User Needs Assessment of Information Seeking Activities of MIT Students - Spring 2006

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Executive Summary

The SFX/Verde Group was authorized to complete a user needs assessment in the form of a Photo Diary Study with MIT students in the spring of 2006. The goal of the study was to inform the MIT Libraries of online tool improvements that should be implemented to meet our most pressing user needs. Sixteen graduate students and sixteen undergraduate students participated in offering a fascinating glimpse into the information-seeking aspects of their academic lives.

The team categorized user behaviors into goals and tasks and then analyzed the 277 goals and tasks and the 507 methods shared with us by the students in the study. The study yielded the following priorities for the Libraries' online tools:

- Make discovery easier and more effective
- Incorporate trusted networks in finding tools
- Continue to put links to the Libraries' services and resources where the users are

The study also showed that the students used a variety of highly successful strategies for performing quick lookups of information and finding specific known items. Finally, while the assessment focused on aspects of the students' work related to online tools, it also yielded rich information that could be useful in improving other aspects of the Libraries' services.

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MIT Libraries Photo Diary Study

The SFX/Verde Group met with DLG/TSAC and other library administrators in December 2005 to offer a vision for access to electronic resources[1]. At that meeting, the group was authorized to carry out a user needs assessment in the spring of 2006, with the goal of identifying specific services that should be implemented to meet our most pressing user needs. A subgroup was created to develop and to carry out this user needs assessment, focusing on how MIT students seek information related to their academic lives.

This report summarizes the results of the user needs study, and findings related to the online search and retrieval environment provided by the MIT Libraries for the MIT community. Complete documentation for the study can be found at: http://macfadden.mit.edu/webgroup/userneeds/index.html.

The Photo Diary Study was built using a methodology from the field of anthropology known as a "cultural probe" – a first for the MIT Libraries. The premise behind a cultural probe is that better results can be achieved by studying people in their own environment. Since it is not practical to observe participants at all times, a device (such as a camera, as we used here) is used by participants to help them record what they do, and then is later used to prompt memory of the events captured. This method is currently being applied in the field of information architecture, and is used to get a more complete picture of users and their culture.[2] As a qualitative approach, a cultural probe tends to generate creative thinking and insight related to a user group's behavior, rather than statistically significant data results. Nevertheless, results can be coded and analyzed to suggest trends and to move beyond impressions and anecdotes, bringing a larger pattern of behavior into sharper focus. In this case (especially as the more quantitative, formal, and extensive survey had just been done by the Libraries) we believed the cultural probe would help spark new ways to understand the information needs of our users, by allowing us to see more of the breadth of their information seeking behavior. [3] Seeing this complete context would, we anticipated, help highlight the service gaps that the MIT Libraries could fill.[4]

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[1] The SFX/Verde Group was formed in January 2005, and has been working on a series of recommendations about how the MIT Libraries should redesign access to electronic resources, as part of a move to a commercial electronic resource management system.

[2] See Understanding Your Users : A Practical Guide to User Requirements Methods, Tools, and Techniques by Catherine Courage and Kathy Baxter, Morgan Kaufmann, 2004, chapter 7: Interviews; and see Contextual Design : A Customer-Centered Approach to Systems Designs by Hugh Beyer and Karen Holtzblatt, Morgan Kaufmann, 1997, chapter 7: The Interpretation Session.

[3] The MIT Libraries carried out a detailed and largely quantitative, representative survey of all users on campus in the fall of 2005. The results of the survey contained rich data that also provide insight into the needs and requirements of the MIT community. The User Needs subgroup of the SFX/Verde team examined the survey results to extract relevant data to inform the evolution of our online tool environment (See Appendix A). Given this rich storehouse of information on our users, the User Needs Assessment was designed to complement both the approach and the information gathered in the Libraries Survey.

[4] For results from other studies conducted with similar goals in mind, see the Selected Bibliography in Appendix B.

We identified particular questions to answer with this study:

- What are our users' information-seeking goals?
- What are our users' information-seeking tasks?
- What are the various information-seeking methods used by students?
- Can these information-seeking methods be categorized?
- Do the goals, tasks, or methods identified vary by discipline?
- What is the larger context for how people seek information and how do the various information-seeking tasks interrelate?

Methodology

We asked students to use their own cameras (or take screen shots) and take notes of what they were doing every time to looked for information related to their academic life over the course of a week. They were then asked to bring the photos, screen shots, and notes to an interview with us and use those images and words to jog their memories about the details of what they did. [5]

For this study, we aimed to recruit 20 graduate students and 20 undergraduate students in proportion to the enrollment in the 5 schools (we were ultimately able to interview 16 in each category). The focus of the study was on students, as the largest user set of the MIT Libraries, and because the time-intensive nature of the study made faculty participation unlikely. We recruited from a pool of volunteers who had indicated their willingness to give feedback for future projects in the 2005 Library Survey.

Further information regarding the methodology, demographics, and limitations of the study are contained in Appendix C.

Findings about Overall Use of Information Resources and Technologies

> ***"Now the student's created software that scans list of contents, fetches the site, parses descriptions of articles from the descriptions given, and prints titles and it asks him, do you want full text or the abstract? The program queries him about 80-90 articles per week and combines the result into digest form." -- Interview notes, Physics graduate student***

We offered a set of standardized lead-off questions in the interviews to help establish the overall context for the students' specific information seeking habits. The key findings were:

- While there wasn't as large a distinction as between graduate and undergraduate students use of the physical libraries, graduate students used electronic resources more than the undergraduate students in the study:

[5] We secured permission from MIT's COUHES - Committee on the Use of Humans as Experimental Subjects.

# uses of physical libraries	total # of students	# of grads	# of undergrads
0-1 per month	3	1	2
2-3 per month	10	5	5
4-5 per month	5	2	3
6-10 per month	5	4	1
>10 per month	8	3	5

# uses of electronic resources	total # of students	# of grads	# of undergrads
1-10 per month	11	3	8
11-20 per month	9	6	3
>20 per month	10	6	4

- All of the students responded that they sought information of any kind one to ten times every day.

- There were not many early adopters of new information technologies within the group. While there were many programmers among the participants, it was clear that most were not interested in a pure hacker space but instead required finished products. Though the majority said they wouldn't be interested in hacking library data, many of the students said they knew someone who would be very interested in doing so. Adoption of new information technologies did not vary significantly between undergraduates and graduates.

Questions	# Yes	% Yes	# No	% No	NA	% NA
Do you do programming or scripting?	14	44%	18	56%	0	0%
Would you be interested in programming/scripting library data?	8	25%	20	63%	4	13%
Do you use RSS feeds?	6	19%	25	78%	1	3%
Do you use social bookmarking systems?	3	9%	27	84%	2	6%
Do you use browser extensions?	10	31%	19	59%	3	9%

Key implication: While a majority of the students in the study are not interested in hacking library data, a minority would be interested in such a capability.

Key implication: These students are constantly engaged in locating information throughout their day for personal and academic reasons. A significant minority of these information seeking tasks do involve library-provided resources and facilities.

Findings on Goals

> ***"The student is excited. She just passed her generals and now needs to do more work on the thesis proposal. Her advisor says she needs to do a better literature review and this is the overarching task for the week. Her advisor wants state-of-the-art modeling of low density fluids." – Interview notes, Aeronautics and Astronautics graduate student***

The most common goal of information seeking for the graduate students was to support their research and for the undergraduates was to support their course work. The graduate students performed 110 information-seeking tasks over the seven-day study with 64% of the tasks supporting research. The undergraduate students performed 148 tasks with 75% supporting course work.

Goal categories	**Graduate students**	
Research	70	64%
presentations and publications	15	14%
current awareness	10	9%
write programming code	4	4%
help lab function	3	3%
course-related preparation	2	2%
help friends and family	2	2%
get funding	1	1%
job search	1	1%
personal development	1	1%
networking	1	1%
Average tasks per student	6.9	

Goal categories	**Undergraduate students**	
course-related preparation	115	75%
research	11	7%
current awareness	10	7%
help friends and family	5	3%
participate in MIT clubs and social activities	5	3%
job search	3	2%
other	2	1%
prepare teaching assignment	2	1%
Average tasks per student	9.6	

There was variation in the number of different goals pursued by grads (eleven different goals) in comparison with undergrads (eight different goals). The undergraduate students did not seek information for personal development or networking (although they did seek information in support of social activities, which may not be dramatically different behavior). They were not seen seeking information to support writing programming code. The key findings were:

- For graduate students in the study, 87% of the time, the goal of information seeking was to support one of three core areas: research, presentation/publication, and current awareness.

- For undergraduate students in the study, 92% of the time, the goal of information seeking was to support one of three core areas, two of which were the same for grads (research, current awareness) and the third of which, by far the most significant, was coursework.

Key implication: The Libraries could meet the vast majority of user needs by focusing on services that support four core areas: research, publication/presentation, coursework, and current awareness.

Findings on Tasks

> ***"Another of the student's projects involved some research for her father. He asked her to find comparative information on high schools in Rhode Island and was especially interested in comparisons of the schools' standardized test scores. … She observed that not only did she help her father but she also found the data relevant to her study of issues in an Economics of Education class. The information helped her think more about educational policy issues." Interview notes – Sloan School undergraduate***

The study showed that the students engaged in a wide variety of information-related tasks in order to accomplish their goals. Below is a list of tasks that shows a breakdown of information-related tasks engaged in by graduate and undergraduate students.

