The Journal of Academic Librarianship xxx (2012) xxx–xxx

Contents lists available at SciVerse ScienceDirect

The Journal of Academic Librarianship

Patterns of Undergraduates' Use of Scholarly Databases in a Large Research University

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ARTICLE INFO

Article history:
Received 18 May 2012
Accepted 16 October 2012
Available online xxxx

Keywords:
Undergraduates
Databases
Information literacy
SQL analysis

ABSTRACT

Authentication data was utilized to explore undergraduate usage of subscription electronic databases. These usage patterns were linked to the information literacy curriculum of the library. The data showed that out of the 26,208 enrolled undergraduate students, 42% of them accessed a scholarly database at least once in the course of the entire semester. Despite their higher levels of learning and expected sophistication in information seeking skills, juniors and seniors used databases proportionately less than freshmen and sophomores. The University Library conducts a variety of introductory seminars that introduce freshmen to databases in the Fall semester. There was no evidence that this momentum is sustained in the subsequent years when higher-level more sophisticated skills are needed.

INTRODUCTION

Studies have shown that about three quarters of undergraduate students conduct their research over the Internet as opposed to being physically in the library (Jones, 2002; Tenopir, 2003). Web resources included search engines, Web portals, course-specific Web sites, and the campus library Web site. Percentages of preference of the Internet over the library differ with discipline with 88.4% of the biology majors in Tenopir's study, for example, and 69.8% of engineering students. Another study (Voorbij, 1999) found that 60% of the respondents in the humanities and 78% of the respondents in social sciences use the Internet for study. As more students use online resources for their research, Waldman (2003) found that many of them were confused between resources that were freely available on the World Wide Web and those that were licensed through the library and accessible through the Internet.

According to Cockrell and Jayne (2002), students would rather stick with their World Wide Web search skills than try to learn new skills needed for searching different scholarly databases. This is reinforced by other studies (OCLC, 2002; Voorbij, 1999) that show that up to two-thirds of undergraduate students perceived that their Web searches yielded as much or more information than they needed. Nevertheless, Graham (2003) found that although students were not only prone to misinformation but also to advertisements, only a few of those who participated in the experiment verified the information they found on the Web. Moreover, Herring (2001) found that faculty are concerned about their students' ability to evaluate the information they found on the Web. Her study showed that, for that reason, more than 83% of faculty who participated required their students to use other sources in conjunction with the Web.

Libraries have long advocated for use of scholarly databases because of their richness in academic material and scarcity of advertisements. On average, university libraries belonging to the Association of Research Libraries (ARL) were spending about 47% of their materials budget on electronic resources in the 2006–2007 academic year (Association of Research Libraries, 2008). The highest percentage was as high as 73% for Wayne State in the 2003–2004 academic year (Association of Research Libraries, 2005). What proportion of undergraduate students is impacted by these significant expenditures? This study helps to answer this question by showing the number of undergraduate students who use these resources.

In doing so, the article will present a brief background of the University of Michigan-Ann Arbor campus, where the study was conducted. Following this overview, the article will review the literature concerning undergraduates' use of online resources. Then the research approach used in this study will be outlined followed by the findings. Lastly, the article will discuss the ramifications of the study.

PURPOSE OF THE STUDY

Information literacy – framing the question, finding information, assessing sources, evaluating content, assimilating it, and communicating new knowledge – has long been in the education system. According to the Middle States Commission on Higher Education (2003), students at all levels should have some exposure to all six of these components. As students gain mastery of various subject areas, their information needs become increasingly sophisticated, as should their information seeking strategies. This study seeks to find out if more undergraduate students use scholarly databases as their information needs increase.

The study utilizes authentication data to explore undergraduate usage of subscription electronic resources and relates these usage patterns to the information literacy curriculum of the library. Various

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http://dx.doi.org/10.1016/j.acalib.2012.10.004

other methodologies have been used in the past, including surveys, interviews, observations, transaction logs, and focus groups. This methodology eliminates the need for sampling by unobtrusively capturing all authenticated access to the resources. The study does not directly link students' use of scholarly databases with their ability to seek information or conduct research. Rather, it seeks to compare the proportion of students who use databases by year of enrollment from freshman through senior.

RESEARCH QUESTION

The following research question is addressed:

Does the number of undergraduate students who use scholarly databases increase with their gained mastery in their discipline as they progress from freshman through senior years?

