AskA's

Lesson Learned from K-12 Digital Reference Services

The Internet has brought libraries to a crossroads. The nature of collection, service, and information organization is changing rapidly. There is considerable anxiety about changing roles and responsibilities in this new digital environment. While a great deal of research and development is occurring in both collection development (such as NSF's Digital Library Initiatives) and information organization (metadata), little attention has been paid to how reference and user services will function in this new digital environment. This article outlines some of the thinking in this area as it relates to K-12 digital reference services. These services answer thousands of questions every week and have addressed many issues involved in providing human-intermediated information and referral services via the Internet.

For the purposes of this article, digital reference services are defined as mediated interfaces between users in an "anomalous state of knowledge" and a collection of information. The user's anomalous state of knowledge is operationalized as a question that needs to be answered. This question may be expressed as an e-mail request or a query to a system. The collection is a set of information in the form of documents, files, and/or knowledge (including human expertise). In digital reference services, all information is delivered to a user electronically (such as via the Internet).

Mediation between the user and the collection is the central topic of reference research. Mediation can be performed either through a human expert (e.g., reference librarian) or an automated interface (e.g., online catalog). The primary purpose of the interface is to match the user's information need to the system's organization and capabilities. The mediator (automated or human) becomes the user's advocate to the system or collection. While this view of reference is maintained in today's electronic reference environment, the role of the mediator is changed when the collection becomes vast (millions upon millions of documents), changing (with new Web sites and resources becoming available every day), and heterogeneous (with no common organizational scheme).

Impacts of the Internet on Reference Services

The literature shows that greater access to the Internet and Internet tools has resulted in significant impacts on reference services. These impacts include new skills needed by information and reference librarians. The Internet is also expanding traditional library collections and improving location and access to reference resources (e.g., ready reference materials and finders through Web sites, access to catalogs and electronic reference sources through telnet). Most significant, the Internet allows reference services the ability to conduct entire reference transactions (from specifying users' needs to delivering information from the collection) via the Internet.

A great deal of literature has focused on augmenting traditional reference services with Internet resources and capabilities. This literature ranges

Reference & User Services Quarterly, vol. 38, no. 1, pp. 63

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from evaluation criteria for online reference sources to discussions of technology used to locate and access Internet resources. In these discussions, the interface to the user remains the same, but the collection is expanded to include Internet resources. These new resources change the reference environment. Mardikian and Kesselman present five “rationales for changing reference”:

1. increasing access to resources beyond the library (networked resources including the Internet),
2. lack of geographic constraints for users (“users may no longer need to come to the library to obtain information”),
3. the need to differentiate services to different populations of users (i.e., inside an organization and outside an organization) in the face of shrinking budgets,
4. increases in complexity of information resources and the need for specialized knowledge, and
5. new options (primarily in staffing) for answering reference questions.\textsuperscript{8}

All of these rationales concentrate on having librarians redefine their roles within a traditional, geographically defined library setting.

\section*{Changing Roles of Reference Librarians}

These changes in the reference environment focus on the reference librarian and the training of that librarian in response to the “increasingly automated [library] over the past three decades.”\textsuperscript{9} In an article published in 1995, He and Knee called for librarians to update their skills in response to perceived changes to the reference environment. They observed, “It is important for electronic services librarians to be familiar with traditional as well as electronic reference sources. By learning traditional sources, they will be able to recognize which Internet resources may also be valuable.”\textsuperscript{10}

Librarians’ skills must also include an ability to evaluate networked resources. McClure, drawing on VanHouse et al., defines evaluation as “the process of identifying and collecting data about specific services or activities, establishing criteria by which their success can be assessed, and determining both the quality of the service or activity and the degree to which the service or activity accomplishes stated goals and objectives.”\textsuperscript{11} The burden of learning and applying the evaluation skills of the Internet falls upon the librarian, who must master the new Internet tools for his or her users. The reference librarian acts as “a bridge which has technology at one end and the user at the other.”\textsuperscript{12}

Learning, however, is not limited to just applications and technology. It also applies to dealing with change. As McClure et al. stated, “library staff...must learn from their colleagues in the computing services how to become more comfortable with the type and rate of change that will accompany the networked environment.”\textsuperscript{13} This notion of change and the need for technical proficiency are echoed throughout most of the literature concerning reference services and the Internet.