Task category	Graduate students	Undergraduate students	Totals
known item	21	25	46
topical search	20	21	41
facts/quick lookups	7	28	35
partially known item	13	20	33
note taking and organizing information	13	3	16
complete class assignment	0	16	16
check web sites/RSS/scripts/email for current awareness	9	6	15
study for class	0	15	15
learn about software program	9	4	13
Do course readings	0	10	10
manipulate data sets	5	1	6
browsing	4	0	4
locate data sources and data sets	4	0	4
find paper topic	0	4	4
plan for information gathering	3	0	3
check job listings	1	2	3
locate contact information	0	3	3
interact with experts	2	0	2
share information with others	0	2	2
collect data	1	0	1
attend lectures	0	1	1
get news	0	1	1
other	0	1	1
Total	112	163	275

While many of the information-related tasks did not require information resources that the Libraries would provide (e.g. attend lectures, check job listings, locate contact information, etc.), the most frequent information-related tasks were those that would have been likely to involve library-provided resources and services. Those top tasks, which made up 56% of the total, are:

- Searching for known items
- Searching for information on an unfamiliar topic, with no prior information about what might be found (topical search)
- Searching for quick information or facts
- Searching for items with incomplete information (partially known items)

The study also assessed success rates, efficiency in accomplishing the task, and whether or not the student used a trusted resource (tool or person) in completing their tasks. Students determined whether or not they had successfully completed a task; efficiency was assessed by the interviewer. Efficiency was measured by answering the question: Given expert knowledge of information resources and services, in the librarian's opinion, did the student use efficient means for accomplishing the task? Use of a trusted resource was defined as use of a tool that was very familiar to the student even if the student didn't have great confidence in its applicability to the question at hand, or if the student contacted a person to ask for advice or information directly, such as an advisor or a fellow student.

For these three measures, broken down by student type, results are presented below:

	Graduate students Yes	**Undergraduate students Yes**
Did the student judge him or herself successful at completing his/her task?[6]	86%	93%
In the opinion of the interviewer, was the student efficient at accomplishing his/her task?[7]	77%	85%
Did the student use a trusted person or tool in accomplishing his/her task?	80%	69%

This difference in success rate is probably accounted for by the fact that undergrad information-related tasks were generally less complex than those of graduate students. The variation in complexity is often demonstrated by the amount of time undergrads and grads spent on their tasks.

For undergraduate students, whose tasks were overwhelmingly applied towards course-related goals, the requirements of the tasks were generally less complex than those required for graduate students and less time was devoted to them. The undergrads were successful and efficient in the vast majority of cases. Usually their tasks could be satisfied with information that was quickly located and digested and where many sources of "good-enough" information exist to meet their needs.

[6] There were several cases in the study where the student felt successful at a task but the interviewers may not have made the same judgment.

[7] An efficient rating did not take into account whether or not the interviewer felt the student found an excellent source of information. In many cases the student may have been successful and efficient at finding a less-than-optimal piece of information. This is one limitation of this measurement.

While data wasn't collected systematically regarding the amount of time spent on the information tasks, this information was shared anecdotally by the students. Several graduate students reported that they worked on some of their tasks over a period of several days, while undergraduate students typically responded that they spent minutes, or occasionally a few hours, on an information seeking task.

Overall, the graduate students were more likely than the undergraduate students to use a trusted resource in accomplishing their information-related tasks, though this is a relative comparison since both relied on trusted networks quite a bit. It is likely that the relative difference could also be attributed to the nature of the work in which they were both involved. For instance, the graduate students were largely involved in research activities in which a number of colleagues were also involved. It was likely that a network of people and resources was already established in their topical area that they could tap into. For the undergraduate students, most of their work was related to courses on topics to which they had little or no prior exposure, thus limited access to trusted resources on which to depend. Even so, many students mentioned that they automatically went to certain resources because they had used them before or because someone they trusted recommended them.

When these metrics are applied to specific task categories, the following results emerge:

	Graduate students			**Undergraduate students**		
Task Category	**successful**	**efficient**	**used trusted source**	**successful**	**efficient**	**used trusted source**
known item	86%	86%	76%	84%	84%	64%
topical search	80%	40%	90%	82%	64%	57%
partially known item	62%	69%	92%	95%	75%	80%
facts/quick lookups	100%	100%	86%	96%	86%	86%

For more complex tasks, like topical searching or searching for partially known items, the graduate students used trusted sources more frequently and were less successful overall. In general, the graduate students were involved in very complex information seeking activities. Their topical searches and searches for partially known items were more complex than the same tasks carried out by undergrads, and they required uncovering either a wider breadth of information sources to fill the need, or digging much more deeply into scholarly resources.

Sample graduate student complex searches	Sample undergraduate student complex searches
• Find IT trends in the financial industry • Understand drift in position sensors • Understand methods for processing rolled polypyrrole • Understand the physics of low-density plasmas for fluid propulsion • Find resources about ecological output/contribution of urban wilds programs • Delve into the history of coal as an energy source in the United States	• Find information on protocols for rat tissue smears • Find ideas for a car design project • Find books about collagen • Find some papers on race disparity in mental health treatment • Find information about gender representation in government • Find information on the history of FEMA • Find information about temperature sensitive biopolymers • Find 2 algorithms used in comparative genomics • Find a book on facial recognition

It appears from the data for the graduate students that the more complex and ill-defined the information task, the more the students relied on familiar resources and contacts to guide them to answers, yet the less successful they were in the end. In addition, in the interviews, several graduate students voiced discomfort and a lack of confidence about knowing where to start for finding information about unfamiliar topics. Sometimes, even if they discovered an appropriate resource to search, the poor usability of the interface impeded their ability to locate useful information even though what they sought did exist in the tool.

The types of information needed by the undergraduate students for topical searches in the study could often be characterized as requiring overview materials that provide a high-level view of a topic. Finding this type of information was seen to be difficult in current library-provided tools.

As can be seen from the low efficiency rating for the graduate students on topical searches, interviewers believed graduate students could have accomplished their tasks in less time. Many of the interviews yielded examples where, with better guidance, either hours or days of effort could have been saved. In one case a student spent a significant amount of time looking for information about IT trends in the financial industry in Google and news databases, when the data he sought was available in a specific business database. Another student spent hours searching individual library catalogs around the country for a specific resource that could have been quickly located in WorldCat. A third student spent a few days browsing journal displays in three libraries searching for review articles on a specific topic. In these and several other cases the students had used library resources to try to accomplish these tasks, but either because these tools were difficult to find or use, or offered inadequate discover mechanisms, they spent enormous amounts of time using brute force methods.

Graduate students revealed two significant information-seeking needs not reported by undergrads, which further reflect the complexity of their work:

1. There are significant consequences to not finding particular items of information. When working on dissertations, thoroughness in documenting work is especially important. If a student can't trace a work to its original researcher or document, the student may have to redo the fundamental work in order to include it in his or her own research.
2. The graduate students in the study spend a large amount of time managing the vast amount of information they have collected for research. We noted a difference in the level of this need by broad discipline: students from the Schools of Art and Architecture, Management, and Humanities and Social Sciences generally spend more time on this type of task than those from the Schools of Science and Engineering. Through the interviews it was found that there were a wide variety of reasons to organize a collection of information resources:
    - to enable sharing resources with others
    - to stay organized so they can find things again
    - to store and access information
    - to annotate
    - to manipulate and analyze data
    - to find relationships between documents
    - to manage citations for bibliographies
    - to track what they have read
    - to avoid information overload
    - to address the fear of missing something

Students also used a wide variety of tools for this task, including: Excel, Matlab, DevonThink, STATA, Vensim, Microsoft OneSource, Endnote, del.icio.us, RefWorks, BibTex, Spotlight.

Key implication: It appears that the more complex and ill-defined the information task, the more the graduate students in the study relied on familiar resources and contacts to guide them to answers, yet the final result was a lower rate of success. The data suggests that graduate students could benefit from having tools and information that would allow them to expand their network of trusted resources rapidly when confronted with difficult information seeking tasks.

Key implication: Undergraduate topical searches often required overview, or high-level, treatments of topics, which are difficult to locate with current library systems.

Findings on Methods

"In trying to locate a paper by a colleague, the student knew it should be on her work group's web site. It turns out that it was published in a journal and so wasn't there. She searched his name on the work group site but there were too many papers by him. She needed another way; and so went to Google Scholar. She was working from home; and so couldn't get into the journal website. The next day, she walked into her advisor's office (he's the coauthor). He gave her a copy." – Interview notes, Electrical Engineering and Computer Science graduate student

Interviewers recorded methods for each information-seeking goal and task. There was an enormous variety of methods used and the students used the various methods in many creative ways to make progress in their work. In recording the data about methods, the interview teams also noted which methods were used first to see if dominant approaches for various tasks emerged.

Of all of the methods captured, 32% of the methods required the use of a library-provided resource or service.

The following table shows the top methods used to satisfy an information need, broken down by student type (a full table of all methods appears in Appendix F). Also shown is the number of times that particular method was the first used to accomplish a task.

Method Category	Occurrences for graduate students	Occurrences for undergraduate students	Total occurrences	# of times this is the first method	% of times this is the first

					method [8]
search Google	33	45	78	50	64%
go directly to a known URL	23	37	60	38	63%
use Barton to browse or search	15	15	30	17	57%
search a citation database	15	11	26	8	31%
use course web sites	0	23	23	14	61%
review course/lab notes/handouts taken in class	0	17	17	9	53%
search Vera	10	6	16	11	69%
read textbook	0	13	13	3	23%
consult other students	3	10	13	7	58%
consult with guest lecturer/faculty	0	12	12	8	67%
search Google Scholar	6	6	12	5	42%
search other subject databases listed in Vera	6	4	10	5	50%
physically browse a collection	6	3	9	6	67%
refer to books in personal library	4	5	9	6	67%
retrieve a print resource from a library	3	6	9	4	44%
use wikipedia	2	7	9	4	44%

[complete table in Appendix F]

[8] "% of times this is the first method" is a measure of preference. It is calculated by determining the number of times this method occurred in the study, what percentage of time it was it the first method used.