HYPOTHESIS

Given that information needs become increasingly sophisticated as students gain mastery in their fields of study, the proportion of undergraduates who use scholarly databases is expected to increase with years of enrollment.

BACKGROUND OF THE STUDY

The University of Michigan has a population of over 58,000 students on three campuses: Ann Arbor, Flint, and Dearborn. The main Ann Arbor campus has an enrollment of over 41,000 students in nineteen schools and colleges. Undergraduate enrolment in Fall 2009, when this study was conducted, was 26,208 students. The University Library System has 19 libraries with holdings of over 8 million volumes and over 70,000 serial titles. It subscribes to over 1400 databases. In addition, the University is in partnership with Google to digitize its entire print collection as part of the Hathi Trust Digital Library. To date, more than 4.5 million volumes have been digitized (Hathi Trust Digital Library, 2012).

The University is a Carnegie research university. The Carnegie Foundation for the Advancement of Teaching (1994) classified research universities as those which "offer a full range of baccalaureate programs, are committed to graduate education through the doctorate, and give high priority to research. In addition, they award at least fifty doctoral degrees and receive $15.5 million or more in federal support. According to the Boyer Commission on Educating Undergraduates in the Research University (1998), although those universities made up only 3% of the nation's total number of institutions of higher learning, they conferred 32% of the baccalaureate degrees and 56% of the science and engineering doctorates between 1991 and 1995. As such, their graduates are a significant part of the intellectual and cultural community.

LITERATURE REVIEW

According to an OCLC (2002) study, students learn about library online resources through a variety of sources: professors and teaching assistants 49%, look it up themselves 45%, library-user classes 34%, and through librarians 27% (students selected all applicable ways in which they learned about the resources, so the sum of the percentages exceeds 100%). When seeking help, 61% asked their friends while 36% asked their professor or teaching assistant, and 21% asked a librarian. Those who asked a librarian rated the help 7.8 on a scale of 10. Considering the teaching faculty's influence on students, coupled with students' satisfaction with help from librarians, teaching faculty can collaborate with librarians to help the students in their transition from searching on the World Wide Web to scholarly databases. Faculty can include inquiry-based assignments in their curriculum and provide opportunities for students to consult with librarians. Such assignments would satisfy the general education guidelines while encouraging students to be independent learners.

Recognizing that more students find out about online library resources from teaching faculty and friends than from librarians presents challenges and opportunities for libraries. While appreciating librarians' passionate outreach activities in promoting information competence, the Office of Academic Affairs at California State University (1995) evoked research that suggested that ad-hoc attempts cannot reach this goal. They echoed the American Library Association's (1989) report that suggested that a consistent and coherent education process was necessary to ensure that students were self reliant in their research process. In its far-reaching recommendations, the California State University's Office of Academic affairs laid out a two tier strategy approach:

1. Library orientation for freshmen and transition students, and
2. Competencies in general education which would be implemented by faculty in the various programs.

Integration of information literacy in the general education guidelines is increasingly widespread. For instance, it is part of the accreditation requirements for the Middle States Commission on Higher Education (2003). The Commission has a membership of over five-hundred institutions. It defines the concept of information literacy broadly as emphasis on critical thinking and the use of information to produce understanding and new knowledge. Nevertheless, various scholars (Elmborg, 2006; Luke & Kapitzke, 1999; Norgaard, 2003) have noted that librarians' perception of the concept as presented by the Association of College and Research Libraries (2000) has been centered primarily on teachable and measurable skills. As a result, opportunities of meaningful engagement with faculty have been lost.

For example, librarians were represented in the various policy making bodies of the Academic Senate of the San Jose State University (Reynolds, 1989). Through this membership and with support from both the University President and the Vice President for Academic Affairs, the library obtained approval from the Academic Senate Executive Committee to integrate information literacy in the general education curriculum. Nevertheless, the library proposal ended up being a one-hour library lecture "unit in the basic composition course which will familiarize students with basic strategies for locating information" (p. 78).

Although this effort was pioneering and far reaching in attempting to reach all the students, it only addressed the lower-level rudimentary information literacy skills; more specifically, information seeking abilities. The upper-level more sophisticated skills are better addressed through faculty/librarian collaboration at the discipline level. Additionally, the Middle States Commission on Higher Education (2003) cautioned against overemphasizing "one-shot" courses, saying:

> An institution that relies entirely on a single session of traditional library instruction to fulfill its information literacy requirements is placing itself at the lower end of information literacy delivery. It is also likely that in this situation there is little demonstrable collaboration. In fact, the relationship is likely to have the appearance of a "hands off" approach, relegating to the librarian what the faculty member perceives as information literacy (p. 21).

