

# **Real-Time Reference for Undergraduate Students in Science, Mathematics and Engineering**

## **Executive Summary**

Undergraduate science students increasingly use the convenient World Wide Web as their sole source for information to support their research projects. Because only about 6% of Web content is scholarly in nature, educators are concerned about this trend. An informal study indicates that Ask Jeeves, a popular resource, was correct only about 17% of the time. Currently available electronic answering systems are not sophisticated enough to respond to typical student inquiries. This proposal addresses these problems by providing a librarian-staffed science chat room 24 hours a day, seven days a week.

The principal investigators from the University of Arizona, Carnegie Mellon University, University of Hawaii, Online Computer Library Center (OCLC), Oregon State University, and the University of Texas propose to design and staff a chat room 24/7 for eighteen months. Commercial chat room software called LivePerson will be used to support the chat service. Staffing of the chat room will roll across the time zones and will vary somewhat in implementation details from institution to institution to allow for a variety of research questions to be answered. OCLC will provide coordination, marketing plans, implementation, and session analysis. The questions and answers from the chat room will be used to create a database that will eventually support librarians in the chat room and be available as a superior resource to students directly.

The goals of the project are to:

- close the gap between the ease of using the Web and the perceived cumbersomeness of using the library
- make librarians and quality information in science, mathematics and engineering as convenient to access and attractive to consult as the Web
- begin to integrate social interaction into the digital library
- collect an archive of questions for a superior Ask-A database service

A dozen specific research questions will be addressed in the project.

The proposed chat project offers a significant opportunity to study the habits of science, engineering, and technology students working on their research problems. The study will determine whether and how chat software can be used to respond to their information needs. The transcripts for 13,176 hours of reference will provide a unique resource for study and facilitate increased understanding in the appropriate teaching communities. Assessment will involve pre and post tests in selected classes, focus groups, and online surveys.

A few libraries are currently using chat software for reference service, but given the restricted hours of most of these services, one wonders how well they will meet the real-time and often late-night needs of undergraduate students. The proposed 24/7 service of the Library of Congress's Collaborative Digital Reference Services (CDRS) may be better suited to meeting undergraduate needs. However, the project proposed here offers a much more focused and interactive response to users' questions.

This proposal directly supports teaching and learning in science, mathematics and engineering, which are cornerstones of a healthy economy. The 24/7 chat service is part of a comprehensive agenda envisioned by librarians around the country to create and conduct research on digital resources. Spearheaded by the Keystone Group of librarians, the results of the project will be broadly disseminated. Student surveys may allow the identification of its impact on underrepresented groups.

NSF funding will support the purchase of LivePerson chat software, training costs, OCLC's marketing services, assessment activities, and PCs, scanners and partial salaries for the librarians working in the chat rooms. OCLC and the participating academic libraries will contribute all other expenses and waive overhead to support the project.

# **Real-Time Reference for Undergraduate Students in Science, Mathematics and Engineering**

The challenge for reference service in the digital environment is how to extend the critical and underestimated human touch of a librarian to students any time, anywhere.

(Paraphrase Ferguson and Bunge, 1997)

## **1. The Problem and Proposed Solution**

With information consumers directly connected to information producers at the desktop and the rise of distance education, libraries must develop and deliver the full range of value-added, value-based library services either digitally or through real time interactions over the network (Ferguson and Bunge, 1997). Though digital libraries have the potential to increase collaborative learning by engaging remote users in social interaction, developers and definers of digital libraries have focused on the provision of quality content and neglected the services and user perspective that are essential to quality education (for example, Drabentstott, 1994; Miksa and Doty, 1994; Saffady, 1995; Nurnberg, Furata, Leggett, Marshall and Shipman, 1995; Twidale, 1995). To truly support education, today's privatized, solitary digital libraries of content must be transformed into social, exploratory digital libraries of learning (Sloan, 1998b; Lyman, 1997; Higgins, 1993). Engaging students in interactions that enable the growth, adaptation and contentment that constitute learning is the only way to accomplish this transformation (Schmeck, 1988).

Reference service has traditionally provided social interaction between librarians and users. Reference librarians mediate between information users and resources. In the context of the reference interview, they collaborate with users to help them focus and articulate their information needs and identify, evaluate and manipulate resources to meet those needs. The reference interview is valuable to all information seekers, but it is critical to students. Artificial intelligence can neither conduct a reference interview with the expertise of a reference librarian, nor provide the social interaction and engagement required for students to truly learn. Interaction and collaboration with a live person are required for high quality reference service, for student enjoyment and motivation, and to inculcate optimal work habits in undergraduate students (Twidale, Nichols, Smith and Trevor, 1995).

Today many, perhaps even most, undergraduate students use resources indexed by Web search engines. When they use the library, they often use it remotely and without effective assistance from librarians.<sup>1</sup> The apparent undergraduate trend is to use convenient digital information instead of less convenient print information, even if print provides superior resources (for example, Lawrence and Giles, 1998; Payette and Rieger, 1998; Dowler, 1997; Miller, 1995). The trend has educators concerned about the quality of undergraduate research and education. The study proposed here will focus undergraduate student attention on the efficiencies of using librarians and libraries in their information quests by providing a real-time, 24/7 online reference service. The service will use Web chat software customized to attract and engage undergraduate students with reference librarians. Chat software offers a multi-user environment that facilitates communication and social interaction.

