



The SHU Research Logs: Student Online Search Behaviors Trans-scripted



Beth Bloom, Marta Mestrovic Deyrup*

Seton Hall University, 400 South Orange Ave., South Orange, NJ, 07079-2671, USA

ARTICLE INFO

Article history:

Received 17 December 2014

Accepted 1 July 2015

Available online 5 August 2015

Keywords:

Information literacy
Undergraduate research
Library instruction

ABSTRACT

This paper examines students' online research behaviors as well as emotive and affective responses as they conducted online research for their undergraduate courses. It looks at data obtained during the 2011–2012 academic year, drawn from over 42 hours of recordings and includes a brief questionnaire that measured students' research history and feelings about their own research competence.

© 2015 Elsevier Inc. All rights reserved.

INTRODUCTION

Before the onset of the World Wide Web, doing academic research meant understanding how print materials were organized within the confines of a physical space, the library. It meant looking through a card catalog and locating books that were organized according to whichever classification scheme the library used, the most common being the Library of Congress and the Dewey Decimal System. It was easy to identify books by their color and size and by the fact that they were located in different parts of the library. Any kind of discovery was done by browsing the shelves and examining the tables of contents and indexes of books.

Today, because of the success of search engines like Google, which can interpret natural language requests and which rely on the robotic indexing and retrieval of Web documents, the way we do research has changed significantly. The researcher now has the ability to scan and sift through vast amounts of information quickly. Physical format no longer matters, since on a computer screen all material is now flat and one dimensional. In high school, students have learned to do the latter kind of research. They bring the skills and strategies they've developed as online searchers with them to college.

Like many instructional librarians, we had observed the disconnect between the kinds of research being done by undergraduates and the type of research that is rewarded at the university level. Our interest in this process led us to apply for and receive a Google Faculty Research Award (http://research.google.com/university/research_awards.html). Our grant proposal was straightforward and relatively simple: we would recruit upperclassmen who were already working on a substantial academic assignment to

document their search strategy, using a cloud-based screen-recording and voice-capture tool called OpenHallway. Although we did not realize it at the time, this commercial product provided us with a unique vantage point in which to view our students' research habits. Unlike other methods such as log analysis, surveys, and lab observations, which require that the researcher participate in the process, OpenHallway enabled our students to conduct research as they normally would, without our being present. This makes the transcripts of these tapes an enormously rich source of information about how students actually do research—not how they tell us how they do research.

LITERATURE REVIEW

There are many studies that examine undergraduate information-seeking behavior. This literature review focuses on two issues: an examination of the research design of earlier studies, and similarities among the findings. After surveying the literature, we did not find any study that actually matched our research design. However, we found that many of the studies did mirror our conclusions about student online research behaviors.

Several studies were similar to ours in that they recorded students' comments and keystrokes, but always in a controlled environment. Cockrell & Jayne (2002) used the library as the testing site. A test giver explained that the usability of their Website was being tested, not the participants, and asked them to “think aloud” as they performed tasks on the computer. Currie, Devlin, Emde and Graves (2010) used Morae software, which recorded students' mouse clicks, tracked the Web pages they visited, and recorded their verbal comments as they did on-line research; the authors viewed the searches on a projector screen. L. Holman (2011) also used Morae software to survey 21 students. She videotaped each session as the students “thought aloud” and then met with her to discuss their reflections and draw concept diagrams.

* Corresponding author.

Some used log analysis: A. Broder (2002) used this technique to study 3190 random AltaVista users. Judd and Kennedy (2010) employed Internet usage logs in a large open-access computer lab to study how biomedical students searched the Internet. Lorigo, Pan, Hembrooke, et al. (2006) used eye tracking and log file analysis to study how users evaluate Google results.

Many relied on such self-reporting methods as focus or discussion groups, in addition to direct observation of participants. Foster and Gibbons (2007) interviewed faculty. Gross and Latham (2009) used a semi-structured interview and an information IL test. In the Project Information Literacy (PIL) study, Head and Eisenberg (2009) worked with 11 discussion groups of 86 students from seven colleges. Head, in her 2013 update of PIL, performed a series of studies of more than 11,000 students carried out by interview or survey. Zhang (2008) used an instrument that consisted of four sequential parts: a demographic questionnaire asking students' experience with the Web, an interview to solicit students' points of view about the Web, a request to draw a picture or diagram of their perceptions about the Web and provide descriptions for the drawings, and two search tasks. Suarez (2007) employed participant observation, unobtrusive observation, and interviews. Kolowich (2011) describes the ERIAL (Ethnographic Research in Illinois Academic Libraries) project, which enlisted two anthropologists at Illinois Wesleyan, DePaul University, and Northeastern Illinois University and the University of Illinois's Chicago and Springfield campuses, along with their own staff members, and which collected data using open-ended interviews and direct observation, in addition to other methods.

Several studies relied heavily on survey results: Shanahan (2007) surveyed 37 second-year graduate students, whose results indicated a need for IL training. Sorensen and Dahl (2008) distributed a Web-based survey to all instruction librarians in the humanities and social sciences at the Council of Prairie and Pacific University Libraries. Taylor (2012) surveyed millennial undergraduates who sought information as part of an assigned research project. Lee, Paik, & Joo (2012) used a self-generated diary method with 233 undergraduate students.

