Studying Practicing Researchers: How Research within Scientific Industry Can Impact and Influence Information Literacy among Students in Stem Departments

Jenny Emanuel and Charlotte Roh

Understanding how users search and conduct research is a fundamental part of interface and interaction design. It is critical to identify the factors that can affect the research process in order to develop improvements to search interfaces, the search process, and training activities that can help users conduct research more effectively and efficiently.

In a two-year grant-based partnership between the Main Library at the University of Illinois at Urbana-Champaign and The Dow Chemical Company, both quantitative and qualitative methods were used in order to look at the information-seeking habits of industry researchers in the science, technology, engineering, and mathematics (STEM) fields. The results will not only inform Dow as to how their employees search for information, but will impact information literacy instruction towards graduate student in STEM fields at academic institutions.

Goals of Project

The partnership between The Dow Chemical Company and the University of Illinois was designed to increase knowledge about how researchers search for information, specifically within Dow. Dow's primary interests were to examine how they could improve internal search tools for local documents as well as external tools to communicate feedback and give suggestions for improvement to vendors. Dow was also interested in identifying changes that could be made to internal processes and training to help employees research information more effectively and efficiently.

The researchers at the University of Illinois interest was also a better understanding as to how a corporate population searches for literature. There have been many user studies within higher education, but they focus on the information seeking habits of students, and occasionally, of faculty. The researchers believed that investigating corporate users would provide a different view that would help understand how people research. Another aspect of this partnership with Dow included preparing current graduate students for careers at Dow and within industry. The University Library would better understand the research expectations within industry in order to better prepare graduate students for industry careers.

Literature Review

In the past few decades, user studies have concentrated on the shift from print to electronic resources. Countless studies have shown that researchers "indicate a strong preference for obtaining information in the most convenient way possible, which generally

Jenny Emanuel is Digital Services and Reference Librarian at the University of Illinois, e-mail: emanuelj@illinois.edu; Charlotte Roh is Graduate Research Assistant at the University of Illinois, e-mail: croh2@illinois.edu

means for free (they do not pay directly) and via electronic access."[1] This predilection has been established across subject fields[2], and has demonstrated a shift in how researchers interact with their resources. In short, researchers are most likely to stay at their desks rather than go to the library.[3]

This shift in resource access and delivery from library stacks to individual desktops has been a topic of concern amongst academic libraries; a logical connection since those who publish and access research literature are often academics. Consequently, user studies of researchers in the STEM fields have concentrated on the academic environment[4] or on science-specific tools like Elsevier's ScienceDirect and Blackwell Synergy.[5] These studies use a range of methods, but quantitative methods such as surveys and questionnaires[6] make up the bulk of this research and are often delivered electronically. Studies have also extrapolated from online access data such as citation links, articles viewed and downloaded, and other user information for deep log analyses.[7] As for qualitative research, focus groups[8] and interviews[9] of different makeups, sample sizes, and formats make comparison difficult, although each has contributed in its own way to the vast body of literature enumerating the individual differences that influence the adoption of technology.

Methodology

There were two components of data collection for this study. The first was a quantitative approach, which was an online survey administered with Survey Monkey in May and June 2012. An email with a link for the survey was sent to all employees in the Research and Development division of Dow Chemical and garnered 996 valid responses. The survey contained 33 questions that were divided into 9 parts, including (1) informed consent, (2) information seeking at Dow, (3) training, (4) demographic information, (5) education information, (6) language information, (7) technology experience, (8) personal technology use, and (9) follow up information. The survey was designed to address the many different aspects of information seeking at Dow and gather extensive demographic information in order to cross-tabulate results. This paper concerns only data about information seeking, training, and technology use.

The final survey component asked participants if they would be interested in participating in a follow up interview. A total of 168 individuals responded with their email address, indicating that they would be willing to participate. In September 2012, individuals were contacted about their participation, and a total of 27 interviews were scheduled and conducted in October and November. The interviews were semi-structured in format and asked participants to talk about their research and their strategies and tools used to look for information. Participants were then asked why they selected particular tool(s), what they liked and/or disliked, any other issues about the tool, and their thoughts on what would make it easier to use. They were also asked to think about their information seeking habits for non-work activity and compare the tools and skills they used in their personal lives to those they used on the job. Participants were asked how they envisioned their ideal scholarly resource, as well as their thoughts on how they would like training to be provided to them. Finally, they were asked to give any additional, unstructured thoughts.