The following table shows how many methods were associated with the tasks:

	total tasks	# of tasks with only 1 method	% of tasks with only 1 method	# of tasks with >1 method	% of tasks with >1 method	Average number of methods per task
Graduate Students	112	60	54%	52	46%	1.91
Undergraduate Students	164	106	65%	58	35%	1.78

The first methods used for tasks were also categorized:

First method category	% of methods in the category
Start on a web page outside of MIT	38%
Start with a resource provided by the MIT Libraries	23%
Start with a personally-owned or course-related resource	17%
Start with consultation with a person	9%
Other starting points	13%

Appendix G shows a complete listing of methods for the top four task categories: topical searching, known item searching, partially known item searching, and facts/quick lookups, with the most popular methods for each. The table below highlights the most frequent methods for the top tasks:

Most frequently used methods for the most frequent tasks

Task	Method	# of occurrences
Known item searching	Use Barton	16
Facts/quick lookups	Search Google	25
Partially known items	Search Google	18
Topical Search	Search a citation database	17

For facts/quick lookups and partially known items, searching Google was the most frequently used method. For known item searching, a search of the MIT Libraries' catalog, Barton, was the most frequently used method. For topical searches, searching citation databases narrowly edged out Google as the most frequently used method, though Google was the most frequent first method used. For topical searching, if the Google searches were examined further, the data showed that when Google was used as a first method, 58% of the time it was necessary to use at least one additional method in order to satisfy the needs of the task.

Key implication: Ease of use and speed of access often determined what tool the students would try first, whether or not they were confident of success. As a result, a significant minority of tasks required trying more than one method in order to find the necessary information. Enabling search of multiple sources of information could improve user efficiency.

Key implication: Also, ease of use and speed of access often leads students to try web tools outside of the Libraries. Several students commented they liked the linking from Google Scholar to full text articles through the Libraries (though also noting some unreliability). Further efforts in building links in tools outside of the Libraries environment will continue increase usage of library-provided resources.

Overall Observations

Ease of Use

> ***The student said "'The coding system is a nightmare.' (Call numbers) 'I know that I can write down the exact call #, date, author on a card, and bring it with me, then look for the area on the map, then go to that space in the library and look on the shelf. Often times it won't be there. I often have to ask for additional help. Staff go to somewhere completely different to get the book from the shelf." The student will know it's in PQZ, and not find it. She can look for 2 different books on medical ethics, one will be in the back of the Science Library, another will be in the basement at the opposite end. "It's really difficult to browse on the shelves." -- Interview notes, Neuroscience undergraduate***

Most of the students talked about looking for the easiest way to get information. Their definition of "easy" encompassed different ideas including accessibility from their location, immediacy of access, time required to locate information, and effort required to locate and process information, such as using Google to locate journal sites rather than Vera or Barton. Related to ease of use, many of the undergraduates expressed a preference for getting reading materials directly from their course web sites versus having to physically check out a book from reserves or physically copying an article from a print volume.

Fast access to any material was definitely a value for many participants in the study. Relevant anecdotes abounded in the interviews: students preferred links on a web site to "FAST stats" and were impatient that a faculty member hadn't scanned and posted all his/her publications back to the 1970's on their web site.

Complexity of interfaces was a deterrent to students seeking information in the library environment. When a student needs an overview treatment of a topic, the vast array of links and tools presents an insurmountable barrier when the alternative is to search Google or some other well-known, easy-to-use tool.

Key implication*:* Resources which are quick and easy to access from the students' locations are more likely to be used.

Format Preferences

> ***"… but if he doesn't have the book, he'll try to find it online to save a trip to the library. It is useful to find a little bit of info that he needs quickly without having to go get a book. For more complex things or if he hasn't seen the information before, he prefers getting the book. … He prefers books to articles because a book is more complete and in depth. With articles, portions aren't included, and he has to track down references." -- Interview notes, Aeronautics and Astronautics graduate student***

While the interviews confirmed the expected preference for electronic resources over print, perceived ease was a more important factor than format in determining methods used. The students chose to seek print resources when they felt is was the easiest method. Several of the students looked up facts using books in their rooms rather than search online. Also, many of the participants used print materials recommended by a faculty member or TA. There was a vocal but small minority that was passionate about using print.

Key implication: Quick and effective services for print material could make it as valued as digital content.

Browsing Collections

"In looking for a piece of information on a general topic, with no author/title/subject in mind, he wanted to thumb through a book -- any of a number of books would do -- that would have a couple of standard equations he needed. He knew such books existed, but it was not 'something a whole book would be about.' He knows where in the physics section in the Science Library (SL) to find the correlated electron systems materials. He stood there for a bit, thumbed through some and found one that worked.

Next, he went to the reshelving truck by the elevator in basement. He found multidisciplinary, newer books. He figures that many are new and all have been consulted." – Interview notes, Physics graduate student

Though fast access was valued, browsing collections was another valued means mentioned by the students in the discovering of research materials. Participants physically browsed library collections nine times during the study week, and this method was mentioned as important by several study participants. Browsing online titles in places such as Amazon and ejournal databases for chance discovery was also mentioned many times.

Key implication: Serendipity in discovery needs to be built into online systems as well as preserved with physical items on shelves.

Awareness of Library Services and Collections

"He knows from the workshop and from [the librarian] that the Libraries have a lot of good resources but he doesn't know how to pick the one he needs. Workshops are good, he says, but he forgets what he learned two months later." – Interview notes, Sloan School graduate student

It was very clear from this user needs assessment that the students were frequently unaware of the MIT Libraries' resources. The Libraries survey data confirms this fact as well. The undergraduates had very little knowledge of library materials and services and even graduate students had limited knowledge. Of all the tasks performed by both groups of students only 32% of the methods used Libraries' resources. There were examples of instances where this lack of awareness negatively affected the students. As discussed

above, one student spent several hours searching individual university library catalogs rather than WorldCat and another student wasted hours searching for specialized market research in Google as well as a news database provided by the Libraries. These students were not aware of more appropriate resources in the Libraries so relied on trusted resources from the past.

Key implication*:* Enabling obvious, easy access to discovery and searching of tools could positively impact user efficiency.

Information Sources

"Student really likes and finds very helpful, Amazon's reviews, the graphics, and the ability to look inside and view contents. She also likes to use the links to similar and related titles as a discovery tool. Once she has identified some interesting citations in Amazon, she looks them up in Barton to see if she can get them from the library. … She likes Amazon "as a search feature," and uses it as an entrée to library holdings." -- Interview notes, Aeronautics and Astronautics undergraduate

"He returned to Pubmed to learn about the toxicity of the chemical. He learned about Pubmed through a friend of his roommate, who had made a comment like 'is your paper on pubmed yet?' He was driven to use Pubmed since it has a lot of medical information. Google Scholar was more effective for him to get the full text of articles. He can add the word 'medical' to his Google Scholar search and get the same results. … He doesn't use very many other databases." – Interview notes, Mechanical Engineering undergraduate

As expected, the students relied on web-based tools such as Google, Google Scholar, Google Print, Amazon, and Wikipedia for many of their information needs and 39% of all tasks in the study involved the use of one or more of these web-based tools. On the other hand, the students also relied on a valued network of colleagues that included peers, upperclassmen, graduate students, lab cohorts, and faculty. About 18% of all tasks included a consultation with someone in the student's personal network.

In the use of library-provided information, a huge variety of specific resources were mentioned. In many cases, when asked, the students could recall how they learned about specific ones. Many learned about the resources through personal recommendations from faculty or other students. A minority found resources through using a variety of discovery methods, including browsing Vera or physical collections.

There were many cases where the students used trusted tools in order to evaluate particular items they sought. For instance, for a particular book, students would look at Google Print or Amazon in order to view the table of contents and the first chapter to figure out if the content of the book would ultimately be useful to them. Also, they used tools like Google Scholar to see who had cited the book, both as a discovery mechanism for additional related works, and also to evaluate the credibility of the material.

Key implications*:* Students preference for and reliance on trusted personal networks could be leveraged to expand their resource toolkits.

Seeking Information Help

"She uses Google often. She volunteered that she does not use reference librarians at all, and she is not sure why. She has 'never really felt the need to use reference librarians.'

[later…] Talking to people worked really well. She notes that it is 'much easier to go to people who have direct knowledge, like the Starbuck's manager'…than to struggle with search strategies and databases." – Interview notes, Sloan school undergraduate

Asking for help from library staff was not common among any of the groups of students interviewed. Generally the students depended on a large network of friends, other students, colleagues, and faculty. Some students tried to find answers themselves before asking for help while others asked for help sooner. No particular trends were observed regarding when they asked for help. Graduate students were more likely than undergraduates to consult members of the faculty (typically their advisors) for help. One contributing factor to this trend is that the undergraduates were "satisficed" (that is they were satisfied with what would suffice, rather than what was best, a documented trend named by Peter Morville in "Ambient Finability") with information retrieved unlike the graduate students. Several students mentioned that it never occurred to them to ask for help from librarians, while several others believed that they would be bothering the staff or would be perceived as not knowing what they were doing, if they asked for help. Graduate students were willing to use online documentation, online books, and discussion boards, especially for help with software and equipment. They often used Google to find these things.

Key implication*:* Barriers to self-help may be lower for online tools than for in-person tools. Indirect access to staff, such as access via Google search result, could spur more use of staff.