LIBRARIAN/FACULTY COLLABORATION

The Middle States Commission suggested the following shared roles in respect to the educational process recommended by the American Library Association's (1989) Presidential Committee on Information Literacy:

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- Faculty initiates the process of determining the nature and extent of information required with reinforcement by librarians.
- Librarians guide the students through the process of effectively accessing information.
- Librarians may introduce the concept of critically evaluating information sources but faculty ultimately determines resources sufficient for the final product.
- Faculty builds the course context in a manner that engages the student in critical evaluation of information content. Librarians and other external subjects may help the students as needed.
- Faculty and librarians jointly and continuously help students to understand the economic, legal, and social implications surrounding access and use of information.

As Luke and Kapitzke (1999) pointed out, librarians can do considerable disservice to information literacy efforts by approaching faculty with a narrowly defined view of information literacy as primarily centered in library instruction. Instead, librarians can partner with faculty to define information literacy components in the various courses and their (librarians) roles in implementing them. Explicit reference to the information literacy components in the syllabus can be used as a metacognitive toll for students to take control of their learning. It is important for librarians to appreciate that ultimately, faculty decide the aspects of information literacy that are useful for individual courses. Instructors design course curriculum in line with their curriculum goals while taking into account discipline needs and course level.

As a first step towards implementing campus-wide information literacy, librarians can take leadership in taking inventory of the information literacy elements that are spread out across campus. In addition to managing library-user instruction initiatives, librarians are uniquely placed to take the lead in helping to define institutional goals and positioning information literacy within the institution's larger plans for defining and assessing student learning. These include implementing institutional general education guidelines at the program, course, and library levels. The Middle States Commission on Higher Education (2003) postulated that planning for information literacy begins with taking inventory of where the institution stands in its efforts.

METHODOLOGY

The method used in a study determines what kind of conclusions can be drawn about the sample of participants and what findings can be generalized in the population as a whole. This is especially so when sampling academic institutions due to their diversity of disciplines, experiences, preferences, and expertise. This study is unique in that, unlike previous studies which relied on selected clusters of participants, it recorded every instance of database access through Search Tools, the University of Michigan Library's federated search engine. The data was then mined for activity by our target group: undergraduate students. Thus, the limitations imposed by sampling error were eliminated.

This study was conducted during the Fall 2009 semester at the University of Michigan, a large university with enrollment of 26,208 undergraduate students. Data was gathered for all access to the University of Michigan databases through Search Tools and analyzed for undergraduate users. The University of Michigan Library subscribes to over 1400 databases catalogued and managed by a Web application called Search Tools, the locally-used name for Ex Libris' Metalib product. Metalib or similar products are commonly found in academic libraries to conduct research in the scholarly record. Metalib provided the following services: browsing and searching of the list of databases catalogued by the University of Michigan Library, searching across multiple databases such as ProQuest, PsycInfo or Web of Science at the same time and from a single interface, and providing "permalinks," stable URLs that redirect patrons to the database so that the database remains accessible even when the URL for the resource changes. The library used these permalinks in a variety of places, including the University of Michigan's course management portal (CTools) and library catalogue (Mirlyn).

Access to Search Tools was managed by the University of Michigan's single-sign-on protocol named Cosign. It manages access to a suite of services for faculty, staff, students, and other eligible users affiliated with the university. The services range from Webmail, to course management tools, employee business, and student services. Using Cosign means that a patron who has authenticated to one of the University of Michigan search services such as Webmail can then be automatically authenticated by other University Web sites without needing to pass through an additional login screen. When an authenticated user accessed any of Search Tools' functions, some basic data about the transaction were logged. The log comprised data from three sources: 1) the patron's academic standing from the Office of the Registrar's data; 2) the academic status (student, staff, faculty), school affiliation, and declared academic majors and minors from the Online Directory; and 3) the resources accessed via Search Tools. It is important to note the students are able to opt out of providing this information in their directory entry, as a matter of preserving their privacy.