To be effective, interactive reference must be delivered in ways and times that match user preferences and lifestyles and facilitate user independence (Ferguson and Bunge, 1997). The "teachable moment" is the time of student information need (Dusenbury and Pease, 1995). Students use Web search engines because they are available 24/7 from dorm rooms and apartments, accept and execute poorly defined searches, almost always get rapid results, and have graphically exciting user interfaces. The chat service proposed here will be available 24/7 from dorm rooms and apartments; accept, negotiate and answer poorly articulated questions; almost always provide rapid results; and provide a graphically exciting user interface. In addition, it will provide the collaboration and social interaction that add value to information transfer and the ease of access, equity, privacy, confidentiality and personal touch that have always been the hallmarks of high quality reference service (Ferguson and Bunge, 1997; Sloan, 1998b).

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<sup>1</sup> Remote use varies from 15% to 75% depending on the wired component of the campus and the nature of the student body.

## 2. Goals and Objectives

The goals of the proposed project are to

- close the gap between the ease of using the Web and the perceived cumbersomeness of using a library
- make librarians and quality information in science, mathematics and engineering as convenient and attractive as the Web is to undergraduate students around the country
- begin to introduce into the digital library the kinds of social interaction essential to an effective learning environment
- provide an archive of questions and answers as the raw data for a Web-based “Ask-A” database service that students can use independently

More specific research questions to be addressed in this project are:

- From the perspective of undergraduate students, is a chat room an effective way to deliver quality information and library instruction in science, mathematics and engineering?
- From the librarians’ perspective, does chat room software provide satisfactory support for an online reference service?
- Can undergraduate students be attracted to a better information source for answering their questions than the information indexed by popular Web search engines? If provided with convenient, real-time support for quality resources, will undergraduates use it?
- What ideas do students in focus groups have about attracting student attention to the chat room and keeping students engaged in a chat room for science, mathematics and engineering?
- How many reference questions will undergraduate students ask? When will questions be asked? Where (from what Internet domains) will questions be asked? To what extent will questions repeat?
- What is the taxonomy of reference questions in science, mathematics and engineering? Questions about facts? Requests for resources, complete citations, or instruction? Some other classification?
- What domain expertise and resources must librarians have to answer these questions?
- How can the questions and answers from the chat room be transformed accurately and efficiently into an automated Ask-A-type resource that students can use independently?
- Were there technical problems associated with the equipment or chat software selected for the project?
- How much staff does it take and how much does it cost to run a reference librarian chat room around the clock? After costs have been aggregated, what models can be developed to sustain the project in a post grant environment?
- What additional digital resources, services and tools are needed to support student work in science, mathematics and engineering?
- Can chat software be used effectively to support additional social interactions in the digital library?

## 3. Significance

Student reliance on the results retrieved by Web search engines is unfortunate because:

- Less than 6% of the information currently indexed by Web search engines is scholarly in nature (Lawrence and Giles, 1999).
- The provenance of Web materials varies widely.
- No single Web search engine indexes more than 16% of the publicly indexable Web (Lawrence and Giles, 1999) and no research indicates that undergraduate students query multiple Web search engines.
- Problems created by poor search strategies are magnified on the Web (Nims and Rich, 1998). Queries often return thousands of undifferentiated resources. Undergraduate students are often unable to distinguish appropriate from inappropriate materials for use in class assignments.

Even if Web-based tools are developed to guide students to appropriate resources, there is little evidence to indicate that the selection of appropriate resources alone will improve student work (Ackerson and Young, 1994). Direct

intervention, instruction and counseling throughout the research process are required to help students access, evaluate and use information effectively (Kuhlthau, 1993). The project proposed here will provide real-time intervention, instruction and counseling to meet the specific information needs of science, mathematics and engineering students working on assignments, projects and laboratory reports. It will provide librarians with insights into the needs, expectations and habits of undergraduate students, and answer basic questions about the efficacy of using chat software to provide reference service. Expectations are that chat reference service will help students bond with librarians, increase their appreciation and satisfaction with libraries, and enhance their learning experience. The data gathered from the project will enable libraries to more accurately market library services to undergraduate users. If chat technology is an effective way to provide reference service to undergraduate students, chat rooms for the humanities, social sciences and fine arts may need to be developed for strategic use by academic libraries.

Transcripts of 13,176 hours of reference service in science, mathematics and engineering will provide an enormously rich resource for study. Analysis of the transcripts will indicate what areas in these disciplines confuse students, what facts are difficult for them to locate, and how librarians parse user questions. The results of the project will be disseminated to the teaching community, to other science and technology librarians, and to developers of online help resources. The question banks that will be created as part of this project will provide concrete data about which areas of content should be included in a science, mathematics and engineering resource that students can use independently. The taxonomies developed through this work will also inform librarian thinking about what additional resources, services and tools for these disciplines need to be made available on the Web.

#### **4. Relation to Present State of Knowledge**

Providing a good fit between media and communication activities requires understanding the characteristics of different media, the interactions among these characteristics and different communication activities, and the media usage patterns of users (Rice, 1987). The medium selected to provide digital library services must compliment the user's habits, personal style, technical capabilities, situational requirements and needs (Schilling-Eccles and Harzbecker; Payette and Rieger, 1998).