Key Conclusions for Service

The User Needs Assessment team felt extremely privileged to have this rare glimpse into the academic lives of the MIT student community. The goal of the study was to understand types of information seeking tasks engaged in by MIT students and thus understand how to prioritize potential improvement efforts in our online tools and environment. The data that was collected points to a variety of actions and priorities to improve the information seeking environment for the MIT community. Please note that these priorities are related to online tools available through the web, and this section does not address the many other potential service and resource improvements that are suggested by this data. For this reason, one recommendation from the User Needs subgroup is that the data from the study be shared with other MIT Libraries' groups to see if other service and resource recommendations beyond web-based tools become apparent.

Make Discovery and Search Easier and More Effective

> ***"After she looked at individual journals, she started going through databases in Vera. This is where she feels her work 'started to break down.' If trying to be thorough, she uses a keyword and searches with this through all of them. She goes down the list in the subject grouping of databases for Urban Planning. She believes that this is 'not the best way.' She says she doesn't know how all the databases are different but they all turn up different articles on her keyword searches. She uses the descriptions in Vera to do some weeding from the list, and says that these descriptions are very important. She also worked her way down the list of databases in the Architecture subject grouping." -- Interview notes, Urban Studies and Planning graduate student***

While the students engaged in known-item searching and topical searching in roughly equal proportions, topical searching was considered more difficult and time-consuming than known-item searching. The graduate students typically sought significant detail on a topic whereas the undergraduates looked for general overviews. When confronted by the vast array of tools available to them, the students often exhibited uncertainty about what to do next and often reverted to tools with which they were familiar versus digging deeper to understand how new tools could be more effective. The students very effectively and instinctively used a variety of discovery tools not available to them through library interfaces, such as faceted browsing of categories, "customers who bought this also bought" links, "browse similar titles" links, etc. The topical information needs were different for undergraduate and graduate students. Improving topical searching could be facilitated in a variety of ways:

1. Reduce the number of starting points for discovery. Allow users to search many tools at once.
2. Provide more guidance in the selection of tools to use for discovery.
3. Provide user-friendly access to metadata in results sets for further search strategy refinement and discovery.

Incorporate Trusted Networks in Finding Tools

> ***"Another way she does research is to click on links friends send. She uses colleagues a lot. She's meeting tonight with a new group of people she networked with who are ethanol experts." -- Interview notes, ESD graduate student***

A surprising finding of the study was the extent to which the students relied on the opinions of others when choosing tools and information to use. Whether they asked advice from of others, or used online facsimiles of others' opinions in the form of citation searching or recommended books in Amazon, the students actively sought this type of information in order to help them efficiently evaluate which materials to spend time to acquire. Initially the team knew that students relied on well-known tools, but the pervasiveness of this preference moved this issue up in priority and was brought to the forefront of our thinking in a way that it hadn't been before. Incorporation of trusted network data into library tools could happen in several ways:

1. Add links within library tools that facilitate linking to sources of trusted network data, such as Amazon, book review sites, Google Print, citation databases, etc.
2. Incorporate social networking and reviewing capabilities into our tools for input from users.
3. Expose our own circulation and use data to help people understand what is heavily used.
4. Incorporate relevancy rankings into results lists in our tools.

Continue to Put Links to the Libraries Where the Users Are

> ***"She did a quick web search on Google to look for a synopsis of this work. She notes that she also found an interesting bibliography that links her to 'way too many other books.' … She mentions Amazon as another possible source for finding synopses. While reading, she often goes to Google to look up books, programs, citation patterns, etc. that are mentioned in the reading. Based on the synopses, she decided to get this particular book." -- Interview notes, Urban Studies and Planning graduate student***

While only 23% of all tasks were begun using Library resources, the students ended up consulting a resource from the Libraries in about 36% of the tasks. Since the students often started their information seeking outside of the Libraries' web space, it would make sense to continue to find ways to put links, tools and MIT Libraries metadata in widely popular web sites, search engines, and databases that lead our community back to resources available to them in the Libraries, as has been done with Google Scholar. There are a variety of ways to continue this work:

1. Continue to partner with outside web sites, as we have already with Google Scholar and Windows Live Academic, to provide deep linking to our resources.
2. Take advantage of browser extensions and toolbars that enable integration of our links on sites often used by our students, (such as those that make direct links from a title on Amazon to a title in our catalog). Extensions like these make it possible to incorporate and integrate our services and links without needing the cooperation of the outside web site. These are becoming more and more popular as users in the outside world are finding useful ways to link libraries and bookstores, as well as other creative combinations.
3. Tools like browser extensions and toolbars are part of a larger culture of "hacks" and "betas" that have become popular in recent months. We should invite our own students to contribute to the project of modifying and improving some of these hacks and submitting them for possible use by others. It would be simple to create a web page on our site for listing some of these tools and inviting our students to hack and improve them. As we saw in the study a small number of students were interested in hacking library data themselves, but almost everyone knew a fellow student who would be interested. it would only take a few students like this to create interesting, productive tools that could benefit many others.

Implications for Other MIT Libraries Services

The Photo Diary Study offers direct evidence of actions the Libraries need to take to support the information-seeking experiences of the MIT students. Most notably:

1. *Raise Awareness:* The Photo Diary Study echoed the results from the Libraries Survey in that it showed that students are often unaware of the vast amount of relevant information available to them in the Libraries.
2. *Reduce Barriers to Services:* Because ease and speed of access are core values of the MIT community, a review of services to identify barriers would be useful.
3. *Focus on Customer Service*: MIT's culture is to discover things on your own and not to ask for help. It's critical that every interaction with the Libraries be positive in order to overcome this barrier as well as to become part of the trusted network.
4. *Close the Skills Gap*: The information-seeking skills of the undergraduates would not be sufficient if they chose to pursue a graduate degree based on needs of the graduate students in this study. Effort should be directed to assisting current graduate students and preparing undergraduates for the future.
5. *Assist Personal Information Management*: The number of tasks and the amount of time the graduate students devoted to information management was significant. Promoting tools and their use to students should help them increase their productivity and provides an opportunity for the libraries to partner with the students in additional ways.

Future Steps in User Needs Assessment Efforts

Since user centered design is a priority for the MIT Libraries, the cycles of user testing will continue. As we move forward with possible new technologies for cross-searching, faceted browsing, integration of our "silos," and putting our services where users are, we will need further input and testing with our users.

In mid-June, the Web Advisory Group will disband and a new group will take its place: the User Interface Group. The charge for this group has been approved by Steering Committee (see Charge in Appendix H). This group will lead the next round of user assessment efforts. Some examples of methods likely to be used are:

1. *Focus Groups and Interviews:* Test concepts for new approaches and get feedback.
2. *Group Task Analysis:* Identify steps and sequence of steps users do to complete a particular task (such as topical searching or metasearch). Find out what steps do and don't work for the users. Identify which user groups to target and include about 6 users around a table for 1-2 hours.
3. *Traditional Usability Testing:* Test design prototypes when building new systems. Involves observing volunteers use a new interface while thinking out loud.

The choice of methods will depend on decisions about resources, priorities and goals. We will select user needs assessment methods appropriate to where we are in the cycle of planning and development.

There is an enthusiastic group of graduate students from the Graduate Student Council that is very interested in becoming involved in recruiting students for these activities. We also have lists of volunteers from the Library Survey, since a large number of people who took the survey volunteered to help us further.

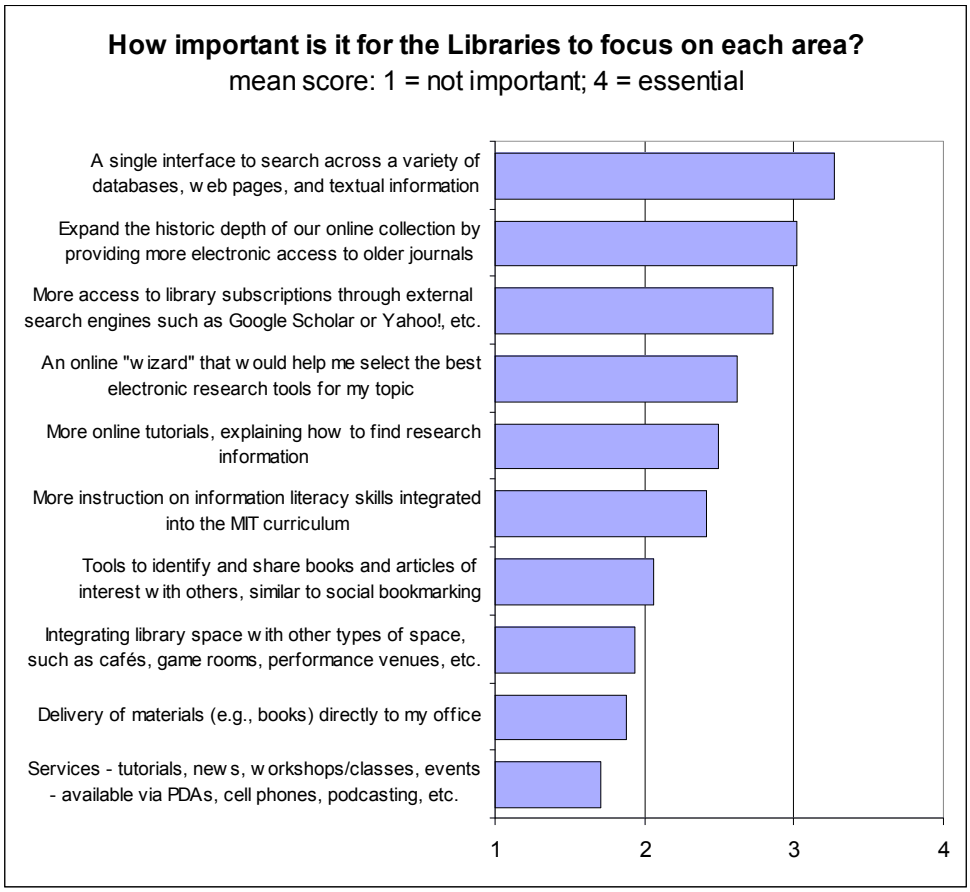
Appendix A: MIT Libraries' 2005 Survey

During the Fall of 2005, the MIT Libraries surveyed all students, faculty and researchers in the MIT community, soliciting feedback about all aspects of Libraries' operations. Results from the parts of the survey that pertained directly to the issue of online tools used in information discovery and location are summarized here.