Accompanying the changes in reference librarians’ skills are changes in the reference librarians’ roles, particularly in regard to staffing. Oberg states “paraprofessionals can and do perform well at a reference desk, freeing librarians to concentrate on higher-level tasks.”\textsuperscript{14} Mardikian and Kesselman have constructed a three-level staffing model to reflect the changing role of the reference librarian. See table 1.

In addition to this shift in responsibilities for reference librarians (to higher-level tasks), there has

\begin{table}[h]
\centering
\caption{Mardikian and Kesselman’s Staffing Levels}
\begin{tabular}{|l|}
\hline
Level 1: Minimum Human Intervention \\
Self-guided building tours \\
Automated telephone answering machines \\
Better signage \\
Better floor maps \\
Library quick guides \\
Step-by-step guides \\
Computerized-assisted instruction for self-service instruction \\
Computerized information kiosks \\
\hline
Level 2: Library Interns/Trained Paraprofessional Staff \\
General library orientation and general bibliographic instruction \\
Directional inquiries \\
Ready reference searching \\
Bibliographic verification on OCLC, RLIN, and the online catalog \\
Assist with search strategy formulation \\
Technical assistance with machine problems \\
Basic informational services with referrals as needed \\
\hline
Level 3: Librarians, Subject Specialists \\
Individual research consultations \\
Specialized reference services \\
Office hours in departments \\
Member of a research team with teaching faculty \\
Liaison activities with departments \\
Specialized instructional services \\
Integrated information literacy into the curriculum \\
Research and development efforts \\
Mediated online searching \\
Create CAI programs and expert systems for users \\
Ongoing evaluation and needs assessment \\
\hline
\end{tabular}
\end{table}
been a call for greater collaboration with other types of professionals. Lewis believes the infusion of new tools for location and access into libraries means “a significant upgrading of skills of most librarians and will mean professionals who are not librarians will have to be offered positions along side of, or in place of, librarians.” McClure, et al. listed partnering with computing services, faculty and other “external organizations and companies” as critical success factors in building the virtual library. 

Digital Libraries

The Internet is also used to provide better access to a library’s collection, by organizing materials for reference patrons and allowing them access to reference sources, such as Online Public Access Catalogs (OPACs). The literature on this topic includes discussions of standards for information interchange, presents a continuum for reference services and access in relation to the Internet, and seems to agree that libraries and reference services are headed “towards a virtual future.” However, this future has not been widely explored.

Sutton’s four-part typology of libraries anticipated the expansion of reference collections to include the Internet, as well as the use of the Internet to access an individual library’s collection. This typology (figure 1) created a continuum from a paper-based (“traditional”) library to a fully “digital” library without walls. It consists of the following types:

- **Traditional.** “A specific place with a finite collection of tangible information bearing primary entities like books and journals...[denoted as] paper.”
- **Automated.** A mix of paper and digital reference resources and metainformation that “point to nondigital media.”
- **Hybrid.** Typified by the use of both print and digital meta-information sources (increasingly digital) and the coexistence of both digital and paper primary resources. This type of library allows for the first time remote access to “some subset of the library’s digital collection or to digital resources.”
- **Digital.** “The library as a logical entity. It is the library without walls—the library does not collect tangible information bearing entities but instead provides mediated, geographically unconstrained access to distributed, networked digital information.”

From this typology, Internet information systems, specifically digital reference, can be seen as digital libraries. Since such services transact all information delivery via the Internet, they are fully digital.

One interesting aspect of a digital library’s reference service is the ability of the Internet to hide the process of reference services. According to Still and Campbell, “one big difference [between traditional reference interactions and using the Internet for reference work] was that e-mail has made the internal operations of the library invisible to the patron; they are unaware of which department handles each request. The patron simply asks the question.”

Sutton stated that in a digital library, the primary task of the librarian is to provide “context.” That is to say, the collection becomes so large (it could be considered to consist of the entire Internet) that patrons no longer desire the full range of information available on a given topic, but only the “best” information. In that case, the librarian’s role shifts from advocate of a collection to a filter for the user. Since they are not restricted by either geography or technology, users will select services
based on how well they create a useful context. So the selection of K–12 digital reference services could be seen as a selection of contexts.

