How do Engineering Students and Faculty use Library Resources?

Ms. Janet Fransen, University of Minnesota, Twin Cities

Janet Fransen is a liaison librarian at the University of Minnesota, working primarily with students and faculty in Aerospace Engineering, Computer Science, Electrical Engineering, and History of Science and Technology. Fransen often acts as a voice for user communities on library groups developing new services and technology tools. Her interests include analyzing the types of literature used by researchers in engineering and computer science, and finding ways to education new researchers on the breadth of material that will be useful to them.

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Introduction

In 2011, library staff at a large Research I university began looking for ways to track use of library resources by students, faculty, and staff. Access points tracked in Fall 2011 ranged from loans and use of digital resources to workshop attendance and appointments with peer research consultants. Access points related to consultations with archivists and media librarians were added in Spring 2012.

Working with campus institutional research staff, we were able to correlate Fall 2011 library use with higher term GPA and retention for first year students while controlling for other variables related to student success.[1] The Student Success line of inquiry is useful for demonstrating that successful students do find value in the library. However, as students move beyond their first year, the factors contributing to student success become increasingly complex and interrelated. Therefore, while we continue to collect first year data and plan to check the correlation strength each semester, we are not extending this area of study beyond first year students.

The rich dataset used for the Student Success analysis lends itself to another use, one that is arguably more "actionable" than the first: By aggregating the collected data over college, level (undergraduate, graduate student, etc.), and other groupings, we have our first good look at who is using library services (and who is not) as well as what they are doing.

The work in progress combines data collection in the Fall 2011 and Spring 2012 semesters and focuses on just science and engineering students, faculty, and staff. As of this writing, we have conducted basic demographic analyses on how College of Science & Engineering (CSE) faculty and students differ from their colleagues in other colleges, and have investigated possible correlations between library use and student success indicators for CSE first year students. We have also uncovered data limitations that will affect how we use the collected data, and how we refine data collection in the future.

Research Questions

In order to both explore library use in a particular college and discover the limitations of the data available, we formulated the following research questions:

- Faculty members tend to think that because they haven't walked into the library building in years, they are not library users. What kind of library use does the Spring 2012 data show for engineering and science faculty?
- How does graduate student use compare with undergraduates? With faculty members?
- Are there differences in how engineering and science undergraduates use library resources when compared to undergraduates in other colleges?
- Are there discernible differences among departments?
- Do student success correlations with library use found for the entire cohort of first year students hold for CSE first year students?

Literature Review

Libraries have always gathered data about use of materials, but interest in using data to better understand the library's users and to correlate use with institutional success factors has grown appreciably since the publication of the ACRL report The Value of Academic Libraries.[2] Some studies focus on identifying demographic characteristics of library users[3], while others attempted to correlate type and quantity of library interactions with grade point average or retention.[4-7]

Some institutions have investigated differences in library use and correlations with success factors for specific populations, such as Wong and Webb's work with correlating circulation data with GPA by major.[6] Studies that differentiate among fields of study or compare undergraduates, graduate students, and faculty are more likely to rely on survey and focus group information than logged data, however.[8, 9]

This study, like the work by the University of Minnesota that precedes it[1, 10], differs from previous work in these ways:

- The study relies on quantitative data
- The study incorporates many different library access points
- Analysis of correlations between library use and success measures controls for other factors known to impact student success.

This study builds on the previous University of Minnesota work by focusing on students and faculty in one college, the College of Science & Engineering.

Methods

Starting with the Fall 2011 semester, library staff have been collecting library transactions in as many separate library resource and service usage areas as possible. The only qualification for this first year of data collection is that the transaction must be associated with a unique user ID that can be matched to institutional demographic data. Table 1 lists the library access categories used for the 2011-12 dataset, with a summary of the access points that make up each category.

Library Access Point	Category
Digital	Database, e-journal, e-book, library website
Circulation	Loans, renewals, and interlibrary loan requests.
Reference	Online reference transactions, peer research consulting appointments, Archives & Special Collections consulting, SMART Learning Commons consulting, other individual consultations (Note: Consultations are only included in a University Internet ID was recorded.)
Instruction	Course-integrated, Intro to Library Research, workshop registration
Workstation	Computer workstation located in a library

Table 1. Library access points used for analysis.

User privacy is protected by tracking only the fact that a transaction of a certain type occurred; no other information about the transaction (which books were checked out, which databases were

searched, etc.) is included. In addition, once matched to the institution's demographic data, the user ID was removed in favor of an anonymized ID that is in no way associated with the actual user.

Although the library access points range across the library landscape, they do not present a complete picture of library use. Points of access we cannot currently capture include:

- Reference desk transactions
- Workshop and in-class instruction attendance (only registration is tracked)
- Use of a library space (beyond workstation login)
- Use of materials within the library that are not or cannot be checked out
- Digital resources logins from within the institution's IP range, when the user is not logged into any other authenticated service (such as email).