Innovations, Expansions, Improvements:
Survey participants were asked about potential innovations, expansions or improvements, and to indicate how important it is for the Libraries to focus on each of these. The results are presented in the chart below, showing that of the top four responses, three represent innovations that would simplify a user's experience in locating information through various information tools:

- a single interface to search across a variety of resources;
- more access to library subscriptions through external tools; and
- an online "wizard" to guide users to help them select the best resources for their topic.

These same preferences were identified in the Photo/Diary study.



Preferred resources
Participants were asked which resources they use first for specific types of materials. [Questions 11-13] The results are summarized below.

Question	Response	Number of responses	% of responses
11. When you are looking for an article, what is the FIRST place you would turn to find the full article?	Vera	1933	34%
12. When you are looking for a book, what is the FIRST place you would turn to find the book?	Barton	4004	70%
13. When you are looking for basic facts and figures, what is the FIRST place you would turn to find it?	Google	4328	76%

The results of the question about basic facts, Question 13, correspond directly to the data collected in the Photo Diary study concerning the first method used for facts/quick lookups, with Google the top choice again. (The Photo Diary study did not capture data that directly compares with questions on first resources for articles and books, questions 11 and 12.)

We categorized user comments in response to questions about what the Libraries' top two or three priorities should be for the next three years (question 15) and what participants would like us to know or think about that we have not already asked regarding comments about online tools (question 17). (In some cases, more than one category was assigned.) Of the approximately 5,600 comments received from the community, 3322 concerned the online tool environment. 5,268 categories were assigned as follows:

simplify search	2658
usability	876
web site improvements	382
personalization	381
Barton	285
Vera	245
courseware	197
off campus access	104
access	61
current awareness	48
SFX	31

The category of simplify search, receiving about 50% of category assignments, includes the concepts of searching across multiple resources and having a single search box to search all Libraries resources.

Appendix B: Selected Bibliograpy: Research Studies on User Needs and Information Seeking Activities

There are thousands of studies of user needs and information seeking. Most focus on sources and information systems. Relatively few are concerned with users' needs and problems. Qualitative studies such as ours, which investigate information seeking by eliciting and analyzing users' own experiences and perceptions, are rare. Barbara Valentine's 1993 study perhaps comes closest to ours in spirit and methodology. Some of the studies noted here, both qualitative and quantitative, were included because they generate data and findings on users' needs and problems as a by-product of some other research question. For example, many librarians are deeply disquieted about the effect of the internet on student research skills and practices. In describing student behaviors and preferences in the hybrid information environment, they have in the process generated useful data on student's needs and problems. Finally a fairly comprehensive literature review on user's problems with search interfaces has also been included because it complements some of the findings of the other studies in this bibliography.

Bates, M.J. 2003. Task Force Recommendation 2.3 Research and Design Review: Improving User Access to Library Catalog and Portal Information, Final Report (Version 3). ***Library of Congress Bicentennial Conference on Bibliographic Control for the New Millennium***. Available at: http://www.loc.gov/catdir/bibcontrol/2.3BatesReport6-03.doc.pdf (5/31/06)

Purpose: Review of literature on users' problems with library catalogs and other search interfaces in order to support recommendations and further research on how to improve catalogs.
Study group: Various.
Methods: Literature review of studies with various methods and units of analysis.
Findings:

- Many findings re: catalog use and searching behavior, but primarily:
  - Users work from the principle of least effort and will not seek potentially relevant information that is hard to get or use.
  - People model information seeking behavior on that of influential figures in their lives; academic researchers tend to follow models of their advisors.
  - People take what they've learned from earlier experiences to new environments (high school libraries emphasize browsing; university libraries present more challenges).
  - As they move up the academic ladder, researchers do less topical and more known item searching. This may be a function of subject expertise.
  - Undergraduates are more likely to do topical searching.
  - OPACs and other interfaces are very hard to use; searchers often try a few keywords and then abandon the search if they get no results.

Holliday, W., & Qin, L. 2004. Understanding the millennials: updating our knowledge about students. ***Reference Services Review***, 32(4): 356-366.

Purpose: To know whether Kulhthau's Information Search Model still holds up for students born after 1982 and with extensive experience with the web and technology. The researchers were especially interested in changes in emotional content related to the research process.
Study group: Undergraduate students at Utah State Libraries. N=35
Methods: Qualitative. Data derived from students' written statements, journals, interviews, and focus groups.
Findings:

- Students do not seem to go past Kulthau's step three, Prefocus Exploration, to step four, Focus Formulation.
- This appears to limit information seeking activities to initial exploration, and students don't move to more sophisticated and targeted searches for relevant information to support their focus.
- Authors suggest the failure to focus may be due to decrease in note taking because full text is easily downloaded.
- Students experienced high levels of frustration, which is not one of predictable emotions Kulhthau poses.

- Students were frustrated by research because they couldn't find things or kept getting things that were "too specific" when they needed more general overviews.
- Students would not seek help from librarians despite failures to find appropriate sources.

Lippincott, S., & Kyrillidou, M. 2004. How ARL university communities access information: highlights from LibQUAL+. ***ARL Bimonthly Report 236***. Available at: http://www.arl.org/newsltr/236/lqaccess.html.

Purpose: To understand the priorities, preferences, and concerns of library users in order to continuously improve services. (2003 and 2004 iterations of LibQUAL+)
Study group: Undergraduates, graduates, and faculty. 2003 N=26,260; 2004 N=25,178.
Methods: Quantitative. Survey analysis.
Findings:

- 90% of patrons use search engines on a daily or weekly basis.
- Library as place was more important to undergraduates (19% use daily).
- Only 11% of undergraduates say they use the library website on a daily basis and 5.5% said they never use it.
- Undergraduates gave their lowest rating to their perception of how well the library keeps them informed of useful services.
- Undergraduates also rated perceptions of ease of use of electronic resources as below their minimum level of acceptable service.
- Both students and faculty are dissatisfied with how well the library helps them "distinguish between trustworthy and untrustworthy information."

Lombardo, S., & Condic, K. S. 2001. Convenience or content: a study of undergraduate periodical use. ***Reference Services Review***, 29(4): 327-338.

Purpose: To determine how well students mastered the retrieval process for print and full text articles, and to gather their opinions on the value of both formats. The researchers were concerned that students were favoring full text to the exclusion of potentially relevant print articles.
Study group: Undergraduate students (1st and 2nd year) at Oakland University, Michigan. N=111.
Methods: Quantitative. Pre-test and post-test of students' familiarity with library resources was given before and after bibliographic instruction. A final version of the test, including questions about student reactions to the article retrieval process. was administered again at completion of the research project at the end of the semester.
Findings:

- Student performance decreased on the final test suggesting that retention from bibliographic instruction is very limited.
- Students rarely mastered database search skills.
- All students, even those who tried to find print articles, preferred the full text sources.
- Students value relevance in articles but those who actually attempted to get print articles were stymied by multiple steps and obstacles inherent in the library set up of print journals.
- Authors conclude: "it is crucial to remember, before we label them as 'lazy', the difficulties students face in identifying and locating print resources." They call for more bibliographic instruction.

OCLC. 2002. OCLC White Paper on the Information Habits of College Students: How academic librarians can influence students' web-based information choices. Available at: http://www.oclc.org/research. (6/01/06)

Purpose: "To describe the end-user market segment populated by college and university students and to present their views of successful information delivery." Focus was on use of campus library websites.
Study group: US college students aged 18-24. N=1050.
Methods: Quantitative. Survey questionnaire conducted by Harris Interactive via Internet.
Findings:

- 7 in 10 students use library's website for some assignments and 1 in 5 for most assignments.
- The most frequent uses were of full text journals (67%), library catalog (57%), and databases and indexes (51%).
- Students say they value face-to-face help, and few used Ask a Librarian online services.
- 67% of students were satisfied with librarian-provided help but only 21% have asked a librarian for help, with most preferring to ask professors.

- Perceived barriers included:
  - Difficulty in searching and navigating within physical library and its website
  - Costs of photocopying and printing
  - Shortage of knowledgeable librarians
  - Inability to easily access other libraries resources
  - Difficulty in finding complete articles, critical analyses, bibliographies, locations of books and journals, and descriptive summaries

Seiden,P., Szymborski, K., & Norelli, B. 1997. Undergraduate students in the digital library: information seeking behavior in an heterogeneous environment. ***ACRL 8th National Conference***, April, Nashville, TN. Available at: http://www.ala.org/ala/acrbucket/nashville1997pap/seidenszymborski.htm. (5/31/06)

Purpose: To learn how users would integrate digital and full text into their repertoire of resources and information seeking strategies and how digital resources would impact behavior.
Study group: Undergraduates at Skidmore College. N=42
Methods: Qualitative. Individual and group interviews conducted by librarians.
Findings:

- Students preferred to limit information seeking to digital and full text resources because of time pressures and convenience.
- Students had difficulties navigating various interfaces and "their poor understanding of the information environment was magnified by the digital library."
- Students had difficulty in picking appropriate databases, selecting search terms and devising effective search strategies.
- Students did seek help from librarians, thus creating opportunities for education "about not only the system, but information seeking strategies in general."
- The authors concluded that librarians must intensity their efforts to educate students "about the information environment rather than simply providing a knowledge of how to use specific tools."