Others applied source citation analysis methods to their research results. Hearst, Elliott, English, et al. (2002) created Flamenco, "a search engine that addresses many desired functions...". McClure & Clink (2009) paired an examination of source citations with deeper analysis of source use and discussed both methods in relation to responses in student and teacher focus groups. Rempel (2010) researched how graduate students carry out literature reviews and followed it with a library workshop. Walraven, Brand-Gruwel, & Boshuizen (2009) studied secondary school students after giving them 12 Internet searching problems in three areas: geography, physics, and language/culture. Although the above-mentioned studies varied from ours in terms of research design, the conclusions the authors drew very closely resembled our own. The literature reflected almost unanimously the observation that students showed a lack of understanding of how databases worked. They tried to find the shortest path to finishing their research project. They did not take time to read directions or helpful clues offered by the databases, and they were confident that they would be able to solve their research problems by continuing with their search strategies without reevaluating their success or lack of success. For example see Cockrell and Jayne (2002).

Many students' behaviors indicated that they did not want to take the time to learn or process new information. Foster and Gibbons (2007) surmised that their students tend to summarize readings instead of reflecting upon them and writing critical, thoughtful papers. Moreover, they found that a student who cannot find resources for her/his paper assumes that the library simply does not have the resources. Gross and Latham (2009) found that students wanted to learn a skill they might need rather than to gain knowledge. Head and Eisenberg (2009) found that the longest part of the information-seeking process was getting to the question to ask. Holman's 2011

study indicated that students assumed that any retrieval problems were connected with their choice of terms rather than search strategy. Hur-Li Lee (2008) noted: "the students preferred Google and keyword searching; then they would check each link from the top or view all items in first couple of pages." If at that point they didn't find what they needed they would go to library sources or change topic.

Supporting our own research findings, Shanahan (2007) found that "Whilst students have a very positive perception of their ability to search databases the survey results show low skill levels in constructing structured search statements for nearly all students at the pre-intervention survey." In 2008, she asserted: "Students' dependency on the Google search engine coupled with often non-critical evaluation of the Internet information sources limits the quality of the information resources they will retrieve."

In 2012, Taylor proved that "millennial generation Web searchers proceed erratically through an information search process, make only a limited attempt to evaluate the quality or validity of information gathered, and may perform some level of 'backfilling' or adding sources to a research project before final submission of the work."

Finally, Wallraven, Brand-Gruwel, & Boshuizen (2009) found that "While solving information problems students spent most of their time on searching and scanning and only a small amount of time on processing and organizing information." "Most striking was the fact that students expected to find an answer on one single Website, preferably in the first couple of sentences.... If the author of the site was not mentioned they did not try to find out who the author was. Students wanted the information served on a silver platter and did not want to do a lot of work them." (Wallraven, p. 245).

METHODOLOGY

Upon receiving the grant, we applied for IRB approval, which we received in 2011. We conducted a preliminary study during that summer with six students, but rolled out the official project during the 2011–2012 academic year.

For each of the two semesters, we sent a request, through our Blackboard course management system, for sophomores, juniors, and seniors enrolled in courses that required a sizable research project. Students who did not meet these requirements were not selected. Student participants received training in how to use OpenHallway and signed subject informed consent and video release forms. We encouraged them to log in at their convenience in order to record their online class research. OpenHallway records in 20-minute increments; we required three 20-minute research sessions per student. We also required that they "think aloud" while they were researching. In each instance, after we received their completed research tasks, we sent them a brief survey that probed their own perceptions of their research history and level of success. The students could request help from the university librarians at any time, but would have no prearranged contact with them. After they finished their video-recordings, we asked the students to fill out a survey that measured their feelings about and experience doing scholarly research. Over the two semesters, 42 students participated; each received \$125 for their efforts (please see Appendix for survey questions).

After collecting 42 video recordings that students completed over the seven-month period, we analyzed the 42 hours of data using Atlas.ti, a qualitative data analysis and research software. We coded the students' responses according to the criteria indicated in Fig. 1.

Fig. 1 displays the eight criteria used for coding the research results. By *destination* we were looking to see where the students would begin their search and what degree of specificity they sought in order to orient themselves to their research. *Source evaluation* refers to their online behaviors as the results of their searches manifested. We wanted to know if they immediately read the results or changed their search strategies. We listened to expressions of

a. Destination: Google? Wikipedia? Library?
b. Source Evaluation: behavior while evaluating search results
c. Feelings and Sounds: expressions of frustration/satisfaction
d. Resource Selection: criteria for destination choices
e. Citations: bookmarks, tabs, folders, URLs used to organize research?
f. Search Strategies: choice and application of key terms
g. Search Syntax: phrase patterns in search boxes
h. Webpage Navigation: actions while on page

Fig. 1. Coding criteria for research behaviors.