A review of the literature indicates that many libraries offer reference service via electronic mail, but use of email reference is very low (Bristow and Buechley, 1995; Rocchi, 1997; Schilling-Eccles and Harzbecker, 1998).<sup>2</sup> Apparently the advantages to the user of anonymity, a written record, and unrestricted temporal and geographical access are overshadowed by the disadvantages of response time, "high dialogue penalties" (decreasing usefulness of extended dialogue) and email interoperability problems. Low use of email reference is particularly striking among undergraduate students given their use of email software. A 1998 survey of college freshmen conducted by the Higher Education Research Institute at UCLA revealed that 66% of them use electronic mail (Libbon, 1999). Yet one study of 18 months of email reference transactions discovered that undergraduate students submitted only 6% of the questions (Bushallow-Wilber, DeVinney and Whitcomb, 1996). Another study of two years of email reference transactions found that students submitted only 20% of the questions (Rocchi, 1997).

Several libraries have experimented with videoconferencing technology to provide electronic reference service. The technology is more media rich and immediate than email, but apparently the inconvenience to and intimidation of the user overshadow these advantages.<sup>3</sup> Few people have the requisite hardware and software to make videoconferencing a viable technology for reference service (Morgan, 1999). To use staff time effectively, video reference service hours are extremely limited. Users must schedule appointments and go to the site(s) where the equipment is installed (Sloan, 1998b). At the University of Michigan, fewer than twenty students used video reference over a period of two years, though the technology was installed in residence halls (Folger, 1997). At the

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<sup>2</sup> The library at Boston University Medical Center has been receiving fewer than 20 email reference questions per month since the inception of the service in 1995 (Schilling-Eccles and Harzbecker, 1998). In a study conducted at the University of South Australia, only 57 email reference questions were received in two years (Rocchi, 1997).

<sup>3</sup> At the University of Michigan and Emory University users were self-conscious in front of the camera and some refused to get in front of it (Folger, 1997). Additional problems with videoconferencing reference service included the inconsistent quality of audio and video and the lack of technical support.

University of California at Irvine, a pizza party and gift certificate had to be used as incentives to get students to even try the technology. While the few students who tried it appreciated the outreach, they wanted the technology moved to a separate room because it was distracting and they didn't want to have to go to the library to get resources when the reference librarian directed them to do so.

"Ask-A" services are very popular. Users can ask questions of experts in geology, science, mathematics, medicine, theology, astronomy, paleontology, optometry and many other subjects (<http://www.vrd.org/locator/alphalist.html>). Distance learning centers and libraries are now offering Ask-A services (for example, [www.rrc.usf.edu/ask.html](http://www.rrc.usf.edu/ask.html) and <http://www.vrd.org/locator/sites/ipl.html>). Ask Jeeves is probably the most well known and heavily used Ask-A service, perhaps because it offers an immediate response in the form of a database result set rather than a one to three day delay where the answer comes in email. In January 2000, Ask Jeeves (<http://www.ask.com>) reported 6.4 million unique users (up 21% from December 1999), claiming that the tremendous value and powerful relevance ranking of their service attracts users (Business Editors, 2000). But when Carnegie Mellon submitted 110 reference questions to Ask Jeeves, only 17% retrieved a complete answer with ease; 59% retrieved no relevant information. Ask Jeeves also performed poorly in response to questions asked in the popular game show "Who Wants to be a Millionaire?" (Andrews, 2000). Electronic reference service affiliated with academic or public libraries will no doubt provide better results, so why do undergraduate students seldom use the service? Is it the marketing? Is it the lack of integration into the curriculum? Is it the response time? The user interface design?

In the videoconferencing experiment at the University of California at Irvine, the chat window available with the video software was targeted as extremely useful (Lessick, Kjaer and Clancy, 1997). Real-time communication with chat and instant messaging software is being used to support or provide everything from recreation and school curricula to news headlines and corporate M&A groups (Junion-Metz, 2000; Mather, 1998; [www.webhelp.com](http://www.webhelp.com); Holson, 1999). "Chatting" is so popular with teenagers that retail sales Web sites are using chat software to entice them to linger longer on the site (Tweney, 1998). Chat software designed for the teenage market resembles computer games, with quality graphics and the ability to insert "emoticons" and "avatars" (personalized representations of the users). For example, *Microsoft Chat* provides a set of customizable cartoon figure palettes that enable users to choose their physical representation and facial expression. Users of *eShare Expressions* chat software can submit icons from a scrollable list to denote coffee breaks, handshakes, thumbs-up, etc. *Virtual Places* enables users to choose or design their own avatars to display a range of emotions and gestures and add tone and body language to their words. The 1998 survey of college freshmen conducted by the Higher Education Research Institute at UCLA found that 54% of them use chat software and 80% of them play computer games. The compound "Web chat" program or "Web chat" room is commonly used, "as though the concept of the chat room is linked to the Web itself" (Warshauer, 1998, p. 201).