Interviews were conducted online and recorded through Adobe Connect, which allowed the researchers to view the desktops of all participants and watch as they searched online resources. Data collected through interviews was qualitative in nature and was coded based on themes related to issues, tools, and trainings. Survey data was then compared with the interview data in order to discern common themes.

Results

The researchers were surprised to learn that corporate researchers were not very savvy about conducting literature searches. Even though research is their job and they have to complete regular written reports about their research, few researchers had more than basic search skills, and most preferred to start their research using Google or Google Scholar. Although they used many of the same scholarly tools as academic researchers, including Thomson Innovation, SciFinder, Web of Science, and Science Direct, most of them either used these tools only when required, or if they had learned the tool while in graduate school.

The researchers found that corporate researchers have many of the same desires as academic researchers. They want seamless search interfaces with complete access to linked full text and they want training on demand to meet their needs. The researchers did not feel their corporation was meeting their desires in these areas. There are two major areas that influence information literacy: barriers to access research

materials and user-appropriate training. Academic libraries are also examining these areas, and since they are educating the STEM researchers that will soon fill jobs in the private research sector, what corporate researchers require on the job can help libraries develop better methods of access and training for graduate students in STEM fields.

Barriers to Access

One thing that is clear across the board is the dislike researchers have when it is difficult for them to use resources or obtain the resources that they need. Academic users often complain that research could be made easier if they had more tools available to them, the tools were easier to use, and if everything was seamlessly integrated with a low failure rate. Corporate researchers have the same desires, but believe their needs are not met, citing numerous issues.

Corporate researchers were observed accessing resources through bookmarks on their browsers, through shortcuts on their desktops, and through various links on the main library website. While 93.8% of respondents accessed information resources from their personal workstation, approximately two-thirds of participants search for information while working remotely.

However, we observed that at several points users could and did encounter walls that prevented quick access. Examples included

- Slow or inaccessible connection to a VPN network.
- Multiple logins and passwords for resources.
- Inability to download a found resource because the library is not subscribed to it, even though it shows up in the search results.
- Several steps to access and download resources - researchers did not like being sent from site to site to search resources and obtain the full text of articles. Some researchers were even misled by the steps to think they had to pay for resources when in fact they were available through the library.
- Lack of clarity about which resources were available and which were not.
- Inability to save articles to individual workstations.
- Lack of OCR-enabled text so that PDFs can be searched.

As previous research has shown, many researchers have turned to tools that have low barriers to access like Wikipedia and Google Scholar (which provides OCR-enabled text). These are quick reference solutions that are handy for casual research or brainstorming whilst browsing. However, just as with academic research, users were using these tools as their primary research tools, and then became frustrated that the full text was not available.

User-Appropriate Training

One theme in both the survey results and interviews was that corporate researchers desired training, and their training needs were not being met. Of the 27 individuals interviewed as a part of this project, only three had what the researchers believed were above average information literacy skills. Many others wanted to learn how to be a better searcher, but various reasons held them back from completing training necessary to do so. Additionally, users were mostly independent searchers, and did not want to depend on librarians to help them find literature relevant to their jobs.

Although the company held regular webinar classes, most users did not find them helpful for many reasons. Most complained that the schedule was not convenient to them, as they did not want to take time out of their day to watch a webinar. Many were engaged in field research and therefore not regularly at their computer workstation. Users also complained that webinars were too long and frequently gave overviews on how to use a tool, rather than covering advanced topics or concrete research concepts. Users desired

- Shorter videos on a detailed topic of a resource.
- The ability to watch an experienced searcher show them how they would do a particular search.
- Hands-on sessions that gave participants time to practice their skills and ask questions.

Additionally, users perceived the training that was offered to them as too basic. Many libraries must deal with a broad range of literacy. However, it seems that many STEM researchers are fairly comfortable using the tools available, and even those who demonstrated technological illiteracy are still able to fulfill enough of their research needs to complete their work. This means that most researchers do not need a step-by-step detailed explanation of a tool. Rather, they would prefer a quick overview of a tool with its major fea-

tures, and then a quick resource (such as a tip sheet or FAQ page) to solve any problems they might encounter in their work.