frustration, satisfaction, impatience, excitement, etc., and coded these reactions as *feelings and sounds*. *Resource selection* involved the types of documents the students sought as they started their research. In other words, did they start by defining terms (dictionary), look at encyclopedic resources (Wikipedia), or did they immediately start searching for books or articles? *Citations* represented our interest in determining how students organized their results: bookmark their URLs, put articles in folders, or save articles/Websites in their tab files. At what point did the students choose to save their documents; did they use citations to store their results? We used the *search strategies* rubric to study student use of available search options that the databases offered. We were interested in how students used their search terms within search boxes: Did they combine all terms in one long phrase, or did they use advanced search strategies and apply their keywords in different fields? Did they use proximity operators and truncation? We coded their *search syntax* to determine how the students chose and applied keywords: did they use subject headings? Thesauri? How did they articulate concepts—with a long or short phrase or single keywords? We observed students' *Webpage navigation* in order to learn how much, what, and if they read any material on results pages: What criteria did they look for before moving on to further results? What segments of the page did they peruse? Did they read titles, highlighted terms, section headings, paragraphs? Did they apply criteria to determine authority, page quality, or backgrounds of authorship? How far did they read before determining the usefulness of a given article or result?

RESULTS

Because the information contained in the video research logs was so rich, we made the decision to analyze the data using both quantitative and qualitative means. While Atlas.ti is considered to be a qualitative analysis tool, it did allow us to get a sense of how many students were engaging in a certain activity at a similar stage of the research process. However, we also spent time reviewing the tapes as a kind of meta-narrative to see whether we could spot patterns and similarities among the students. As our final analysis we looked at the student exit survey.

WHAT AN ANALYSIS OF THE ATLAS.TI DATA SHOWED

DESTINATION

In beginning their research, most students exhibited a marked preference for Google. Fifteen students initiated their research on Google. Although 21 students started their research on the library home page

and nine started on our university Website, 19 of them visited Google a total of 92 times. Whereas 20 students returned to the library Website 44 times after trying other sites, only seven returned to the library Website after visiting Google. Seven students went to a previously known Website for their research. Three of our 42 participants searched YouTube for resources.

SOURCE EVALUATION

However, the students did exhibit critical thinking when it came to Website evaluation. One expressed the opinion that dot.com sites are unreliable, while 12 believed that dot.gov, dot.edu, dot.org, or country Websites are reliable. Five students looked for the publication date on a Webpage, while three identified that the information at a Website was dated. One even used references to determine a source's validity. Three students questioned a source's legitimacy. The ability to do this kind of analysis most likely reflected the research instruction these students had received in high school on how to evaluate a Website.

When using Google, students generally expressed frustration with the advertisements. Some complained that the article titles in Google were deceiving or that the headlines weren't accurate. Two students were disappointed in Google Scholar; however, nine students were very satisfied with the results they retrieved from Google and Google Scholar. Two students liked the number of results Google provided. Some comments were: "Awesome; this is great," "Google is 100 times more helpful even though perhaps less reliable than the library Website." One person stated that Google's search results were always the same, and another noted that the best sources could be found in the top three results. However, another student claimed that it was good to check more pages [than one] of Google results, while only one student complained that Google yields too many results.

We also found that students used the Google search engine as they might a library: three students used Google to locate books, eight to find definitions, and one in each category to find film reviews, specific

Table 1
Google use.

Google sources	Using Google to find:
Books	Statistics
Scholar	Film reviews
Documents	Specific articles
Images	Databases
News	Definitions
Video	Searches related to...

Table 2
Wikipedia use.

Wikipedia likes	Wikipedia fears
Likes to start with...	Not supposed to use, but...
Likes its simplicity	Doesn't want to use, but...
Likes its quick links	Doesn't like to use, but...
Likes its references	Knows that s/he can't quote from
Will use its ideas	Validity of information within
Will use article anyway	
Will use citations to find more sources	

articles or sources, statistics, databases, images, documents, news, and videos (Table 1).

Nine students used Wikipedia. Of those, four students expressed an affinity for it, three students liked its quick links and references, two liked its simplicity, three students expressed concern over the validity of information within, two didn't want to use it, six mentioned that they knew they were not supposed to use it, two said they couldn't quote from it, two others were willing to use its ideas, and one stated that she would use its articles anyway. Five students used Wikipedia citations to find other sources (Table 2).

FEELINGS AND SOUNDS

Because students used a variety of resources, we evaluated their general feelings and sounds when engaged not only with the library resources, but also with Google, YouTube, and Wikipedia.

Our participants often were largely silent during the search process. However, the students generally tended to react audibly to the individual sources they found. For example, nine students expressed frustration and 14 expressed excitement that they found a particular source. Six expressed confusion in general. Five students expressed annoyance at the length of the articles they retrieved. Three students mentioned that they would have to purchase a book or article online, and three said that they must be careful with Website content. Three mentioned that the found source was an e-book. Two commented that they found a book from our library. One said, "I need something that is quick; this is very hard for me." Other comments included, "I found a dissertation" and "Oh, it's an excerpt from a book." Three mentioned that they had found an editorial. Only one mentioned the fact that Smart Search was activated, whereas three others made no comment when it appeared. One realized that "there are different results in each search engine," and one was surprised at the discovery that WorldCat [the on-line book catalog] contains lists of books in libraries elsewhere.