Thompson, C. 2003. Information illiterate or lazy: how college students use the web for research. ***Portal***, 3(2): 259-268.

Purpose: Reviews three studies of student internet usage in order to explore whether students' "research shortcomings" are enabled by the internet and to assess the potential impact of expanded information literacy programming.
Study group: Meta-analysis of three studies of undergraduates. (Studies no longer at URLs or traceable in Lib Lit.)
Methods: Various.
Findings:

- Students preferred to start research with search engines.
- Students did not consult library staff about internet research nor did they seek assistance from library web sites.
- Students preferred to seek help from peers or from faculty.
- Students rated their own search skills favorably and felt they were successful at finding the information they need.

Valentine, B. 1993. Undergraduate research behavior: using focus groups to generate theory. ***The Journal of Academic Librarianship***, 19: 300-304.

Purpose: To better understand the undergraduate research process as undergraduates themselves perceive and experience it. The authors note a "paucity of user-oriented research."
Study group: Undergraduate library assistants at Linfield College, Oregon. N=16
Methods: Qualitative - Focus groups and individual interviews conducted by a librarian.
Findings:

- Students "tended to look for the easiest, least painful way to complete a research project."
- Students liked to start with something familiar (going to stacks, starting with a known encyclopedia, browsing known periodicals).
- Classmates and friends constitute an important source of information and help.
- Many students "preferred guidance from those who controlled their academic success" (ie. faculty).

- Students often "misunderstood the librarian's role…and felt that consulting a librarian generated an unacceptable risk of embarrassment or communication failure."

Van Scoyoc, A. M., & Cason, C. 2006. The electronic academic library: undergraduate research behavior in a library without books. ***Portal***, 6(1): 47-58.

Purpose: Examined undergraduates' research habits in the campus electronic library (an information commons), to discover what sources students used and to determine if academic class status (years in school) affected sources used.
Study Group: Undergraduates at University of Georgia. N=884, visits not persons
Methods: Quantitative. Brief questionnaires made available in multiple locations.
Findings:

- Students used search engines and web portals @ 76% of the time.
- WebCT and class websites were used almost as frequently at @ 71% of the time.
- Library OPAC and licensed databases were used @ 36% of the time.
- Fourth year students were no more likely to choose library databases or the OPAC than first years, apparently mitigating the effects of instruction and disciplinary focus of having a major.
- Faculty may be creating "personal, moveable, online libraries" and/or "hidden libraries," which affect student research skill development and resource usage.

Whitmire, E. 2003. Epistemological beliefs and the information-seeking behavior of undergraduates. ***Library & Information Science Research***, 25(2): 127-142.

Purpose: To explore relationship between students' epistemological beliefs and their information seeking behavior, using Kuhlthau's Information Search Process model.
Study group: Undergraduates (seniors) at Yale University. N=20
Methods: Qualitative. Eleven-question interview conducted by librarian (in 1999). (Note: no tests of statistical significance were done; no instruments other than interview were used).
Findings:

- Epistemological beliefs appear to correlate with information seeking activities.
- Students had problems with topical searches.
- Electronic resources were experienced as frustrating.
- Most common information activities were citation chaining, browsing stacks, browsing journal runs.
- Help and advice were most commonly sought from faculty, graduate students, and peers.
- Only a few students asked librarians for help (and these were among those who were rated at the highest level of epistemological development).

Whitmire, E. 2002. Disciplinary differences and undergraduates' information-seeking behavior. ***Journal of the American Society for Information Science and Technology***, 53(8): 631-638.

Purpose: To test the use of Biglan's model of disciplinary differences as a framework for assessing undergraduate information seeking behaviors. Biglan frames disciplines in three dimensions: hard/soft, pure/applied, life/nonlife.
Study group: Undergraduates from national sample.
Methods: Quantitative. Based on dataset generated by 1996 College Student Experiences Questionnaire. N=5175
Findings:

- Frequency of information seeking overall was low.
- Student majors in soft, pure, life disciplines (eg., sociology, literature) were more likely to engage in information seeking.
- Student majors in hard, applied, nonlife disciplines (engineering) were least likely to seek information or use library.
- Author concluded: "Certain types of academic library services may favor one group to the detriment of others."

Appendix C: Methodology, Demographics and Limitations of the MIT Libraries Photo Diary Study

Methodology

We provided participants with instructions, asking them to document their information seeking tasks for the period of one week by taking photos or screen shots and notes on what they did (See Appendix D for a sample portion of a photo diary). They were asked to bring those photos and notes to a 1.5 hour interview session with us. Each student received a $50 Amazon gift certificate in exchange for their time.

The interviews consisted of a list of questions (See Appendix E), including a few warm-up questions and a few closing questions, with most of the time spent on having each student tell us the story of their week, showing photos, screen shots and any notes prepared for the student's diary. The interviewing teams for this project consisted of 8 librarians, in 4 teams of 2 people. At every interview, one librarian asked questions while the other took notes. Both librarians reviewed the notes after the interview was completed.

We analyzed the notes in several different ways:

- Demographic data was identified and coded.
- Patterns, trend, and issues were noted and summarized.
- Lists of information seeking goals, tasks and methods were created.
- The lists were collated, standardized and analyzed in a database.
- Qualitative information seeking patterns were extracted from the data.

Demographics

The aim was for each of 4 teams to interview 5 graduate students and 5 undergraduate students, for a total of 40 students. As expected a few students dropped out, so we interviewed 16 undergraduates and 16 graduate students. While we were unable to get the attempted representative distribution, we did recruit students from each of the schools to participate in the study.

School	# of Graduate Students	# of Undergraduate Students
Art and Architecture	1	0
Engineering	7	7
Science	3	3
SHASS	3	2
Sloan	2	1
Undecided	NA	3
Total	16	16

Limitations of the study

While the study has yielded many interesting insights into the information seeking behaviors and preferences of MIT students, there are several limitations to the study that may have impacted these results. It is not possible to quantify the effects of some of these limitations, though it is possible to consider potential impacts.

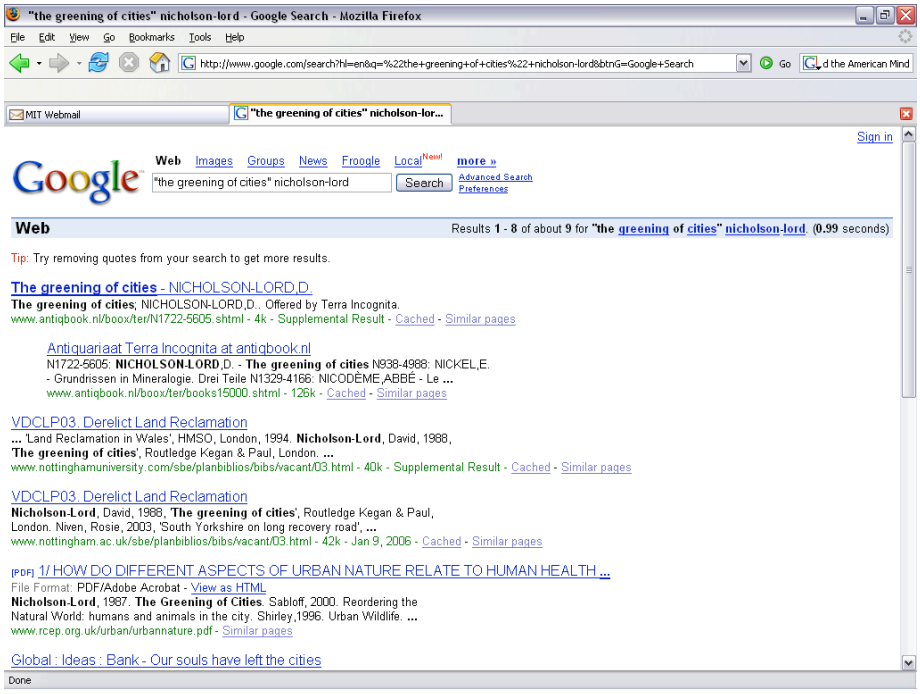
- It must be emphasized that the Photo Diary study is a qualitative study and while the quantitative results accurately reflect the outcome for a particular set of students, because of the sample size it is unlikely the numerical results are an accurate predictor of the general student population.
- Because the participants in the study were solicited from a list of self-identified students interested in providing further feedback to the Libraries, it is possible that the students who participated are those who have a higher-than-Average interest in the Libraries. This effect could manifest itself in many ways. For instance, this interest might have influenced what or how many tasks and information events the students chose to record and share with the interviewers.
- The incentive given to the students was a $50 gift certificate to Amazon. This incentive may have yielded participants who are particularly fond of Amazon. One could imagine that such an interest could produce tasks and methods that might have mentioned Amazon at a higher rate than is experienced in the whole student population.
- Due to the timing of the study the graduate student portion occurred over the Independent Activities Period when there are few credit classes available. The timing of the study has likely caused a general under-reporting of course-related goals and tasks for the graduate students.
- Lastly, while the study team made extensive efforts to ensure representation of students across all Schools at MIT, a few Schools remained underrepresented in proportion to their population at MIT, particularly the School of Art and Architecture and the Sloan School of Management. Also, because the study size was quite small, there was not representation from every academic department at MIT, nor did the makeup of the graduate student sample reflect the percentage of non-U.S. citizens in the student population.