Each point of access is more fully described by Nackerud, et al.[10]

The demographic data provided by the Office of Institutional Research includes all institutional affiliates for each semester, whether or not they made use of the library during that semester. The analysis focuses on the percent of people in a given demographic who used the library, or a particular library access category. We have done little analysis on frequency of use (number of books checked out, number of e-book accesses, etc.) at this stage.

Results

Faculty Use of Library Resources

We did not request Faculty demographic data for Fall 2011, so only analyzed usage for Spring 2012. Table 2 shows that, when compared to other colleges or schools with more than 30 faculty members, science and engineering faculty members were among the most likely to use library resources. 77 percent used the library in some way we could track.

College/School	Number of Faculty Members	Percent Using the Library
Nursing, School of	62	90%
Liberal Arts, College of	550	87%
Pharmacy, College of	94	82%
Science & Engineering, Col of	416	77%
School of Management	98	77%
Food, Ag & Nat Res Sci, Col of	254	76%
Medical School	1036	73%
Education/Human Dev, Col of	171	73%
Law School	51	73%
Public Health, School of	133	72%
Biological Sciences, Col of	92	71%
Design, College of	84	69%
Veterinary Medicine, Col of	77	69%
Dentistry, School of	203	31%
Continuing Education, Col of	31	19%

Table 2. Percent of faculty using library resources by college or school.

When divided by department, differences emerge. Table 3 lists each department, the percent of faculty using the library in any measurable way, and the percent of faculty using the defined library access categories. In most cases, digital use closely matches overall library use.

Note that Mathematics has a higher percentage of Circulation usage than the other departments at 67 percent.

Department	Faculty Count	Workstation (%)	Digital (%)	Reference (%)	Circulation (%)	Instruction (%)	Any Library Use (%)
Aerospace Engineering & Mechanics	19	0.0	89.5	0.0	52.6	10.5	89.5
Biomedical Engineering	14	7.1	85.7	7.1	35.7	0.0	85.7
Chemical Engineering & Materials Science	37	2.7	73.0	2.7	35.1	0.0	75.7
Chemistry	33	6.1	81.8	6.1	57.6	0.0	84.8
Civil Engineering	30	0.0	80.0	10.0	26.7	0.0	83.3
Computer Science & Engineering	35	5.7	62.9	5.7	34.3	0.0	62.9
Earth Sciences	23	4.3	82.6	13.0	56.5	0.0	82.6
Electrical & Computer Engineering	39	12.8	79.5	2.6	46.2	5.1	79.5
Mathematics	76	21.1	80.3	2.6	67.1	3.9	86.8
Mechanical Engineering	45	2.2	64.4	6.7	35.6	0.0	64.4
Physics & Astronomy	45	6.7	68.9	2.2	51.1	0.0	73.3

Table 3. Percent of science and engineering faculty using the library, by department and library access category, for the Spring 2012 semester.

Computer Science & Engineering, Mechanical Engineering, and Physics & Astronomy all show lower digital usage rates than expected. According to the collected data, only 63 percent of the Computer Science & Engineering faculty members, 64.4 percent of Mechanical Engineering faculty members, and 68.9 percent of Physics & Astronomy faculty members made use of the library in a measurable way during Spring 2012.

Graduate Students

Generally, librarians in most areas of science and engineering assume that they will work with more graduate students than either undergraduates or faculty members: Graduate students have the background necessary to read and understand journal articles and other literature in their field. They are also actively working to identify the best resources to use for their coursework, lab work, and, for many, their thesis or dissertation.

Table 4 shows the percentages of users for each library access category by the degree sought. Not surprisingly, undergraduates (students seeking a BS degree) use the workstations found in the libraries more than graduate students. A higher percentage of undergraduates receive some kind of library instruction than graduate students. However, a lower percentage of undergraduates used digital, reference, and circulation services.

In the areas of digital use, circulation, and instruction, there was a marked difference between students seeking a Masters degree (MS) and students seeking a PhD.

At this level, there were no noticeable differences in usage between Fall and Spring semesters for each degree group.

	Workstation (%)			Digital (%)			Reference (%)			Circulation (%)			Instruction (%)			Any Library Use (%)		
	BS	MS	PhD	BS	MS	PhD	BS	MS	PhD	BS	MS	PhD	BS	MS	PhD	BS	MS	PhD
Fall 2011	29.1	19.0	19.9	46.8	61.5	77.9	1.4	2.9	2.6	17.9	28.6	55.9	9.6	1.7	3.3	62.1	66.4	84.2
Spring 2012	27.0	18.1	17.2	51.0	61.6	80.5	1.9	3.6	4.7	17.5	28.5	56.7	11.6	1.0	6.5	64.9	66.2	84.8

Table 4. Library access categories by degree sought.

We were curious about whether graduate student use by department would be similar to faculty use. Because of the differences between MS student usage and PhD student usage seen in Table 4, we analyzed MS students and PhD students separately in Table 5 and Table 6.