When students did speak, we consistently found that their comments and behaviors often contradicted each other. For example, 21 students claimed at one point that they didn't find any relevant articles, but several ended their research sessions with the following statements: "I like this and am definitely going to keep it." "I can deal with this one." "I'm going to stick with this one." "I didn't find an answer to my original question, but I did find some interesting facts...." "All these documents [are] on the side of agreement with my paper." "This is ok—I'm glad I got to use the databases." "Looks like I found something here." "There is not a lot left of what I have not explored; I have done enough research to get this paper to a great start."

RESOURCE SELECTION: STUDENTS' RESPONSES TO LIBRARY DATABASES

Students who used the SHU library Website expressed numerous complaints about how the site was structured. Seven students expressed a lack of familiarity with the library Website. Four claimed that they had trouble finding information in the databases. Two students expressed dislike for the SHU catalog and library Website and two expressed an intention to ask for help. Two had

trouble accessing articles. One preferred to go to the library databases directly rather than use our online catalog. One said she should know how to use the Website, one said it was hard to use the databases, and one stated that she or he knew she or he was in the wrong database.

During the search process, 27 students complained that the source or article was irrelevant (on 109 occasions), and 16 did not get any article results. Nine students said they were unable to find what they wanted. Six students openly expressed their dislike of the results they received. Five complained that they could not open a desired article. Four were unable to get any "satisfactory" search results. Two students stated that they didn't want to read. Two students expressed impatience while waiting for a Website to load and one stated that research is tiring. In an attempt to use our Libguides, one student claimed that the long list of subjects was confusing.

On the other hand, some students expressed satisfaction with aspects of the library Website. One student expressed an affinity for the Ebsco databases because her professor told her to use it, and several mentioned that they had used some of our databases in high school and were comfortable searching them. Other students mentioned that they liked abstracts, advanced searching, bullets, charts and graphs, familiar sources, abstracts, bolded items, e-books, examples, interviews, Lexis Nexis, Proquest databases, timelines, educational pages, "symbols in JStor," a comments section at the end of an article, highlighted terms, and our online catalog. Given all the above, 30 students stated on 169 separate occasions that they found a library source that was good or relevant.

CITATION PATTERNS

In preparing citations, 23 students used tabs to save their documents for later use. Seven students highlighted the article URLs and four students saved them in their favorites, not realizing that they were not permanent. Two summarized articles as they searched, one student highlighted text to remember it for a paper, one student made notes on the articles themselves, one wrote down questions, and one used comments/notes to highlight certain texts.

SEARCH STRATEGIES

Regardless of the chosen location for their research, students' search strategies indicated a lack of planning (see Table 3). They appeared to jump in without strategizing or determining the scope or organization of a given database or search engine. Most (36 students, on 61 separate occasions) browsed immediate search result sets; we also watched 24 students (79 times) revert to previously found results. Twenty-one students chose the first search result or all of the first set of results. Fifteen students searched using terminology that was too broad to render meaningful results. Ten students searched a database inappropriate

Table 3
Search strategies.

Strategy	Number of students
Ignored search engine features	4
Found new sources from current citations	5
Used keywords in articles for new searches	4
Got waylaid by ideas or keywords	4
Chose first search result or all of first set of results	21
Browsed immediate search results	36
Browsed previously-found results	24
Searched wrong database for topic	10
Terminology too broad for meaningful results	15
Searched for topic inappropriate for database searching	6
Typed a full question into search box	4
Used natural language phrasing rather than keywords	10
Expressed willingness to change search strategy	6

for their topic. Ten students used natural language. Six students searched for a topic inappropriate for database searching (i.e., far too general). In order to expand their search, five students found new sources from current citations. Four students ignored some major, helpful features offered by their search engines. Four students used keywords from articles to do new searches. Four students got waylaid by ideas/keywords. Four students typed a full question into an Ebsco or Proquest search box. One student verbalized that he was searching using the wrong word or topic. Given poor results, six students expressed a willingness to change their search strategy. Not one student mentioned that his/her search methodology was too narrow.

SEARCH SYNTAX

In general, students' use of search syntax reflected a lack of reflection or preparation (see Table 4). Thirty students tried to vary their search terms on 153 separate occasions, 23 students tried narrower terms, and 23 students reverted to a brand new search. Eighteen students (56 times) retained the same search topic or term in all search venues. Thirteen students tried broader search terms. Nine students combined incorrect search techniques in their research. Four students changed the search tense or punctuation and four returned to a previous search topic. Three students typed the word "articles" after their search term, and one typed "scholarly articles" in the search box.

STUDENTS' USE OF LIMITS. Ten students limited to full text, eight students used the date limiter, eight students limited by peer review, four students limited by publication type, and three students used a combination of the date, peer review, full text, and language limiters. Two students used the subject limiters, and two students restricted their search by year. Six students demonstrated that they understood Boolean logic (one used the + sign in Google), whereas three students made obvious misuse of Boolean logic by trying to increase results by using the AND operator. Six students employed the keyword limit. Five students used the suggested search terms. One student used the linked subject feature to navigate from one article to the next. However, not one used controlled language.