A few academic libraries have experimented with chat software as a basis for electronic reference service. These experiments are recent and little information is available about them. However, a quick look at some of the interfaces and service hours shows the no-nonsense approach of librarians, not the user-centered design and late-night availability that would appeal to undergraduate students. For example, the interfaces of Temple University Libraries' "Temple TalkNow" chat reference service (<http://155.247.160.17/>) and the University of North Texas Libraries' "Online Reference Help Desk" (<http://www.library.unt.edu/admin/HelpDesk/helpdesk.htm>) resemble Web-based email reference forms. The chat software used at both sites introduces considerable lag time in reaching a librarian. Access to the services is inconspicuous on the libraries' home pages and service hours are limited. "Temple TalkNow" is never available after 9:00 p.m., though it is available on weekends. The "Online Reference Help Desk" at the University of North Texas is available only 10:00 a.m. to 5:00 p.m. on weekdays, when students are likely to be in class. The reference chat service at North Carolina State University has similar weekday hours when students are likely to be in class, and requires users to call or schedule an appointment to chat with a librarian.

Nevertheless, chat software with a fun user interface, 24/7 service hours, and appropriate functionality and promotion may be the delivery medium for electronic reference that undergraduate students will embrace. Estimates are that 40-50 million of the 107 million people who use the Internet use chat or instant messaging software. In 1998, America Online found that its 12 million users spent 19% of their time in chat rooms and 17% of their time surfing the Web (Marriott, 1998). The same year a Jupiter Communications' survey indicated that 41% of consumers are more likely to purchase online if chat or messaging software is available at the Web site (Jupiter Communications, 1998). According to Forrester Research, chat software is expected to account for 50% of all

service requests by 2002. Though research suggests that computer users suffer socially from extensive use of communication services (Bower, 1998), online chat rooms appear to be conducive to creating friendships in cyberspace (Floyd, 1998). Some students may even feel more comfortable communicating in cyberspace than in person (Dunklin, 1999).

The chat reference service proposed here has similarities with the Collaborative Digital Reference Service (CDRS) at the Library of Congress (<http://lcWeb.loc.gov/digiref/cdrshome.html>), but is narrower in scope, as indicated in the Table below. Questions asked in the chat room that are outside the scope of a reference service for undergraduate students in science, mathematics and engineering may be referred to the CDRS or the Internet Public Library (IPL).

	<b>Collaborative Digital Reference Service</b>	<b>Science Chat Reference Service</b>
<b>Target audience</b>	Researchers of all ages, including K-12	Undergraduate students
<b>Service providers</b>	Librarians & credentialed subject experts	Librarians
<b>Application(s)</b>	Email, telephone, directories, chat, Web, fax	Chat
<b>Disciplines</b>	All disciplines	Science, mathematics, engineering
<b>Response time</b>	Some immediate, some delayed	Immediate
<b>Service plan</b>	Three 4-6 week pilots, begin production Oct 1	1.5 years (18 months) in production 24/7
<b>Partners</b>	20 libraries	5 libraries and OCLC
<b>Scope</b>	International	National

## 5. The Project Plan

### 5.1. The Chat Software

To provide real-time online reference service, the project will license commercial chat software called “LivePerson” (<http://www.liveperson.com>). The software runs on a server hosted by LivePerson. It supports secure (SSL encrypted) one-on-one chat sessions using a standard Web browser. The Internet Service Exchange provider is AboveNet, which offers maximum speed and reliability through a one-hop architecture to the Internet backbone, automatic re-routing of messages around congestion points and Internet failures, advanced security and a bandwidth capacity in excess of 24.7 gigabytes. LivePerson provides a fully redundant and professionally managed 24/7 environment. The software, reasonably priced at \$1000 for the initial configuration plus \$250 per month for each simultaneous operator or librarian, will be licensed with NSF funds. The monthly fee includes software maintenance and upgrades.

LivePerson requires no special hardware, software or Web browser plug-ins for librarians or end users. Librarians must login to the system, but users need only click the reference chat link on a Web page and enter a name<sup>4</sup> to communicate with a librarian. Visual and audible cues notify the librarian when users enter the chat room. (Librarians in the videoconferencing experiment at UC Irvine requested an audible cue so that they didn’t have to look at the computer screen to see when a user wanted assistance.) LivePerson chat sessions are automatically conducted in a separate browser window so both librarians and users can chat while viewing other Web-based resources and services. Librarians can send text, images and interactive hypertext links to users in the chat room and also “push” Web pages to open in a separate browser window on the user’s screen.

The ability to send graphics may be extremely important, not only to provide digital resources, but also to convey the non-verbal cues and personality that enrich social interaction and that are lacking in email reference service.<sup>5</sup> The

<sup>4</sup> Users do not authenticate with an ID and password. They need only enter a name to be used to identify their text in the chat room. Expectations are that users will enter “screen names” rather than real names to preserve anonymity.

<sup>5</sup> These enrichments are provided by emoticons and avatars in commercial chat software targeted for a teenage audience, but inappropriate for the project proposed here. For example, the rich graphical environments of *Virtual Places* and *The Palace* would take too long to download and the comic-strip balloons provided for chat text are better suited for recreational use than productive interaction with a professional librarian.

success of chat reference service for undergraduate students may depend on both the textual exchange between student and librarian and the look and feel of the chat room. The appropriate tone and degree of informality in online communication can enhance the personal touch needed to create the kind of enjoyable learning experience that will encourage lifelong learning habits (Gibson, Blackwell and Hodgetts, 1998). Though LivePerson is not designed to render a virtual world or habitat, the extent to which interaction in the chat room can resemble a computer game and evoke a sense of situated, persistent virtual space will be very important to undergraduate students. Successful communication, with rules that enable students to “win,” and the aesthetic experience of the chat room itself may be sufficient to engage students with librarians (see Warshauer, 1998).