Appendix D: Example Pages from One Day of Notes/Photos/Screenshots from a Student

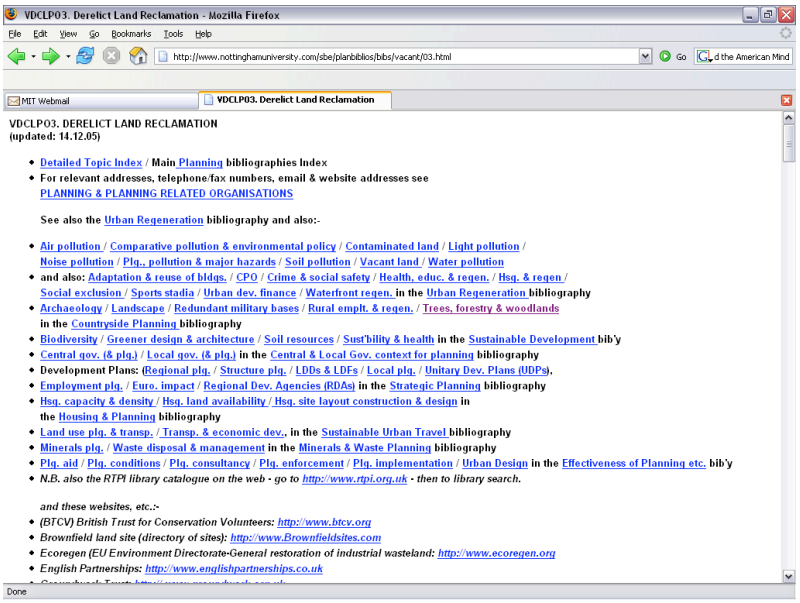
January 11, 2006

I'm working on a literature review on urban greening/green infrastructure – I start out reading a book I purchased last year in a bookstore in San Francisco (*The Ecological City)*. At the time it just seemed interesting, now it's relevant to my thesis research.

I found a reference to another relevant book – search for the book on Google to find a summary, reviews, other places the book is cited etc.



As often happens, this leads me to a huge bibliography which I bookmark to look at later – the main challenge here is how to wade through so many books that sound relevant when I am only doing a master's thesis not a dissertation. I have a number of these bibliographies bookmarked, but have yet to thoroughly go through them.


VDCLP03. Derelict Land Reclamation - Mozilla Firefox
File Edit View Go Bookmarks Tools Help
http://www.nottinghamuniversity.com/sbe/planbiblios/bibs/vacant/03.html
MIT Webmail
VDCLP03. Derelict Land Reclamation
VDCLP03. DERELICT LAND RECLAMATION
(updated: 14.12.05)
Detailed Topic Index / Main Planning bibliographies Index
For relevant addresses, telephone/fax numbers, email & website addresses see
PLANNING & PLANNING RELATED ORGANISATIONS
See also the Urban Regeneration bibliography and also:-
Air pollution / Comparative pollution & environmental policy / Contaminated land / Light pollution /
Noise pollution / Plq., pollution & major hazards / Soil pollution / Vacant land / Water pollution
and also: Adaptation & reuse of bldgs. / CPO / Crime & social safety / Health, educ. & regen. / Hsg. & regen /
Social exclusion / Sports stadia / Urban dev. finance / Waterfront regen. in the Urban Regeneration bibliography
Archaeology / Landscape / Redundant military bases / Rural emplt. & regen. / Trees, forestry & woodlands
in the Countryside Planning bibliography
Biodiversity / Greener design & architecture / Soil resources / Sust'bility & health in the Sustainable Development bib'y
Central gov. (& plq.) / Local gov. (& plq.) in the Central & Local Gov. context for planning bibliography
Development Plans: (Regional plq. / Structure plq. / LDDs & LDFs / Local plq. / Unitary Dev. Plans (UDPs).
Employment plq. / Euro. impact / Regional Dev. Agencies (RDAs) in the Strategic Planning bibliography
Hsg. capacity & density / Hsg. land availability / Hsg. site layout construction & design in
the Housing & Planning bibliography
Land use plq. & transp. / Transp. & economic dev., in the Sustainable Urban Travel bibliography
Minerals plq. / Waste disposal & management in the Minerals & Waste Planning bibliography
Plq. aid / Plq. conditions / Plq. consultancy / Plq. enforcement / Plq. implementation / Urban Design in the Effectiveness of Planning etc. bib'y
N.B. also the RTPI library catalogue on the web - go to http://www.rtpi.org.uk - then to library search.
and these websites, etc.:-
(BTCV) British Trust for Conservation Volunteers: http://www.btcv.org
Brownfield land site (directory of sites): http://www.Brownfieldsites.com
Ecoregen (EU Environment Directorate-General restoration of industrial wasteland: http://www.ecoregen.org
English Partnerships: http://www.englishpartnerships.co.uk
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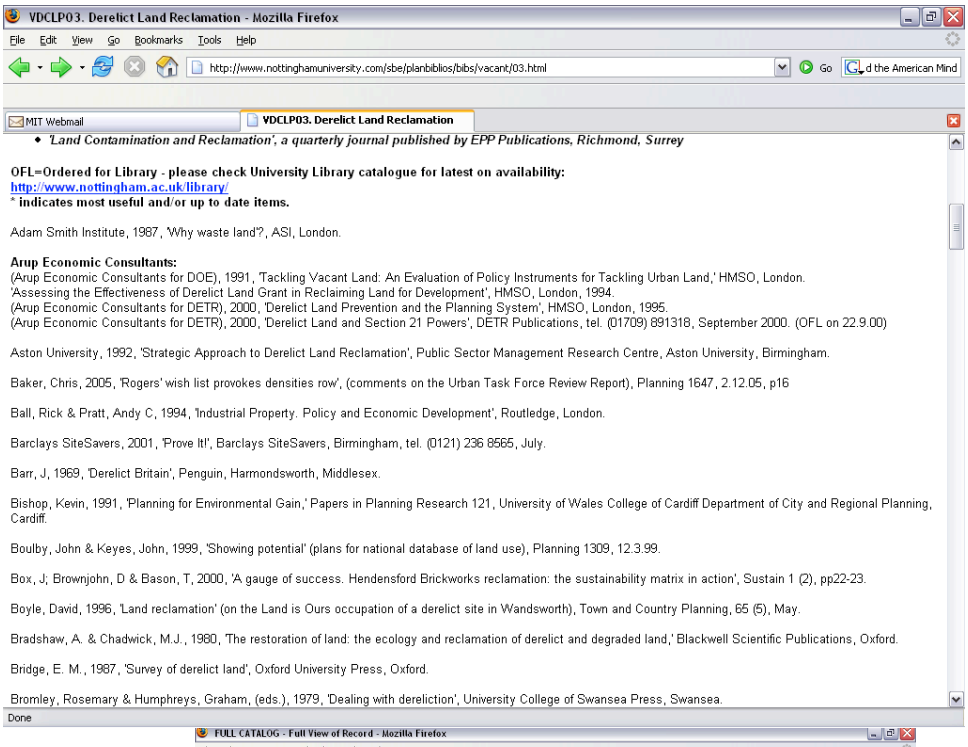
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http://www.nottinghamuniversity.com/sbe/planbiblios/bibs/vacant/03.html
MIT Webmail
VDCLP03. Derelict Land Reclamation
'Land Contamination and Reclamation', a quarterly journal published by EPP Publications, Richmond, Surrey
OFL=Ordered for Library - please check University Library catalogue for latest on availability:
http://www.nottingham.ac.uk/library/
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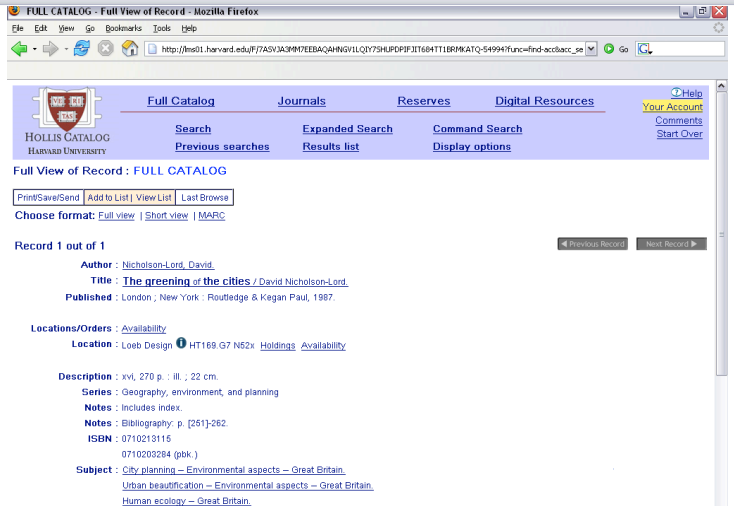
FULL CATALOG - Full View of Record - Mozilla Firefox
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HOLLIS CATALOG
HARVARD UNIVERSITY
Full Catalog
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Display options
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Full View of Record : FULL CATALOG
Print/Save/Send
Add to List | View List
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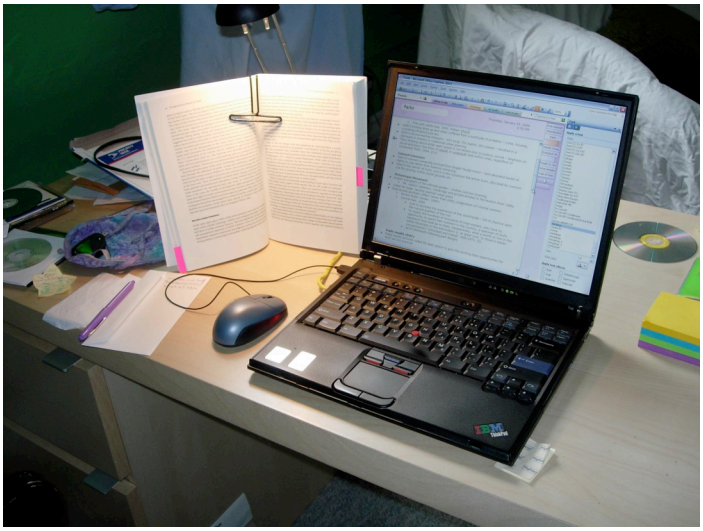
Choose format: Full view | Short view | MARC
Record 1 out of 1
Previous Record
Next Record
Author : Nicholson-Lord, David.
Title : The greening of the cities / David Nicholson-Lord.
Published : London ; New York : Routledge & Kegan Paul, 1987.
Locations/Orders : Availability
Location : Loeb Design HT169.G7 N52x Holdings Availability
Description : xvi, 270 p. : ill. ; 22 cm.
Series : Geography, environment, and planning
Notes : Includes index.
Notes : Bibliography: p. [251]-262.
ISBN : 0710213115
0710203284 (pbk.)
Subject : City planning -- Environmental aspects -- Great Britain.
Urban beautification -- Environmental aspects -- Great Britain.
Human ecology -- Great Britain.