K–12 Digital Reference Services

Reference librarianship and reference services have a long and rich history. It is clear from the literature that the Internet has had a major impact on how reference services are accomplished in the networked world. As figure 1 illustrates, a continuum appears to have been established. The continuum starts at a library with no automation, unaware of the Internet, and ends in a library as "logical entity," where reference services provide context to a globally distributed, fully digital collection.27

The author has been investigating the digital extreme of this continuum in the K–12 context. Through the Virtual Reference Desk project of the ERIC Clearinghouse on Information & Technology, sponsored by the U.S. Department of Education's National Library of Education with support from the White House Office of Science & Technology Policy, an empirical study has been conducted to identify and analyze exemplary K–12 digital reference services. The following information is drawn from that study.

The K–12 community of students, teachers, parents, school librarians, and administrative personnel is a logical place to begin an investigation of digital reference services. President Clinton's call to connect every classroom to the Internet by the year 2000 emphasizes the need for Internet information services focused on the K–12 education community to be organized and prepared.28 As more users (in this case educators and students) look to the Internet to meet their information needs, Internet information service organizations must be able to build and maintain their own services to meet these users' expectations.

Organizations of varying types are using this dynamic electronic environment to meet the information needs of the education community. For example, publishers are building Web sites for delivering product information to school library media specialists.29 The federal government is using the Internet to broadcast funding opportunities through mailing lists.30 Professional teaching organizations (such as the National Education Association) are building databases that match technical teacher mentors to other teachers just getting online.31 They are taking advantage of the unique benefits of the Internet (such as low publication costs versus potential audience and the interactivity of the medium) to build and maintain services.

K–12 digital reference services provide another example of organizations using the Internet to meet educational user needs. Digital reference services are question-and-answer services (sometimes referred to as "Ask A" services, such as AskA-Scientist) that seek to fulfill the reference needs of the K–12 education community. They use a broad range of approaches and Internet capabilities (e-mail, the Web, gopher) to answer the questions of students and educators on the "Net."

Some digital reference services are linking questions from the K–12 education community to expert respondents. These services have been enormously successful. The Ask Dr. Math site run from Swarthmore College and the MAD Scientist Network operated out of Washington University in St. Louis have received enthusiastic reviews.32 Two other award-winning question-and-answer services, AskERIC and Kids-Connect, both run from Syracuse University, are extremely popular resources for students and educators.33 However, these question and answer services run the risk of being overwhelmed if the nation succeeds in connecting its classrooms by the end of the century. KidsConnect alone experienced a 1,000 percent increase in its questions in the month of September 1996 (from 20 questions a week to 200). By the year 2000, projections indicate that there will be approximately 54 million students enrolled in elementary and secondary schools in the United States; 39 million in grades K–8 and 15 million in grades 9–12.34 Considering that only a fraction of today's students have Internet access from their schools, the size of this potential burden on Internet-based educational resources is daunting.

By understanding how these and other
exemplary K-12 digital reference organizations build and maintain services in the complex Internet environment, new strategies and solutions can be developed. New Internet information services might use the existing digital reference services as models for meeting future needs of the K-12 education community. Such information could also be useful to the library community as it wrestles with meeting patrons’ needs via the Internet.

K-12 digital reference services can be one starting point for the larger investigation of building and maintaining digital reference services. K-12 digital reference services are particularly relevant to the larger question of digital reference services because:

- these services tend to involve many different Internet technologies (e-mail, the Web),
- digital reference services cover the full range of information resources, from static (such as marked-up HTML pages) to dynamic communications (such as e-mail reference transactions),
- digital reference services on the Internet are becoming increasingly important as people realize the present limitations of automated information location services (such as AltaVista and Yahoo), and
- current AskA services answer a large volume of questions compared to today’s library-based digital reference services. See table 2.

There is also an identifiable need for this type of study within the education community. Services such as KidsConnect, the MAD Scientist Network, and the Library of Congress have all expressed a need to better understand (and document) digital reference services for the K-12 audience. The U.S. Department of Education has outlined digital reference as a priority in the newly formed National Library of Education. The present administration has also called for the development of guidelines of "Ask An Expert Services."  