Data was gathered using industry standard techniques for tracking Web browser activity similar to Google Analytics. The locally-written software was customized in order to work with the University's user identification infrastructure. When a Search Tools page was loaded, an invisible image indicating what activity had been requested was added to that page's Uniform Resource Locator (URL) as part of the filename. The invisible image was a 1×1 pixel image with the same color as the background. The tracking software's primary logging facility received the requests, recorded the parameters, and kept track of the time these activities were taking place. At the same time, the software checked if the requester had previously authenticated in any Cosign protected resource of the University of Michigan. If so, it recorded their identification at a secondary logging facility.

The following data was gathered from the primary and secondary logging facilities: the action taken, any details describing the action taken, the time the action was taken, the relationship of the actor to the university (student, or faculty and staff), the school the actor was enrolled in (e.g. Education, Literature, Science and the Arts, Nursing, etc.), and the class standing (e.g. 1st year, 2nd year, 3rd year, etc.). For ease of processing, class standings were also recoded to a set of Booleans indicating how many years the patron has been enrolled in the classes, and whether they were presently enrolled as an undergrad or graduate student. SQL SELECT statements were then used to filter out data from patrons who were not undergraduate students. Thus, out of the 472,638 total actions logged for the fall 2009 semester, entries were filtered down to 130,361 which were attributed to the 10,897 enrolled undergraduate students using their class standing. SQL statements such as "SELECT COUNT(user_id_hash) FROM fall_2009 GROUP BY affiliate_school WHERE undergrad = 1" were used to generate the needed counts.

LIMITATIONS OF THE STUDY

The information and Technology Service (ITS) department manages IP addresses for all the University of Michigan Campus units, including the library. The Library policy allows for unrestricted access to subscription databases to all on campus addresses with two notable exceptions: users in residence halls and users on the campuses' wireless networks. Therefore, authentication is required before these otherwise on-campus users can access Library databases. Authentication is also required in order to use the majority of computers in the University of Michigan Libraries. A limited number of workstations are set up for non-authenticated use to accommodate walk-in patrons

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not affiliated with the University. Patrons may log onto these workstations by using a generic username and password provided by ITS. In summary, the following database users were authenticated:

- Off-campus use through Search Tools
- On-campus use through Search Tools over wireless
- On-campus use through Search Tools from the Residence Hall Network
- On-campus use through Search Tools where users either logged onto computers or used any of the suite of services managed by ITS such as Webmail, printing, or course management tools.

These services cover the majority access points for undergraduates, the subjects of the study. Nevertheless, out of the total number of 472,638 times that Search Tools was accessed in the duration of the study, only 61% (287,615) of them were authenticated. It is projected that the remaining 184,753 unauthenticated users were non-undergraduate members of the research community within the University of Michigan campus IP range.

FINDINGS

Out of the 26,208 undergraduates enrolled in Fall 2009, 42% of them accessed a scholarly database at least once. Contrary to the hypothesis that the proportion of students who used databases would increase with years as their research demands increased, the proportions decreased with years: 16% more freshmen used databases than sophomores while there were 2% more sophomores than juniors. The proportion of juniors and seniors were the same at 38% (Table 1).

Table 1 shows the proportion of undergraduate students of all disciplines who accessed a scholarly database at least once in the course of the semester. Freshmen led with 56%, 16% more than sophomores. Juniors and seniors had equal proportions at 38%, 18% lower than freshmen and 2% lower than sophomores.

Table 2 shows the number of times undergraduate students of all disciplines accessed databases. Because of the way Search Tools counts database usage, a database included in a federated search was counted once, just as if it had been searched independently. Counts were accumulated each time an undergraduate student was identified, including repeat visits by individual students. There were 130,361 database searches in the semester. The highest activity was recorded in November, with 37% of the total count. September had the least number of visits with 10%.

Table 3 shows the breakdown of proportions of undergraduate students who accessed databases by school or college. The School of Nursing had the highest proportion with 54% of the 637 enrolled students. Although the College of Literature, Science, and the Arts had the fourth highest proportion (46%) with 7523 unique students, it had more than twice the number of all the other programs put together. The college had an enrollment of 16,223 undergraduate students, more than 60% of the undergraduate enrollment. For that reason, a comprehensive information literacy program with the college would have the biggest impact campus wide.