WEBSITE BEHAVIOR. Most students used simple search, but seven students did use the advanced search feature. Our operative term in describing student evaluation of found sources is "brief." Three students articulated that the length of an article affects whether or not they read it. Thirty five briefly skimmed the article source (315 times). Twenty-one students briefly skimmed the abstract (102 times), 18 briefly skimmed the article title (74 times), 11 briefly acknowledged the source location (17 times), 10 briefly skimmed the table of contents (20 times), and 10 briefly evaluated and acknowledged the source (23 times). One student kept an article based on the title alone. One student did not recognize, and continued to search, an advocacy site, even though she had been warned against using such resources.

Table 4
Search syntax.

Added a couple of words to search	7
Broadened search	13
Narrowed search	23
Changed topic within a search	30 (153 times!)
Retained same search terms in several databases	18
Changed search tense or punctuation	4
Returned to previous search topic	4
Incorrect search technique	9
Reverted to a brand new search	23

Table 5
Website navigation.

Behavior	Number of students	Number of times
Briefly skimmed abstract	21	102
Briefly skimmed article title	18	74
Briefly skimmed article source	35	315
Briefly skimmed table of contents	10	20
Briefly evaluated/acknowledged source	10	23
Acknowledged source location	11	17
Kept article based on title alone	1	1

SETON HALL LIBRARY WEBSITE NAVIGATION (SEE TABLE 5)

Student use of the library Website indicated that many had no discernible plan of action. Twenty clicked on the Databases tab. While 16 found the search box from the library's home page, another 16 indicated that they were unsure as to what to do next on the page. Eight students browsed the library homepage for clues to the next step in their research process. Fifteen clicked on the "Articles and Journals" tab, and 14 used keywords in our database search box. Thirteen students used Academic Search Complete and 11 clicked on our online catalog. Seven searched databases by subject, while another seven just started clicking all over the page in order to find articles. Only one browsed through our E-journals list; likewise, only one student opened our research guides. Nine students went through at least two pages of database search results (whereas six browsed through at least two pages of Google results). Seven students could not open an article (only five reported this problem), and three had trouble logging into the library databases from home. Some examples of students' lack of reading instructions were that two students searched for keywords in our alphabetical database list,

WHAT VIEWING THE TAPES SHOWED

Although the analysis of the Atlas data was revealing, repeated watching of the students' tapes allowed us clearly to see similarities in the way students approached their assignments. The participating students tended to follow five general patterns in their online research behaviors: 1. *Foraging*: there is no research plan and little indication of an understanding of the nature of various resources—the student expects to build his or her thesis based on the material she or he stumbles upon; 2. *Google dependence*: there is no need to search anywhere other than Google because it has everything, "Google is my friend"; 3. *Reliance on only one search strategy, regardless of the database they are searching*: the student does not recognize differences between databases and/or the clues that would ease the difficulty in focusing his or her topic; 4. *Habitual topic changing*: he or she will change the topic before completely evaluating all search results; and 5. *Overuse of natural language and search term stringing*: in other words, the student will type a question into the search box, as if a person were waiting there to answer. Or, the student might list a number of apparently relevant terms in a string, without nesting or the application of Boolean operators.

These scenarios exemplify many of the behaviors demonstrated in other studies of student on-line information seeking activities.

Student #1: goes to EZ-borrow instead of looking in our OPAC! She had tried to do research in Google Scholar but does not trust results. She eventually goes to our list of databases and looks for literary criticism in the alphabetic list of database titles starting with C [Behavior 1, foraging].

Student #2: says that she "doesn't like articles that are too complicated." She searches Google books and says that she prefers

the Google book description to the list of subject headings accompanying our OPAC book information [Behavior 2, Google dependence]. Student #3: types the following into Academic Search Complete: “human trafficking what is the government doing to stop it” [Behavior 5, search-term stringing]. The database yielded no results but reverted to smart search. Finding numerous results, she clicks full text and states, “I am not finding what I want to find” and sighs that this is the difficult part about researching. She is not finding answers to her questions. She reads one abstract about poverty being the cause of trafficking. Although she did not find answers to her questions, she claimed that she did find other interesting facts to be added to her paper.

Student #4: in Academic Search Complete, types “human trafficking” and gets 1876 results. She does not narrow down [Behaviors 1 (foraging) and 3 (single search strategy)]. When she finds an appropriate article, she does not know how to open it. There is no link, “I am not familiar with this kind of research.” She finally copies the abstract. She is trying to cite from the abstract (a positive indication that she understands the need to cite). She explains that she likes to copy and paste into Word and summarize all she understands from it, then tweak it and try to make each article fit and flow in the paper. She puts her found items in what she believes is the right order and comments that she’ll be good. She sounds satisfied and positive. She types in a note to “summarize in [her] own words.” Interestingly, she talks about having read an article but only has read the abstract. She indicates that she does not understand last-name-first syntax. She sees an author listed as “Gallagher, Anne,” but thinks there are two authors: Gallagher and Anne.

Student #5: jumps into our databases without narrowing her topic [Behavior 1, foraging], “clinical care nursing.” After bypassing our book catalog, she enters our journals list and then a Proquest database, where she types in a natural language query, “the role of the critical care nurse in the delivery of bad news” [Behavior 5, search term stringing], which yields no results. Proquest responds with the “smart search” option. She finds and tries to email articles but doesn’t use the option provided by database. She eventually leaves the databases and goes to the American Association of Critical Care Nurses Website.