### Table 2

<table>
<thead>
<tr>
<th>AskA</th>
<th>Questions</th>
<th>Public Library</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>AskERIC</td>
<td>900</td>
<td>San Francisco</td>
<td>15</td>
</tr>
<tr>
<td>IPL</td>
<td>150</td>
<td>Seattle</td>
<td>18</td>
</tr>
<tr>
<td>Ask Dr. Math</td>
<td>270</td>
<td>Salt Lake City</td>
<td>25</td>
</tr>
<tr>
<td>ScienceNet</td>
<td>500</td>
<td>Alachua County (FL)</td>
<td>12</td>
</tr>
<tr>
<td>Ask Shamu</td>
<td>300</td>
<td>Patchogue Medford (NY)</td>
<td>20</td>
</tr>
</tbody>
</table>

2. Experts and expertise can be included in the collection. Further, by doing so, organizations can take advantage of archiving and data-mining.
3. Providing digital reference does not require a computer science degree.

Digital reference is indeed possible in today’s Internet environment. Further, these reference transactions can be conducted asynchronously via technologies such as e-mail and the Web. While almost all of the services examined built extensive Web sites, all acknowledged the need for human intermediated service. The reader should be cautioned, however, that the majority of workflows found in current AskA services were linear, and the processes uncovered were centered on a single question. Traditional library reference, on the other hand, centers on the user and their problem. As Sutton and Holt point out:

In all but the most simple transactions, the steps might be more adequately described as opening the interview (the initial encounter of the parties and the presentation of the user's question or problem); searching for appropriate information in response to the problem (which usually involves a number of questions and interchanges rather than simply locating "the answer" to "the question") and closure of the interview, which should be based on a mutual understanding that, for the time being at least, an adequate amount of information has been communicated, or that it is most productive or necessary to close the interview. Thus, the interview process can be viewed as a problem-centered rather than question-centered process.

This is not to say that a linear or question centered approach is by definition incomplete. Grogan concluded that "most of the library users who put questions to the librarian know exactly what they

### Lessons Learned from K–12 Digital Reference Services, a.k.a. AskA's

While there is much to be learned from K-12 digital reference services (particularly as exemplars of high-volume reference services), three points stand out:

1. Digital reference is possible and it is more than bookmarks and Web pages.

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Volume 38, Number 1

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need and ask for it clearly." Further, Mary Jo Lynch found that fewer than half of the observed reference transactions in public libraries involved interviews and "that only 13 percent of these interviews substantially altered the initial query." This discussion is not presented, therefore, to dissuade builders and maintainers from using the examples of K-12 AskA services, but rather to highlight the need for future research on this topic.

K-12 digital reference services have also found a clear advantage to conducting reference services via the Internet: archiving. The ability to capture and analyze questions is seen as invaluable among these services. Trend identification, creation of Frequently Asked Questions (FAQs), and resource creation based on actual user input were key factors in the success of these services. By archiving and analyzing (data-mining) these records of actual use and inquiry, services can better allocate their resources.

All the services studied in the Virtual Reference Desk project operated in isolation from infrastructure providers. Infrastructure providers are defined in the Lankes/Eisenberg Architecture as "agents that build and maintain hardware and software used to move bits from one place to another on the Internet." Even in the case of Ask Shamu, the one service that had infrastructure detectors, Internet hardware and information transport standards were considered the responsibility of parent organizations. One might conclude that information service provision can be built and maintained without regard to underlying network infrastructure. This fact seems to demonstrate an evolution in Internet information systems. With growing implementation of the Internet in organizations, the expanded number of packaged Internet software solutions, and the content-less nature of the underlying Internet infrastructure, content and service creators appear to be able to operate successfully without deep knowledge of infrastructure (and in large part application) concerns.

The fact that these services and experts are able to operate in Internet information services without regard to infrastructure issues has direct implications for the roles of reference librarians. The exemplary services in this research demonstrated an ability to shelter experts from the "type and rate of change that will accompany the networked environment." Volunteers in these services do not have to be current on Internet technologies and trends. They need only have basic network literacy (i.e., to log on to a Web site) and strong subject skills. Even when the service was involved with technical aspects of information services, the role was in some way isolated from infrastructure issues.

### AskA Software and Other Efforts That Benefit Libraries

In addition to the lessons above, there are several techniques and initiatives occurring in the K-12 AskA community that are directly relevant to library and information centers seeking to build and maintain digital reference services.

#### Analysis and Blueprints

The Virtual Reference Desk has developed a method for analyzing and describing digital reference services. This technique creates a blueprint that succinctly describes the workflow (processes, resources, and technologies) utilized in a service. These blueprints can serve as case studies of existing service, while the analysis and documentation procedures can act as a common language for exchanging ideas and processes across organizations.