Recommendations

Corporate researchers encounter more barriers when they conduct literature searches due to the lack of technologies that are common in the academic world. These include proxy services for remote access, OpenURL, and federated/discovery search tools. Academic researchers expect the ability to link resources together, as done with OpenURL, and seamless access both locally and remotely, as done with a proxy server. Corporate users also desired a "one search" option that would allow them to search for multiple document types under one interface and have the full text linked directly from the results, much like academic library discovery tools.

As corporate users have the same desires for access as academic researchers, it is important for academic institutions to realize that tools that seamlessly integrate resources together are what researchers desire. There are times that corporate researchers want to browse to see what literature is available for a new project, and there are times that they want to quickly look up the full text or reference information of a topic. Academic libraries are clearly leading the way to meet these desires, and should continue to work to develop new and better tools that will help fulfill this desire.

Regarding training, corporate users have the same desires as academic users, and they do want training geared specifically toward their interests and issues. Among the training techniques that academic libraries should utilize are:

- More frequent training sessions.
- Archived online training sessions so that people can look at them later if they are unable to attend.
- Short (less than 1 minute) videos on very specific topics, such as using sharing features in a resource, how to download full text, and how to search by author. People want quick reference videos, and not full-fledged instruction.
- Reference sheets for major search terminology and features for each tool. These reference sheets can be made available on library or department websites and in a format that can easily be downloaded to a user's computer or printed out for later reference.
- Partnered sessions with screen shares or videoconferencing so that researchers can see how librarians are searching and interact for a targeted, directed search.

Many of these formats address user requests for quick cheat sheets or point-of-use training. This is because many people forget training that they do not put in use right away, and they do not have time to go through too much text or the training again if they need the information now.

Libraries should also consider more thoughtfully the personalities of their users. At the risk of generalizing, many STEM researchers are highly intelligent and prefer challenging and engaging tasks if they are to leave their work for any length of time. Even though they are not librarians, they enjoy learning the advanced search techniques that librarians know, and have a strong desire to understand how things work in order to improve their skills.

- Interview subjects indicated they preferred that training is hands on and interactive. Users feel that they are being lectured to in current training offerings, and would like opportunities to follow along and ask questions.
- People want to improve their skills, not sit through training for things they already know about. Target new training sessions on advanced skills, such as structured keyword searching, or advanced Google tips.
- Users indicated that they would like to know the best keywords for a search. They want help constructing a good search.
- Instead of training sessions focusing on a particular tool, it is recommended that training focus on a particular topic. Examples include searching the patent literature, searching for reaction literature, searching for entomology research, or organizing your research.
- Have some unstructured training in which participants are invited to bring their research questions to a smaller group to watch a librarian perform their techniques. Users are very interested in how things work, and would like to see an expert searcher in action in order to improve their own skills.
- Others have already expended extensive research and effort in order to create the available help features that accompany current search tools. Often these help features have

been created in response to actual customer problems. It is recommended that libraries take a look at the available help features of search tools in order to recycle or link them to the library website.

- It is recommended that libraries employ educational technique and theory such as the use of real life examples, problems sets, the integration of user background knowledge, and techniques such as think-pair-share. Libraries should look into self-directed learning, inquiry learning, and evidence-based learning.

In addition to the Association of College and Research Libraries (ACRL) information literacy competency guidelines, libraries should look at subject-specific technology standards, such as the National Institute of Standards and Technology (NIST, for STEM fields) at http://www.nist.gov/index.html. This is a good way of understanding information literacy in the context of a STEM curriculum.

One additional thing that should be incorporated in STEM instruction is patent searching. This is a critical part of industry, which is interested in commoditizing research discoveries, and a significant percentage of researchers noted that they felt unprepared by their education for this aspect of their jobs. Thomson Innovation and free tools such as Free Patents Online and Google Patents are used by corporate researchers to figure out new areas of research as well as prepare them for filing patent applications.

Conclusion

Through the administration of a survey and hands on interviews with members of The Dow Chemical Company, researchers at the University of Illinois gained insight as to how literature reviews are conducted within a major industry researcher corporation. The results showed that corporate researchers were not as information literate as expected, and encountered barriers to conducting research as well as training. Since PhD students in STEM fields at universities are the future researchers at large corporations, academic libraries can work on the information literacy skills of graduate students in order to prepare them for jobs in industry. Promoting how to get around barriers to library resource access and through providing targeted training on key topics and concepts, academic librarians can prepare students for future employment.

Notes

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