows users to have greater independence of time and place in information seeking. However, the popular context to date has been criticized for lacking credibility in its contents (Savolainen, 1999), and sophistication in its resource organization and retrieval (Jansen & Pooch, 2001).

Results of the end-user Web survey help to corroborate the findings of the usage log data, since usage figures alone cannot shed light on how users respond to a system or why they use it. The comparison of BadgerLink usage with findings from studies examining popular Web usage help to identify similarities and differences between both of these contexts. Several similarities were found in how each is accessed and used. Users in both environments most frequently access Internet resources, whether a popular Web search tool or a Web-based GADL, from home. Respondents to Web-based surveys, both for the present study and general Web usage studies, indicate they are more likely to use home access, rather than rely on public access terminals in libraries/schools as their primary access point to the Internet (Lieb, 1999). Like the broader Web, GADL users expect to find everything they need through the one site. And in each environment, users indicate that they are unable to find some information on occasion. The nature of the medium also impacted how users viewed accessibility. At times, within both the general Web and the studied Web-based GADL contexts, response time/speed is considered as one of the major problems of these systems (Lieb, 1999).

The biggest difference between the usage of the GADL and general audience Web IR is the distribution of topics searched. Content within a GADL such as BadgerLink is more closely tied to traditional IR. Despite having broad content in both environments, more requests were made for current events, business/commerce, health/science, and education-related subjects in the studied GADL, whereas Web search engine studies, like the Excite study, are indicative of popular IR searching, characterized by more leisure and recreational interests. Usage of the popular Web is motivated more by personal needs and recreational pursuits, while users of the GADL tend to seek information for research and education purposes. Although different types of usage data in both contexts were compared, one can still gain an understanding of the subject nature of the information requests based on query content or the number of requests made for the retrieval of specific resources. Both data sets highlight the overall nature of the information requests being submitted to each environment. The primary reason for the observed differences in resource usage stems from the purpose for which each context is used.

Both popular Web tools and GADLs contain comprehensive information resources. However, different publication mechanisms dictate which types of resources are included within each context. Public Web search tools rely on freely available information of varying quality to populate their indexes. GADLs rely on selectively indexed published documents from mainstream outlets

and unpublished authoritative resources such as regional information. At present, many GADLs primarily consist of published resources whose origin is not Web-based, and whose accessibility is not facilitated by browsing, which is another characteristic of traditional IR. Search and viewing characteristic responses collected by the BadgerLink user survey revealed limited browsing by users. At the same time, Web surfers on the wider Internet are accustomed to more dynamic access to information via keyword search tools, subject directories, and hyperlinks.

5.3. Recommendations for GADL development

These similarities and differences among GADLs, traditional IR, and popular IR, especially the dual contexts of GADLs, lead to several recommendations for the development and effective use of GADLs. These recommendations relate to the resources GADLs provide access to, in addition to system and interface design features.

The similarities GADLs share with Web access tools may suggest that these systems take on more of the characteristics and content of popular IR tools. GADLs should contain broad coverage of published and unpublished resources, to meet the needs of all types of users. The content of a GADL should consider the needs of different age groups. The small number of survey respondents under 30 years of age, a group that is commonly thought of as the typical Internet user, has its own expectations when using the GADL. Younger respondents differed in their purpose of usage and were more likely to indicate that they had not benefited from the resources available, leading to the conclusion that the contents of the GADL did not meet their information needs as well as it did for older users.

Emphasis should be placed on those resources most frequently accessed by users. GADLs should promote those resources dealing with current events, business/commerce, health/science, and education to users by having different defaults for different types of users who may not be familiar with the range of database resources. This is not an issue with most standard Web search tools since users search a single comprehensive database. In addition, it is important for the GADL to provide access to specialized information resources of interest to its primary users, for example, by making resources of regional interest available.