The functionality of LivePerson may increase the frequency and productivity of reference service. The software enables librarians to customize and submit pre-formatted introductions or responses to frequently asked questions, saving the time it would take to type or compose similar text. For example, a pre-formatted introduction could welcome users into the chat room, ask what the librarian can do to help them and personalize the interaction by including a picture of the librarian. Librarians can monitor their reference service performance using LivePerson’s visual indicators of the length of each chat session and the time intervals between user query and their response. LivePerson enables librarians to chat with up to four simultaneous users.<sup>6</sup> Each user will communicate with the librarian in a separate (private) chat room. Additional users will receive a “busy” signal with the option to “hold” or to submit their question in electronic mail. When users on “hold” are admitted to a chat room, the LivePerson chat window will pop to the top of their computer screen.

Like Ask Jeeves, the chat reference service will provide convenient, real-time access, “rely on human intelligence to refine search queries, filter and direct the results” and take users “to the answer, article or tool designed to provide the answer” (Basch, 1999). Unlike Ask Jeeves, the chat reference service will provide social interaction with a librarian and quality answers, resources and tools appropriate for undergraduate students.

The chat reference service will be available to undergraduate students in six months from the inception of the project. Eighteen months of usage data will be gathered in the project. Librarians will manually log periods when the service is temporarily unavailable due to power outages or Internet access problems.

## **5.2. The Users and the Librarians**

The chat reference service will be available to all undergraduate students in the United States, not just to students at the partner institutions. There will be no limit on the types of questions students may ask in the chat room, but experience indicates that most undergraduate students in science, mathematics and engineering seek facts, formulas, data or complete citation information. Fewer students in these disciplines seek pointers to indexes, abstracts and full-text resources, and still fewer seek instruction in how to use databases and digital resources. Expectations are that chat reference questions will somewhat resemble email reference questions, though this will be confirmed or denied by the project. One study of email reference found that 74% of the questions could be answered by consulting standard reference materials, 12% of the questions were about library policies and services, 7% were instructional questions about using the OPAC, and 7% were requests to purchase materials (Bushallow-Wilber, DeVinney and Whitcomb, 1996). Questions about specific library policies and services will be routed to that institution. Users will of course be informed if their questions are routed via email or given a telephone number or email address to follow-up themselves.

To provide 24/7 access, the chat service will be provided by librarians in all time zones across the United States, specifically by librarians at the University of Hawaii at Manoa, Oregon State University, University of Arizona, University of Texas at Austin, and Carnegie Mellon University. Coverage will be in 4 hour shifts with Carnegie Mellon covering two shifts and each of the other partners covering one shift. OCLC and each academic library participating in the project has a Principal Investigator:

- Terry Noreault, OCLC

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<sup>6</sup> The effectiveness of handling multiple users at the same time is affected by many factors, including typing speed.

- Karyle Butcher, Oregon State University
- Karen Holloway, University of Arizona
- Drew Racine, University of Texas at Austin
- Gloriana St. Clair, Carnegie Mellon University
- Paul Wermager, University of Hawaii at Manoa

Due to limitations on the NSF forms, one of the PIs is listed as Senior Personnel on the forms.

Because of the similarities with email reference, participating librarians will follow Abels' model of effective email reference in the chat room: negotiating the question, summarizing the user's information need and constraints, and providing the answer (Abels, 1996). The responsibilities of the librarians will be clearly articulated and documented early in the project. Chat reference service will be integrated with their other duties. The librarians will work four-hour shifts in the chat room. They will NOT simultaneously staff the physical reference desk or handle telephone reference calls. The chat service will be their top priority, though of course they may be doing other work when no users are in the chat room.

Each of the participating libraries will be given PCs with large monitors and attached scanners purchased with NSF funds. (Librarians in the videoconferencing experiment at UC Irvine requested large monitors.) The large monitors will enable librarians to display adequately both the chat room windows and other resources they need to view to answer user questions. The scanners will enable them to provide users with information that cannot be typed in the ASCII-based chat window, for example mathematical and Greek symbols.

At all partner sites except the University of Hawaii, the PC and scanner will be situated in the library near the physical reference collection because of the observation that a critical mass of digital reference materials is not yet available to answer reference questions (Sloan, 1998a; Tenopir, 1998). The University of Hawaii, heavily engaged in distance education, will test this observation by providing chat reference service from two remote locations outside of the library with access to digital resources only. The University of Texas at Austin and Carnegie Mellon University have multiple science libraries, but will be given only one chat station (PC and scanner) which will be located in one of the science libraries. These institutions will endeavor to answer student questions using digital resources.<sup>7</sup> The results of these tests may indicate that a sufficient body of information in science, mathematics and engineering is available electronically to meet undergraduate needs.

Initially, only one librarian will be assigned to the chat reference service per four-hour shift. If the chat service becomes so popular that one librarian cannot handle the question load in a shift, another librarian will be assigned to that shift at an additional LivePerson cost of \$250 per month.<sup>8</sup> If additional costs are incurred, participating institutions will reallocate internal resources or seek external funds to cover the expense. The LivePerson software does not log information that enables tracking the number of users who receive a "busy" signal. However, periods when there are frequently four simultaneous users chatting with a librarian or when frequent email messages are received from the LivePerson mailer will suggest that users are getting a "busy" signal. Librarians working each shift will manually log the dates and times when four simultaneous chat sessions were underway and when email was received through the LivePerson mailer. Monitoring these manual logs will determine when an additional librarian is needed for a shift.