Student #6: understands search sequencing but does not understand how to build a search strategy. Instead, the student uses the Control F key to find keywords in an article that she feels is appropriate for her topic [Behavior 1, foraging]. Eventually, she uses advanced search when given the “search within” option. She saves pertinent articles, goes to Google for definitions and explanations, using it as a dictionary and an encyclopedia [Behavior 2, Google dependence]. She chooses to use the articles with which she agrees.

Student #7: searches for animal behavior and its similarity to human behavior. Confused by the library home page, she ends up on our “dissertations and theses” page and types “animal rights vs. human rights,” getting results that have nothing to do with her information need [Behavior 5, search term stringing]. She talks to her friend, saying “Apparently people don’t know how to write here...I’m not having fun.” She then goes to Google and types in “animal rights articles.” She mentions that her thesis is basically that they [animals] should have rights, but she does not define or explain or inquire about what those rights should be. She looks up “animal welfare” in Wikipedia. She then finds a book in Google Books. She starts to read a page at random in a book. Back in Google, she types “animal

vs. human rights” and ends up in the “Intellectual Conservative: Conservative & Libertarian Politics” Website. She provides no indication that she realizes that this is an advocacy site. She continues a discussion with her friend about the concept of racism as compared to differences between humans and animals as she returns to the dissertations Website. She wants to get a thesis because she feels pressed for time “in defense of an animal’s right to life.” She finds a dissertation that she feels she can use. She argues the author’s thesis with her friend, “I love this dude”; she is discussing author’s thesis by just reading initial paragraphs. She reads the table of contents and saves the dissertation [Behaviors 1, foraging, and 2, Google dependence].

Student #8: needs five sources. She is looking for information on the benefits of public healthcare. Instead of researching her topic in order to develop a hypothesis, she looks for articles that support her preconceived ideas. Using natural language syntax [Behavior 5, search-term stringing] she searches our databases, first ATLA (the American Theological Library Association) where she finds a chapter in a book and then Proquest for information on Joan Kelly, a particular expert in the field. She then goes to the Joan Kelly finding aid in Harvard and locates a book about her in Google. She proceeds to our online catalog and looks for Joan Kelly, highlighting the author field. She goes back to Proquest and then to CQ Researcher. She locates information on Australia and New Zealand healthcare. At this point, she has found only two sources she feels she can use. She then returns to Proquest where she types in a few words and receives search term suggestions from the database. With 724,000 results, she skims the first few. She chooses the peer-review option, explaining that she needs reliable articles. She chooses an article for search terms but somehow ends up in MESH (Medical Subject Headings) lists. Choosing a general term, she adds “Australia” to it but without the intervening AND operator [Behaviors 1, foraging, and 4, topic changing]. She explains that Proquest is her go-to database, because she usually finds something within 5 minutes. She mentions that she gets frustrated when she finds something she can use without a link to the full text.

Student #9. The topic is artificial intelligence (AI), true or false. The student starts with Academic Search Premier (ASP), looking for the “Chinese room argument” by John Searle. The student immediately locates three usable sources. In this case, Google phrasing works successfully in ASP. She needs examples but doesn’t bother to read an article that is available in full text. Then the student goes to the Opposing Viewpoints database. She misspells “argument,” so the system assumes she means “garment.” Then she opens Lexis Nexis. She says she doesn’t know where to start, but she doesn’t want to read or figure it out [Behavior 1, foraging]. Eventually she finds an article but refers to it as a book. She tries to find a philosophy research guide in our institutional repository. She goes to our book catalog and looks up an author in the title field. She then goes back to read the PDF of one of her found articles. Admitting she is lost, she tries to search the library but clicks on library hours. She then looks in ASP for background information on AI. Eventually she opens up Britannica Online in her search for the “Chinese room argument.” She finds a weak definition of AI in Google and returns to Britannica, which she refers to as a search engine [Behaviors 2, Google dependence, and 3, reliance on a single search strategy].

Student #10: uses Google to access the New York Times (even though we have a subscription) for information on Michelle

Bachman. She then types in “Sara Palin sexism.” Then she tries “Sarah Palin Michelle Bachman Hillary Clinton sexism in media portrayal,” then “Newsweek Michelle Bachman” [Behaviors 2, Google dependence, 4, topic changing, and 5, search term stringing]. She locates a blog; then she returns to the SHU library databases. In the Opposing Viewpoints database, she tries “Newsweek Michelle Bachman,” with no results. She tries the same search in Google but returns to the Seton Hall Library Website and tries the Gender Watch database, where she types “Newsweek Michelle Bachman.” She ends her search in the Communication and Mass Media Complete database, where she searches for Newsweek as a keyword.

THE SURVEY

SURVEY ANALYSIS

We developed our questions with an awareness of the IL progression standards for New Jersey colleges and universities as articulated by the NJLA/ACRL College and University section: i.e., how students identify and address information needed; access information effectively and efficiently; evaluate and think critically about information, and use information effectively for a specific purpose.