Table 4 presents the fifteen most frequented scholarly databases. Search Tools provided for either selecting a preferred database or performing a federated search involving several databases. In the case of federated searches, results from a database were counted as access to that database regardless of whether the searcher clicked on them or not. The University of Michigan's Library catalogue, Mirlyn, was included in the federated searches. The catalogue counts reflected in Table 4 were for federated searches that included Mirlyn. Direct access to the catalogue was not counted.

Table 1
Database access by enrollment and class standing.

Class standing	Enrollment	Number of unique users	Percentage usage
Freshman	5865	3284	56%
Sophomore	5867	2347	40%
Junior	6406	2434	38%
Senior and Special	8070	2832	38%
Total	26,208	10,897	42%

Table 2
Database access by month.

Month	Number of database searches[a]	Monthly percentage of searches
September	12,476	10%
October	40,459	31%
November	48,553	37%
December	28,873	22%
Total	130,361	100%

[a] A search constituted a direct search or a query through a federated search.

DISCUSSION

These results show that 42% of the entire undergraduate student body accessed a scholarly database at least once in the Fall 2009 semester. Freshmen had the highest percentage of users with 56%, sixteen percentage points higher than sophomores who were the second highest. The University Library maintains a calendar that indicated that ninety-seven freshmen introductory seminars were conducted in Fall 2009. The average class size was eighteen students. More than 200 sessions were held in the semester on a wide variety of fields ranging from technology to curriculum associated sessions at all academic levels, open workshops, library tours, campus outreach, and community presentations. Ninety-seven of them, nearly half, were 100-level freshmen sessions that included hands-on instruction on conducting database searches.

Although many of the freshmen who attended library instruction seminars logged onto scholarly databases for the first time during those sessions, it is important to note that firstly, only about 1746 out of the enrolled 5865 freshmen (about 30%) attended the seminars. Secondly, some students attended more than one seminar and many of those who attended had accessed databases beforehand. Thus, in planning for a comprehensive scheme for freshmen library-user introductory seminars, as much attention needs to be put in preparing course materials as in taking into account the scheme's overall impact on the student body. For example, is there a systematic effort to reach specific groups of students or programs?

A systematic scheme of library-user instruction becomes even more challenging if it attempts to engage the entire undergraduate body. That is especially so for large institutions such as the University

Table 3
Database access by school or college.

	Enrolment	Number of unique users	Usage percentile
Nursing	637	347	54%
Kinesiology	811	409	50%
Music, Theater and Dance	781	393	50%
Literature, Science and the Arts	16,223	7523	46%
Dentistry	112	41	37%
Art and Design	511	185	36%
Architecture and Urban Planning	219	78	36%
Business Administration	1082	349	32%
Engineering	5459	1512	28%
Education	214	55	26%
Pharmacy	44	2	5%
Public Policy	115	3	3%
Total	26,208	10,897	42%

Note. Some colleges and schools, such as Education, Pharmacy, and Public Policy admit students after completing at least two years of undergraduate education. Graduate programs with no undergraduate students are not included in this list.

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Table 4
Top fifteen databases.

Database	Number of unique users
ISI Web of Science	4255
ProQuest	3888
OAIster	3518
PsycINFO	3250
General OneFile	2777
Readers Guide Abstracts	2739
Mirlyn (Library catalogue)	2653
ArticleFirst	2635
Wilson Select Plus	2619
Google Scholar	2173
JSTOR	2058

of Michigan with an enrollment of over 26,000 undergraduate students. Still, as demonstrated by the Office of Academic Affairs at California State University (1995), a large university system with over 433,000 students, librarians do not have to face this task on their own. With collaboration between the administration, faculty, and librarians, California State University developed a two tier system whereby librarians were charged with the responsibility of conducting orientation programs for freshmen and transfer students. Other information literacy competencies were to be built in the general education curriculum in a variety of ways including stand alone courses and distributed components in the disciplines. Partnership between discipline faculty and librarians was underscored as an important aspect that determined the success of implementing such a curriculum.

CONCLUSIONS

Less than half the number of enrolled undergraduate students accessed a scholarly database at all in the Fall 2009 semester. Juniors and seniors had the least proportions of database users in spite of their higher levels of learning and expected sophistication in information seeking skills. The University Library conducts a variety of introductory seminars that introduce freshmen to databases in the Fall semester. Nevertheless, this research did not find any evidence that the momentum was sustained in the subsequent years in which higher-level and more sophisticated skills were expected.

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