Two or three librarians from each partner institution will be trained in a two-day workshop to be held at the University of Texas. The chat reference service currently offered at the University of North Texas revealed that while end-users were familiar with chat software and needed little support, librarians had a steep learning curve because the technology was new to them (Antonelli and Tarlton, 1999). LivePerson staff will provide hands-on

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<sup>7</sup> The University of Texas at Austin will try to answer all user questions using their CD ROM-based science resources.

<sup>8</sup> The LivePerson fee is \$250 per month for each simultaneous operator librarian, so adding a second simultaneous librarian to one or all of the four-hour shifts would cost only an additional \$250.



basic training in how to use the software. Initial training through a Web-based teleconference is included in the one-time set up cost of \$1000. The training provided by LivePerson will be augmented with training provided by Carnegie Mellon librarians, who will license and use LivePerson before the project proposed here begins.<sup>9</sup> Carnegie Mellon training will focus on pre-formatted responses with appropriate graphics and additional instructions. For example, one pre-formatted instruction for students may be to enlarge the chat room window to increase the size of the text-input box because the size of the input box affects the length of student utterances (Gants, 1998). Carnegie Mellon librarians will teach partners how to create and submit pre-formatted responses, how to deliver scanned pages to users and, to facilitate extraction from the LivePerson transcripts, how to indicate the well-formulated question and answer during the real-time chat session.

From the user's perspective, the success of the chat reference service may depend more on the librarian's performance and the look and feel of the chat room than on the quality of the answer or resources that the librarian supplies. Therefore training provided by Carnegie Mellon will also include issues of performance and presence in the chat room, such as:

- conveying personality through the quality and rhythm of the librarians' responses (Warshauer, 1998)
- using correct spelling, punctuation, grammar and good writing to help create a computer-game atmosphere that will engage students (Bartle, 1990)
- using the social structure of the traditional reference interview to balance interaction and narration in the chat room (Murray, 1997)
- using text and graphics to reflect cultural values, create a sense of orientation and place, enhance user enjoyment and influence user perception of the quality and convenience of chat reference service (Roth, 1998; Richmond, 1996)

Research indicates that three-dimensional graphics have a powerful influence on Web users. ZAXOR Software, for example, discovered that online shoppers perceive quality, selection and security to be better in 3-D virtual worlds than 2-D worlds. Though users spend more time on 3-D Web sites than 2-D Web sites, they consider the experience a convenient, time saving, leisure activity in comparison to time spent in 2-D worlds (Richmond, 1996). These results suggest that the provision of high-quality, 3-D graphics in the chat room may influence user perception of the quality and convenience of chat reference service and increase user enjoyment, which could facilitate repeat use. Experiments conducted by Carnegie Mellon prior to the operation of the chat reference service proposed here will identify the size of graphics that can be submitted in LivePerson without significantly impeding performance.

### **5.3. Marketing**

Because undergraduate students typically make little use of reference service, marketing the chat service is a very important component of the project.<sup>10</sup> OCLC will develop a project logo and marketing campaign designed to transform student need into student demand for real-time, remote reference service. The campaign will include campus publications, posters, tri-fold pamphlets and perhaps a public service television announcement on radio or late night television. Animated, colorful access to the reference chat room will be displayed prominently at the top of library home pages and other relevant Web pages, including OCLC's FirstSearch pages. Related services or resources will be placed to the right or directly below animated access to the chat room.<sup>11</sup> In addition, librarians will

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<sup>9</sup> Carnegie Mellon will pay the LivePerson licensing fee for this preliminary work.

<sup>10</sup> Approximately 56% of the Carnegie Mellon undergraduate students who responded to a random sample survey in 1998 had never used or heard of reference service. The project therefore needs to involve students in the official naming of the service.

<sup>11</sup> These decisions are based on research conducted by ZAXOR Software to determine the impact of Web site development techniques on the purchasing behavior of online shoppers. Given the low student use of reference service, the project proposed here needs to "sell" itself to students. The ZAXOR research revealed that animated objects were purchased more frequently than inanimate objects. Objects located to the right or directly below animated objects were purchased more frequently than inanimate objects located elsewhere. Objects directly above

target classes on their campus that are likely to need reference service, match available reference resources and have receptive faculty to further promote the chat service.

## 5.4. The Research and Evaluation

Librarians from all partner institutions will conduct focus groups with undergraduate students early in the project to clarify user needs and expectations for reference service and chat rooms. The results of the focus groups will be used to name the chat service and help define the design of graphics and social interactions that will attract and engage students with librarians. The librarians will also work with faculty to identify two to three large introductory courses in science, mathematics and engineering at each institution and conduct pre-tests and post-tests with the students each semester to ascertain what resources students use, how they find them and how they use them. Comparing the test results from the three semesters that the chat service will operate during the project will indicate whether the chat service had a positive effect on student habits of information seeking and use. OCLC will design the focus group and pre-test/post-test questions in collaboration with project partners. Each participant's Institutional Review Board (IRB) will approve the human factors research before it is conducted.