In addition to demographic information such as age, sex, major, and academic level, our questions covered research instruction history; i.e., how students developed their research skills: through library instruction, trial and error, from friends, college professors, or high school teachers; how the students determined the quality of the resources they found; i.e., popular magazine, as opposed to a scholarly journal article. We asked about resource types; i.e., when they look at an online source, how do they determine what kind of material or format (book, article, citation, or abstract) they have found, and whether it matters to them. We also asked them how they identified primary sources.

We wanted to know how the students evaluated resources for quality and how they decided that an online resource was credible. What did they feel was the most efficient way to find related sources? We asked the students to report on their research behaviors; i.e., did they work alone or in teams, how long might it take them to find information to write a paper, when did they decide they had enough information to write their paper, whom did they ask if they had difficulty with their research assignment, and what difficulties did they often face when doing research (topic, search terms, choosing the right articles, too many or few articles). Finally, we asked them how they reasoned and articulated their search strategy based on their research or on a research process we asked them to describe in the survey.

Thirty-six students completed the survey. Most (66.6%) claimed they learned their research skills from their high-school teacher. Of those who learned from a librarian, 36% said the librarian came to their freshman orientation of English class. Regarding the first source students chose in order to find information on a topic, 61% mentioned Google. 41.66% claimed they read the title first when they open a Webpage. We asked the students what keeps them from moving from one website to another. Most (33.3%) mentioned the relevance of the information to their topic as most important, and 25.9% said that the credibility of the information on the website was very important. We wanted to know how many pages or screens students would search before leaving a website; 36% mentioned two screens. Most students (75%) responded that format (article, book, or dissertation) was important to them. Even more students (80.55%) told us that when they look at a webpage, the title helps them determine what type of information they are looking at. When they find an article appropriate to

their topic, 77.8% reported that they use similar words (as opposed to links, bibliography, or author) to find similar information in other locations.

DISCUSSION

Ironically, many hours of analyzing the video logs that the students recorded of themselves doing research led us to the conclusion that Google has had the largest influence on undergraduate research habits, so much so that it is the major impediment for them understanding library information structures and engaging with the scholarly literature in a meaningful way. Although students identified their research topics at the outset, they could not articulate their goals and plunged into database searching without any sort of granular approach to their research. As their research experience progressed, they stalled, seemed to retract and/or reverse their direction, expressed frustration, confusion, and would often change their topics midstream.

Students who completed our survey did not reflect any discomfort with these patterns. They did not indicate any perceived deficits in their own research skills or efficiency. We found that, based on our standards, the students had an inflated view of their on-line research skills: 23 (64%) agreed or strongly agreed with the following survey statements: “I feel confident about my ability to find information,” and “I feel confident about the quality of sources I choose.” Twenty students (55.5%) agreed or strongly agreed that “I am able to do research in a reasonable amount of time.” And 19 (53%) disagreed or strongly disagreed with the following statement: “I am unsure of my ability to find information.”

CONCLUSION

Of course there are limits to our study. Variables common to an ethnographic analysis such as time of day, general attitude toward the class or teacher, health, mood, attitude toward research, among others might have affected our students' research behaviors. Our initial study group of 42 students excluding freshmen and graduate students was self-selected and only a small representation of the Seton Hall University student body. Moreover, we examined the survey results as an aggregate rather than by looking at each individually and thus were unable to compare a student's video log against his or her written statements. However, authors are currently undertaking a follow-up study that will address some of these issues. We have included freshmen and graduate students in the second iteration of our research. The new study also ties the survey results with each student while employing the same methods (a screen-recording and our newly implemented EDS discover layer). This vendor product is one of several currently on the market that provide the user with a “Google like” experience to search library resources. However, as is made clear from the results of this study, technology can only do so much—no matter how sophisticated a search engine or indexing system is, students still need to learn how to search for and evaluate information. The information seeking behavior of our undergraduate students, which we have categorized as Foraging, Google Dependence, Reliance on a Single Search Strategy, Habitual Topic Changing, and Overuse of Natural Language or Search Stringing are strategies that seemingly were developed earlier in the students' careers. Given these issues, the research habits that many students have adopted have resulted in stumbling blocks that can be ameliorated only by honest discussions within the profession.

ACKNOWLEDGEMENT

This research was funded by an unrestricted gift from Google. The authors would also like to thank Dr. Carol Kuhlthau, our mentor, without whose ideas and support this project would not have existed.

APPENDIX. SURVEY QUESTIONS

What is your name?

What university/college do you attend?

What is your age?

What is your major?

What is your academic level?

- Sophomore
- Junior
- Senior
- Graduate student
- Other. Please specify.

What is your sex?

- Male
- Female

Who helped you develop your research skills? (check all that apply)

- My high-school teacher
- My high-school librarian
- My friend(s) in high school
- I learned through trial and error--on my own
- My friends in college
- My college professor
- The college librarian
- None of the above
- Other. Please explain

From the question above, if you checked: "The college librarian." How did you request the library instruction?