#### Software

It is in the area of software development that K-12 digital reference services can contribute the most. Several exemplary AskA services studied have created PERL based software workflow packages to manage their question answering processes (e.g., Dr. Math's Doctor's Office and MAD Scientist Network's MODERATOR). The packages developed by these services and partners will significantly aid the K-12 digital reference community and the library community. Such a package also has larger implications for the help desk software industry and the growth of digital reference in general. Removing the barrier of software development from AskAs may well stimulate the growth of these services, just as NCSA's release of an easy to install and modify World Wide Web client (Mosaic) and server (NCSA's HTTPD) prompted the growth of the Web by removing the software development burden from Internet information service providers.

#### QuIP

As part of the software development effort among AskA services, a metadata development process is underway. The Question Interchange Profile (QuIP) is a means of representing threads of questions and answers in an electronic record. This standard will incorporate pairings of questions and answers, transaction data (allowing for restrictions of who answers question, at what cost, in what
Table 3

<table>
<thead>
<tr>
<th>QuIP Components</th>
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<tbody>
<tr>
<td><strong>Component</strong></td>
</tr>
<tr>
<td>Transaction Wrapper</td>
</tr>
<tr>
<td>Metadata Representation</td>
</tr>
<tr>
<td>Blueprint Module</td>
</tr>
<tr>
<td>Questions</td>
</tr>
<tr>
<td>Answers</td>
</tr>
<tr>
<td>User Profile</td>
</tr>
</tbody>
</table>

A Common Answer Format

There are larger implications in the creation of a standard way of encoding and distributing questions and threads. In essence, QuIP creates an object. That object has certain attributes (a metadata representation, a blueprint pointer, a profile) and certain functions (transaction mechanisms) inherent in the object and separate from the process that created it. The object-oriented nature of the QuIP allows for a transaction space that goes beyond the meta-triage system discussed above. QuIP would allow the creation of a question/answer marketplace in which question objects could be exchanged and bid upon. For example, an organization could outsource a question, paying some fee to a third-party “answering organization.” This third-party organization could subsist solely by answering questions without a direct user interface. Organizations could use the QuIP concept as a foundation for cooperative support and reference services. Originating services (those that receive the questions) could include minimum requirements in answering questions and a maximum amount they are willing to pay for each answer. Third-party answering agencies could “bid” on the question, allowing a sort of supply and demand economy to develop. This bidding could be either automated or human-controlled. Money doesn’t have to be the only resource exchanged. A barter economy (e.g., “I’ll answer one of yours if you answer one of mine”) could develop. Such a system of either resource swapping or fee exchange is essential in the development of cooperative reference services.

In today’s public and research libraries there is a debate over how to support digital reference efforts. How does a public library in New York get reimbursed when it answers a question from California? What is the library’s incentive to offer such services? This becomes particularly problematic when it is nearly impossible to determine a question’s point of origin. With the use of QuIP, electronic IOUs or actual dollars can provide an incentive to these libraries not only to answer the occasional question, but to seek out questions. Such a marketplace of questions and answers would not need to be solely human mediated; instead, it could be a common market, where QuIP formatted questions could be reviewed by answering agencies (though it is assumed that special reciprocal relationships would be established to ensure prompt quality responses).

This marketplace of objects is only one example of the uses of QuIP. Imagine a major computer company that establishes blanket support contracts with its largest customers. In such an agreement the customer has paid the computer manufacturer to answer any and all questions. If the customer asks a question on a piece of third-party software, the company can use QuIP to forward the question to the third party and pay the third party to answer that question. By utilizing the blueprint standard
discussed above, this entire transaction can be customized so that the computer company's request gets a high priority in the third-party's question/answer process. Further, using the structure inherent in QuIP, the computer manufacturer can make the entire transaction seamless to the customer. One can imagine question brokers creating value-added support services that broker question/answer services.

Conclusions

Libraries are changing. The nature of the collection is changing, the role of the library in society is changing, the role of the librarian is changing, and so must reference service. As the library profession debates what direction to take, a group of innovators in the K–12 domain has begun implementing digital reference services. These so-called AskA services are answering thousands of digital reference questions each week. Few of the people responsible for these services have library backgrounds. There is no doubt that the library profession can inform these services in areas of privacy, the reference process and information organization. At the same time, however, the library profession has much to learn from the hallmarks of AskA services: scale, volume, provision of answers, and context.

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Ian Ousby
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