In addition, LivePerson provides data and reporting tools that OCLC will use to assess the chat reference service. Detailed performance and activity reports with data catalogued by reference librarian and by time will be available online at the LivePerson Web site in real time. Chat transcripts and historical tracking reports will be issued by LivePerson to help monitor service patterns.<sup>12</sup> LivePerson provides a secure mechanism through which OCLC will retrieve the transcripts and reports for further analysis to determine the

- frequency of questions
- usage patterns (time, day, week, month)
- sources (Internet domains of students)
- access points (Web-pages from which students connected to the chat service)
- average duration of chat sessions per librarian
- average number of student and librarian responses per chat
- average length of time until students and librarians respond per chat
- librarian productivity (handling of simultaneous chat sessions)

OCLC will extract the librarians' well-formulated questions and answers from the chat transcripts and engage the help of a science librarian in developing a taxonomy of undergraduate questions in science, mathematics and engineering. The taxonomy and question and answer pairs will be used to create a Web-based "Ask-A" service that students can use independently of the chat room. The taxonomy may be used to code chat transcripts to determine the average duration of chat sessions per question type.

OCLC will also customize a LivePerson exit survey to capture user demographics, satisfaction ratings and other feedback that will facilitate user profiling and ultimately improve the reference chat service. The exit survey will pop up automatically when users click the "End call" button in the chat room. LivePerson statistics indicate a 20%

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animated objects were seldom purchased. The ZAXOR study concluded that the most effective online shopping Web site would be a multimedia chat room because a sophisticated chat room can provide service that "rivals the efficiency" of interaction with a live person (Richmond, 1996, p. 1479).

<sup>12</sup> LivePerson's historical tracking reports provide real-time access to previous chat sessions with the same person over the previous four months. Historical tracking is done based on a combination of user name (which need not be the person's real name), IP address and Web cookie. In the case of students using public computers in laboratories or libraries, the IP address and cookie will be the same for different users. At the time of writing this proposal, project personnel were working with LivePerson staff to determine what can or may take precedence when the same IP address and cookie are associated with different user names. If tracking can be done based on user name, the tendency for undergraduate students to provide unusual screen names in chat rooms (like "Stu the Monkey") may enable the historical tracking of student use of the chat reference service, identify repeat users and strengthen the bond between librarians and students.

response rate to their exit surveys. The proposed project will include the automatic exit survey periodically during the eighteen months that the chat service operates. When the survey is being offered, a pre-formatted response from the librarian will encourage students to complete the survey. LivePerson provides textual and graphical analyses of the survey results, including a way to filter results to see only specific responses.

Cyberspace may require new categories and dimensions of market segmentation different from the traditional segmentation by age, income, gender, profession and geography. For example, undergraduate student aficionados of MUDs (Multi-User Domains), MOOs (MUD Object Oriented), and MUSHs (Multi-User Shared Hallucinations) will probably need an online reference service with a different design and functionality from what is required to engage users unfamiliar with these technologies. Data gathered from chat transcripts and exit surveys will inform the development of online collaborative services needed to create an immersive and effective academic learning environment for generation X.

## **5.5. The Archive of Question-Answer Pairs**

OCLC will analyze the LivePerson transcripts and develop a way to extract question-answer pairs for inclusion in a database accessible to users. The OCLC developed software will extract candidate question answer pairs from the Liveperson transcript file. Those candidate pairs will be entered into a provisional database record. The provision record will be placed in a work queue for evaluation by professional library. After editing and acceptance by librarians the Q&A pair will be entered into the database. Project personnel will monitor the development of the Question Interchange Profile (QuIP) with an eye towards adopting it when it becomes a standard.

## **5.6. Sustainability**

The success of the chat reference service for science, mathematics and engineering will necessitate its continuation. Success will be determined by a combination of usage statistics, user satisfaction ratings, librarian satisfaction, and service costs. The cost of personnel to run the chat room is about \$25 an hour per librarian plus benefits. A 24/7 chat service would run 8,760 hours a year, with an estimated cost of \$270,684 (with benefits calculated at 23.6%) for one librarian working the chat room per shift. When a second science reference librarian is needed to meet demands in the chat room, staffing will need to be expanded and costs will increase accordingly. Additional costs for licensing host-based chat software, analyzing transcripts, extracting question-answer pairs and updating an "Ask-A" database service that users could use independently would add another \$50,000 per year.

Academic librarians who envision a digital future for libraries assume that they will pay to have digital resources and services available to students on their campuses. *ACRL Guidelines for Distance Learning Library Services* call for institutions to provide financial support for addressing the needs of remote library users (1998). One objective of this grant is to determine what economic model will best distribute these costs among those who benefit from the resource. The Keystone principles developed for the digital future of libraries suggest that this service be offered by a non-profit organization (<http://www.arl.org/training/keystone.html>).<sup>13</sup> Whether that might best be OCLC, a consortium of individual academic libraries, or some new entity, founded on the JSTOR model, will be explored as a part of the grant.

Some alternatives for sustainable funding include:

- Membership fees for libraries with students who use the chat reference service. Usage would be identified by IP address. Some libraries might work the chat room in lieu of payment. Many different models exist for determining such fees.
- Billing libraries for student use of the chat room based on their IP address. Librarians have traditionally been resistant to paying for information resources by the individual unit and to signing up for services where demand would be difficult to anticipate.
- Seeking corporate and foundation funding for the project in the form of direct advertising, sponsorship, or contributions.