- I went to the reference desk
- I made an appointment with a librarian

REFERENCES

- Broder, A. (2002, September 01). A taxonomy of web search. *ACM Sigir Forum*, 36(2), 3–10.
- Cockrell, B.J., & Jayne, E.A. (2002, May 01). How do I find an article? Insights from a Web usability study. *The Journal of Academic Librarianship*, 28(3), 122–132.
- Few participants took the time to read explanations, descriptions, search hints, or help screens; they carried over their Web search habits to searching library databases; they were inclined to reach hasty conclusions, for example, that no record existed when an improperly constructed search did not return one; some individuals (especially undergraduates) were inclined to give up very easily; many participants were not selective, choosing the first item in a list of indexes or the first record in a list of citations; and many participants did not scroll down to information that was displayed lower on the screen. For each task, most participants selected pages rapidly and scanned through them briefly, hoping to encounter an obvious solution. Few paused to investigate their options or to read descriptive annotation. Cockrell, B.J., and Jayne, E. A., 2002. "How do I Find an Article? Insights from a Web Usability Study," 129.
- Currie, L., Devlin, F., Emde, J., & Graves, K. (2010, January 01). Undergraduate search strategies and evaluation criteria: Searching for credible sources. *New Library World*, 111, 113–124.
- Foster, N.F., & Gibbons, S. (2007). *Studying students: The undergraduate research project at the University of Rochester*. Association of College and Research Libraries (available at: http://www.ala.org/acrl/sites/ala.org/acrl/files/content/publications/booksanddigitalresources/digital/Foster-Gibbons_cmpd.pdf).
- Gross, M., & Latham, D. (2009, July 01). Undergraduate perceptions of information literacy: Defining, attaining, and self-assessing skills. *College & Research Libraries*, 70(4), 336–350.
- Head, A.J. (2013). Project information literacy: What can be learned about the information-seeking behavior of today's college students? *ACRL 2013 Proceedings* (Retrieved from: http://www.ala.org/acrl/sites/ala.org/acrl/files/content/conferences/confsandpreconfs/2013/papers/Head_Project.pdf).
- Head, A.J., & Eisenberg, M.B. (2009). Finding context: What today's college students say about conducting research in the digital age project information literacy progress report. Retrieved from: <http://eric.ed.gov/?id=ED535161>
- Hearst, M., Elliott, A., English, J., Sinha, R., Swearingen, K., & Yee, K. -P. (2002, September 01). Finding the flow in web site search. *Communications of the ACM*, 45, 9.
- Holman, L. (2011, January 01). Millennial students' mental models of search: Implications for academic librarians and database developers. *The Journal of Academic Librarianship*, 37(1), 19–27.
- This award (http://research.google.com/university/relations/research_awards.html), for those not familiar with it is given to university faculty who work on some form of human-computer interaction. Most awards are in the \$40,000 to \$70,000 range and are structured as unrestricted gifts.
- Judd, T., & Kennedy, G. (2010, December 01). A five-year study of on-campus Internet use by undergraduate biomedical students. *Computers & Education*, 55(4), 1564–1571.
- Kolowich, S. (2011, August 22). What students don't know, Inside Higher Ed, Retrieved from: https://www.insidehighered.com/news/2011/08/22/erial_study_of_student_research_habits_at_illinois_university_libraries_reveals_alarming_poor_information_literacy_and_skills.
- Lee, Hur-Li (2008, May). Information structures and undergraduate students. *The Journal of Academic Librarianship*, 34(3), 213.
- Lee, J.Y., Paik, W., & Joo, S. (2012, March 01). Information resource selection of undergraduate students in academic search tasks. *Information Research: An International Electronic Journal*, 17, 1.
- Lorigo, L., Pan, B., Hembrooke, H., Joachims, T., Granka, L., & Gay, G. (2006, July 01). The influence of task and gender on search and evaluation behavior using Google. *Information Processing and Management*, 42(4), 1123–1131.
- McClure, R., & Clink, K. (2009, January 01). How do you know that?: An investigation of student research practices in the digital age. *Portal: Libraries and the Academy*, 9(1), 115–132 (Top of Form).
- Rempel, H.G. (2010, November 09). A longitudinal assessment of graduate student research behavior and the impact of attending a library literature review workshop. *College & Research Libraries*, 71(6), 532–547.
- Shanahan, M.C. (2007, August 01). Information literacy skills of undergraduate medical radiation students. *Radiography*, 13(3), 187–196.
- Shanahan, M.C. (2008, January 01). Transforming information search and evaluation practices of undergraduate students. *International Journal of Medical Informatics*, 77(8), 518–526.
- Sorensen, C., & Dahl, C. (2008, November 01). Google in the research and teaching of instruction librarians. *The Journal of Academic Librarianship*, 34(6), 482–488.
- Suarez, D. (2007, Winter). What students do when they study in the library: Using ethnographic methods to observe student behavior. *Electronic Journal of Academic and Special Librarianship*, 8(3) (Retrieved from: http://southernlibrarianship.icaap.org/content/v08n03/suarez_d01.html).
- Taylor, A. (2012, March 01). A study of the information search behaviour of the millennial generation. *Information Research: An International Electronic Journal*, 17, 1.
- Walraven, A., Brand-Gruwel, S., & Boshuizen, H.P.A. (2009, January 01). How students evaluate information and sources when searching the World Wide Web for information. *Computers & Education*, 52(1), 234–246.
- Zhang, Y. (2008, January 01). The influence of mental models on undergraduate students' searching behavior on the Web. *Information Processing and Management*, 44(3), 1330–1345.