GADLs should also try to adopt usability features of popular Web search tools familiar to general audiences. Although end-users of the general Web environment are accustomed to browsing, the results of this study indicate that they did less browsing than searching. Lack of browsing mechanisms mainly account for the differences in the searching behavior. Well-designed browsing mechanisms are needed and will facilitate users in their search for relevant information. Even though users access full text documents, requests for abstracts far outweigh requests for full text documents. GADL interfaces to browse search results must provide more information than a popular Internet search tool would (e.g. URL, text excerpts). More flexibility in full text document and document surrogate presentation is desirable.

The dissatisfaction expressed by some users regarding the success in their ability to finding information leads to the recommendation for training on how to effectively make use of the systems. Respondents of the survey were more likely to access BadgerLink from home than from other locations such as work, an educational institution, or a library. The majority of respondents also reported that they learned how to use BadgerLink on their own. Even frequent Internet users, who are assumed to be versed in the technologies and resources available, expressed some diffi-

culty in using the system. Online training is needed to help users to make more effective use of these systems. Since users largely access GADLs from home, such training should take the form of interactive, self-paced online tutorials.

5.4. Study limitations and need for further research

The newness of the GADL concept and the recent emergence of popular IR create many opportunities for further research. More studies of direct comparisons of the system and user interaction differences between traditional and popular IR systems with larger study audiences are needed. To date, most studies of the popular IR environment have relied on general IR assumptions and models. Additional evaluation studies of the GADLs themselves are also needed to confirm the unique nature of the GADL context.

Anonymous log data, which are generally readily available in large quantities, are very useful for providing objective data for how resources within a given system are used, but they cannot reveal user motivations, goals, and intentions for their search behavior. Web-based surveys are invaluable in collecting user demographics and reactions to system contents and features. As with every voluntary survey, however, respondents are a self-selected group and may only represent a segment of the user population. Considering the potential size of the user population, the sample size for the current study was relatively small. Further studies should increase the sample size and, more importantly, should examine users' information seeking processes within the GADL context. In addition to log and survey data collection approaches, researchers can apply observation and "think aloud" methods to record user–GADL interactions and their associated intentions and feedback to provide a more comprehensive understanding of IR in GADL context.

6. Conclusions

As information retrieval has become more widespread, the contexts in which they are used continue to be defined and redefined by the increasing variety of content they provide access to, the environments in which they are used, and the user populations they serve. The traditional context of IR, involving specialized bibliographic content for targeted user groups, has also given rise to a popular context for IR with fewer boundaries, exemplified by general information retrieval systems supported by the Web. In the past several years, the development of general audience digital libraries has increased, providing general access to a broad array of electronic information resources with traditional IR functionality. The emergence of the GADL defines a context that represents a hybrid of both traditional IR, using bibliographic resources, and popular IR, exemplified by public search systems available on the Web.

The authors have investigated user response to and utilization of BadgerLink, an example of a GADL, to gain a better understanding of this new IR context. Analysis of user survey data and database use logs revealed that the studied GADL is used to meet a variety of information needs. Usage patterns varied by age, with more mature survey respondents using the system for work-related information needs. Based on a topic analysis of information requests and comparison to general Internet usage studies, usage of a GADL such as BadgerLink differs from that of a general Web search tools. Users rely on each type of system for different purposes, with BadgerLink being

used more for research and educational purposes, while general Web IR tools are being used more frequently for recreation and leisure information needs. In the GADL environment, users are more likely to engage in search activities, as opposed to "surfing" as in the popular IR context. From the study findings, several recommendations were made to improve usability of the GADL environment, including broader resources, increased browsing and viewing mechanisms, and more interactive online training. A model defining the GADL context was developed based on the data findings along with existing IR models developed for general environments and other specific contexts. The findings show the GADL takes on features of both traditional and popular IR, representing a different context, which cannot be characterized by either the traditional or popular context alone. By integrating the best features of each of these contexts, GADLs can effectively accommodate the information needs of general audiences.

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