Next I find the book in the Harvard library catalog – more convenient for me to stop by than the MIT library today (going to Harvard Square this evening)

I go back to note taking on my laptop in the program Microsoft Office OneNote. My reading/note taking set-up looks like this:



Appendix E: Questions Asked During Photo Diary Study Interviews

Warm up questions:

- What is your name?
- What dept. are you in?
- How long have you been at MIT?
- Do you mind if we ask your age?
- How many times a month do you use the physical MIT libraries?
- How many times a month do you use the electronic resources of the MIT Libraries?
- How many times a month do you search for information, not using the libraries?
- What are your top 3 likes and dislikes about info-seeking in your academic life? (Could be asked at the end of the session as an alternative)

During the body of the session:

- tell us the story of what you did this week, in detail
- for each task, we'll be looking for the following information:
    - What worked?
    - What problems did you run into?
    - Where were you?
    - What were you doing?
    - Tell about your strategy for searching for this info.
    - What resources did you use?
    - How did you first learn about this resource?
    - What specifically are you searching for?
    - What order did you go about it?
    - What strategies did you use?
    - When did you do it (time of day? day of week)
    - What devices did you use?
    - How often do you do this task?

After the narrative:

- Are there other tasks that you typically do that you didn't do this week? Can you tell us about those?
- Do you ever do programming or scripting? If so, would you find it useful to have more access to library data (such as the contents of Vera or Barton) in order to write your own programs with it?
- Have you used any of the following web technologies? RSS, social bookmarking, Firefox extensions/scripting. Tell us a little about that.

Appendix F: Complete List of Methods Used in the Photo Diary Study

Method Category	Occurrences for graduate students	Occurrences for undergraduate students	Total occurrences	# of times this is the first method	% of times this is the first method
search Google	33	45	78	50	64%
go directly to a known URL	23	37	60	38	63%
use Barton to browse or search	15	15	30	17	57%
search a citation database	15	11	26	8	31%
use course web sites	0	23	23	14	61%
review course/lab notes/handouts taken in class	0	17	17	9	53%
search Vera	10	6	16	11	69%
read textbook	0	13	13	3	23%
consult other students	3	10	13	7	58%
consult with guest lecturer/faculty	0	12	12	8	67%
search Google Scholar	6	6	12	5	42%
search other subject databases listed in Vera	6	4	10	5	50%
physically browse a collection	6	3	9	6	67%
refer to books in personal library	4	5	9	6	67%
retrieve a print resource from a library	3	6	9	4	44%
use wikipedia	2	7	9	4	44%
search/browse an ejournal package	6	2	8	3	38%
consult friends	2	5	7	3	43%
look at materials from an old class	3	4	7	4	57%
ask for help from libraries staff	4	2	6	3	50%
consult with TA	0	6	6	2	33%
create an Excel spreadsheet	1	5	6	3	50%
search other library	5	1	6	0	0%

catalogs					
search/browse Amazon	2	3	5	4	80%
do field research	1	3	4	2	50%
use the MIT web site	1	3	4	4	100%
consult with advisor	3	0	3	3	100%
consult with colleague	2	1	3	1	33%
use MIT Libraries web site	1	2	3	1	33%
visit other libraries	3	0	3	2	67%
borrow books from other libraries	0	2	2	0	0%
call people	2	0	2	2	100%
email people	1	1	2	1	50%
follow a link from an email	0	2	2	2	100%
get class files from Athena	0	2	2	2	100%
search Vera A to Z list	1	1	2	1	50%
type notes from class	0	2	2	1	50%
use ask us	1	1	2	2	100%
use ILB	1	1	2	0	0%
use software help screens	1	1	2	2	100%
attend lectures	0	1	1	0	0%
browse MIT Libraries web site	1	0	1	1	100%
follow a link from a bibliography	1	0	1	1	100%
meet with people	1	0	1	1	100%
search an e-books database	1	0	1	0	0%
search FullText Finder	0	1	1	0	0%
search Google groups	1	0	1	0	0%
search Google Images	0	1	1	1	100%
use facebook.com	0	1	1	1	100%
visit an MIT Library	0	1	1	1	100%

Appendix G: Top Task Categories with most common methods and frequency of first methods.

Task Category	Most common methods	occurrences	number of times is first method
facts/quick lookups	search Google	25	17
	go directly to a known URL	12	6
	use wikipedia	4	1
	refer to books in personal library	3	3
	consult friends	1	
	consult with colleagues	1	
	do field research	1	
	physically browse a collection	1	1
	read textbook	1	
	retrieve a print resource from a library	1	1
	review course/lab notes/handouts taken in class	1	
	search Google Images	1	1
	search other subject databases listed in Vera	1	
	search Vera	1	1
	use Barton to browse or search	1	1
	use MIT Libraries web site	1	
	use the MIT web site	1	1
	visit other libraries	1	1
known item	use Barton to browse or search	16	11
	search Google Scholar	7	3
	search Vera	6	4
	retrieve a print resource from a library	5	2
	search a citation database	3	1
	search Google	3	2
	search other library catalogs	3	0
	search/browse Amazon	3	3
	search/browse an ejournal package	3	3
	use course web sites	2	2
	ask for help from libraries staff	1	0
	borrow books from other libraries	2	0
	consult other students	1	1
	consult with advisor	1	0

	do field research	1	1
	follow a link from a bibliography	1	1
	follow a link from an email	1	1
	go directly to a known URL	5	5
	physically browse a collection	1	0
	review course/lab notes/handouts taken in class	1	1
	search FullText Finder	1	0
	search other subject databases listed in Vera	1	1
	use ask us	1	0
	use ILB	1	0
	visit other libraries	1	0
partially known item	search Google	18	14
	go directly to a known URL	7	4
	use Barton to browse or search	5	2
	search Vera	5	3
	search a citation database	4	2
	search Google Scholar	3	0
	use the MIT web site	2	2
	physically browse a collection	2	0
	consult with guest lecturer/faculty	2	1
	ask for help from libraries staff	2	1
	use wikipedia	1	0
	use MIT Libraries web site	1	1
	use course web sites	1	1
	search/browse an ejournal package	1	0
	search other library catalogs	1	0
	retrieve a print resource from a library	1	0
	refer to books in personal library	1	1
	read textbook	1	0
	look at materials from an old class	1	0
	consult with advisor	1	0
	consult other students	1	1
topical search	search a citation database	17	5
	search Google	14	12
	use Barton to browse or search	8	3
	search other subject databases listed in Vera	5	2
	go directly to a known URL	5	2
	use wikipedia	4	2

	ask for help from libraries staff	3	2
	search/browse an ejournal package	2	0
	search/browse Amazon	2	1
	search Vera	2	2
	search other library catalogs	2	0
	search Google Scholar	2	2
	look at materials from an old class	2	1
	visit other libraries	1	1
	use ILB	1	0
	use course web sites	1	0
	use ask us	1	0
	search Vera A to Z list	1	1
	refer to books in personal library	1	0
	physically browse a collection	1	1
	consult with guest lecturer/faculty	1	0
	consult with colleague	1	0
	consult other students	1	1
	consult friends	1	0
	call people	1	1

Appendix H: Charge to User Interface Group

The User Interface Group serves as the decision-making team for design of the Libraries' public user interfaces. This includes the following:

- libraries public web site
- libraries staff web site (for staff communication, but also is viewed by the public)
- Barton catalog
- Vera
- SFX
- Illiad web pages
- any new system we implement that has an interface for use by our public users that can be modified

The group works in an advisory role with the DSpace Product Manager on interface design issues of DSpace at MIT.

The group also looks for opportunities to make our information accessible via web services for use in other interfaces at MIT (such as RSS feeds, xml web services, etc.) This means that the writing style of our content needs to be considered for contexts other than the web site that it originally appeared in. This group will be positioned to consider how our content might best be presented for those various contexts.

Chaired by the Web Manager/Usability Specialist, the group is responsible for initiating and coordinating user interface design of our web-based services. Its members may lead subgroups, act in a liaison role, or coordinate discussions among groups and individuals responsible for various systems we implement for our public.

The User Interface Group will replace the Web Advisory Group.

Membership
The User Interface Group is chaired by the Web Manager and shall consist of:

permanent members:
- the Web Manager
- the Librarian Web Assistant
- the OPAC representative to the Barton Group

appointed for two-year terms:
- 2 collection services librarians
- 1 public services librarian
- 1 member-at-large

The terms of the initial appointments will vary so that the membership will turn over on a staggered timetable. The collection services librarian, the librarian cataloger and public services librarian appointments shall be made by the Associate Directors for Collection Services and Public Service in consultation with the Web Manager. The member-at-large shall be recommended by the members of the User Interface Group in consultation with appropriate Associate Directors.

The user interface group reports to both the Associate Director for Technology and the Associate Director for Public Services.