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<sup>13</sup> The Association of College and Research Libraries (ACRL) ratified the principles at an ALA meeting.

- Developing electronic commerce methods to charge mini-payments directly to students. This alternative would not be consistent with the Keystone principles and might prove deleterious to learning.

Each of these alternatives has a number of pros and cons that need to be discussed in conjunction with experts from OCLC, JSTOR, Association of Research Libraries (ARL), Association of College and Research Libraries (ACRL), Oberlin Group, University Library Cohort, and the Council on Library and Information Resources (CLIR).

## 6. The Impact

**Teaching and learning support:** The proposed project will test whether chat software is an effective method for providing reference service and, if so, provide guidance for developing a comprehensive chat reference service in the future. The research entailed in the project will provide results that directly support teaching and learning. An important part of the undergraduate experience is learning how to locate information needed to complete an assignment quickly and efficiently. The burden of this proposal will be both to make the Web a better and more reliable place for students to seek information and to provide human assistance when it is needed. As the body of data on student questions and answers grows, opportunities will be sought to communicate with the appropriate discipline communities about the nature of the information that students seek.

**Underrepresented groups:** Students like the anonymity of the Web and its chat rooms. The only identifying information captured in this proposal will be student IP addresses. Students will be surveyed after the chat room has been running for a few months to discuss their experiences and their suggestions for improvement. Part of the survey will ask students to identify their gender and ethnicity. This information will be correlated with statistics about the gender and ethnic composition of science students nationwide to see if typically underrepresented groups (women, minorities) were finding their way into the chat room and succeeding there.

**Infrastructure for research and education:** The Keystone Group's digital library initiatives were conceived to improve the Web infrastructure for education and research. (See Section 7 below.) As these initiatives are implemented, the amount of scholarly material on the Web and the tools and services there to support undergraduate education will increase. Because convenience is so important to traditional age students, education must attempt to become more convenient. Distance education, which offers many opportunities to serve new constituents, will be greatly enhanced by the existence of a digital library that provides not only quality content, but also quality services and social interaction. The proposed project will test a collaborative, nation-wide service; identify resources needed to answer undergraduate student questions in science, mathematics and engineering; and provide Q&A pairs for a new digital resource that students can use directly.

**Broad dissemination:** Because this project has so many partners and because the Keystone initiatives will involve an even larger group of academic institutions, this knowledge will be disseminated broadly. The PIs will have access to the major librarian groups who have already been involved in discussions of the Keystone projects and principles. Attempts will be made to push information into the forum used by computer scientists working on digital library issues and, as described above, to communicate important results to the disciplines. Project personnel will disseminate the results of the project through publications and presentations in appropriate forums like the American Library Association (ALA), Coalition for Networked Information (CNI) and Digital Library Federation (DLF) meetings. Participating institutions will pay travel expenses for conferences and meetings.

**Societal benefits:** This project has been designed to benefit undergraduate students in science, mathematics and engineering. Education in general and science education in particular are cornerstones of a healthy society and economy. The Library of Congress's efforts with a reference chat room are designed for the more general public. Information will be exchanged between the projects. As the science chat project progresses, expansion may be both necessary and possible.

## 7. Relation to Long Term Goals of the Principal Investigators

The Principal Investigators on this project are part of a group of librarians who envision a new resource for library service in the Web environment. This work began at a conference sponsored by the Association of Research Libraries (ARL) and OCLC's Research Institute in Keystone, Colorado, September 1999. The "Keystone Group" of

librarians and other librarians have been meeting together at CNI and ALA to move forward the development of a more comprehensive library resource. The goals of the group are to establish a strong presence for libraries on the Web, develop tool sets for the Web environment, and reduce redundant work among libraries.

The Keystone Group is interested in more comprehensive chat services, in correlative work that would create discipline specific question-and-answer databases that students could use directly, and in higher quality Ask Jeeves-like services and automated reference assistants to guide undergraduates to appropriate resources. The envisioned strong library presence on the Web would assist students and faculty with locating appropriate refereed resources in all subject areas. The vision includes directories and pathways for researchers to connect with librarian experts, which are part of the Library of Congress's Collaborative Digital Reference Service. Other areas of interest are support for the scholarly community to create, publish, manage and archive journals that are born digital; the creation of a Scholars' Forum for digital refereed discipline materials; and the promotion and management of various kinds of discipline-related servers. More digital book content, more tools for physically disabled individuals, and attention focusing tools that enable scholars to define their areas of interest and be notified when relevant materials become available are likewise of interest. The goal of all these projects is for librarians to provide scholars and students with the right resources for current needs in real time at the desktop.

The Keystone Group and other librarians who met at ALA Midwinter and CNI selected the chat reference service project as the premier offering and implementation of their vision because of its importance and visibility. The research questions that will be answered by this project will inform the development of many of the other products for digital libraries. Most obviously, the need for comprehensive library directories will surface, the topic of expert reference databases will become clearer, and the requirement for expert reference links to answer the hardest questions will be illuminated.

## **8. Results From Previous Projects Funded by NSF**

OCLC has received no NSF funded grants in the last 5 years.

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