Table 5 shows that, like their faculty counterparts, a higher percentage of PhD students in Mathematics use library workstations and check out items than in other departments. A higher percentage of PhD students in every department used both workstations and circulation services than did faculty in those departments, and in many cases the percentage was substantially higher.

The percentage of Chemistry PhD students in the Spring 2012 semester and Computer Science PhD students in both semesters receiving instruction was much higher than their peers. Each spring, the Chemistry librarian speaks to a class in Ethics that all first year graduate students must take. The Computer Science department offers a year-long course for first-year PhD students, and the Computer Science librarian spoke to the class both semesters.

Department	Count		Workstation (%)		Digital (%)		Reference (%)		Circulation (%)		Instruction (%)		Any Library Use (%)	
	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
Aerospace Engineering & Mechanics	66	60	24.2	20.0	83.3	85.0	1.5	5.0	69.7	65.0	0.0	0.0	89.4	85.0
Biomedical Engineering	101	98	18.8	19.4	87.2	81.6	4.0	8.2	48.5	51.0	2.0	2.0	86.1	85.7
Chemical Engineering & Materials Science	173	168	12.1	13.7	76.9	87.5	4.6	8.3	59.5	58.9	1.2	0.6	86.1	91.7
Chemistry	232	220	20.7	15.0	89.7	86.8	0.9	4.6	58.2	57.3	0.9	25.5	98.7	90.9
Civil Engineering	85	78	24.7	19.2	82.4	83.3	1.2	3.9	67.1	61.5	5.9	1.3	87.1	85.9
Computer Science	224	219	11.6	7.3	67.4	69.4	1.8	2.3	39.3	37.0	16.5	14.6	72.8	73.5
Earth Sciences	50	44	18.0	9.1	88.0	95.5	4.0	6.8	86.0	65.9	0.0	0.0	90.0	95.5
Electrical Engineering	215	205	21.9	17.6	78.1	78.5	2.8	4.9	49.3	53.2	0.5	2.0	83.7	84.4
Mathematics	135	128	32.6	35.2	81.5	82.8	3.0	3.1	72.6	75.0	0.0	1.6	91.1	89.1
Mechanical Engineering	173	168	24.3	21.4	81.5	90.5	5.2	5.4	65.3	69.6	2.9	1.2	86.1	92.9
Physics & Astronomy	159	151	17.7	17.2	59.5	60.9	0.6	2.0	55.0	52.3	0.0	0.0	72.2	68.2

Table 5. Library access categories for graduate students seeking PhD degrees by department.
*** Note: Departments with fewer than 10 PhD students are not included.**

For those departments with more than 10 students in both programs, a higher percentage of PhD students used digital materials and checked out items than Masters students in almost every case.

Department	Count		Workstation (%)		Digital (%)		Reference (%)		Circulation (%)		Instruction (%)		Any Library Use (%)	
	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
Aerospace Engineering & Mechanics	35	34	14.3	20.6	60.0	70.6	2.9	8.8	37.1	52.9	0.0	2.9	60.0	76.5
Biomedical Engineering	33	28	12.1	7.1	63.6	64.3	3.0	0.0	18.2	10.7	0.0	0.0	66.7	67.9
Civil Engineering	67	69	13.4	15.9	76.1	68.1	3.0	10.1	19.4	37.7	4.5	0.0	77.6	72.5
Computer Science	272	254	11.8	6.7	52.2	55.2	2.2	1.6	19.1	17.3	1.8	0.4	55.2	55.5
Earth Sciences	11	12	18.2	8.3	81.8	100.0	0.0	8.3	63.6	41.7	0.0	0.0	90.9	100.0
Electrical Engineering	268	235	29.1	27.7	67.5	76.2	4.9	3.8	40.7	38.3	1.1	0.9	74.3	80.9
Mathematics	109	101	31.2	37.6	55.1	36.6	1.8	1.0	24.8	22.8	0.0	1.0	67.0	57.4
Mechanical Engineering	138	124	17.4	16.9	62.3	31.3	2.2	4.8	37.7	35.5	3.6	3.2	67.4	62.9
Technology Leadership Institute	57	47	3.5	2.1	61.4	48.9	1.8	2.1	5.2	6.4	1.8	0.0	63.2	48.9

Table 6. Library access categories for graduate students seeking Masters of Science degrees by department.
***Note: Departments with few than 10 MS students are not included.**

Undergraduates

Undergraduate students have opportunities and reasons to use library resources for their liberal arts electives. However, the need for library resources is not as apparent in undergraduate science and engineering courses. To get a sense of how library use by science and engineering undergraduates differs from use by students in other colleges, colleges were grouped into a non-science category and four science categories:

- Science & Engineering
- Biological Sciences
- Food, Agriculture, and Natural Resources
- Health Sciences

Note that we assigned these categories to facilitate data analysis. These science and non-science categories and definitions are not used elsewhere within the University.

Table 7 illustrates that overall, and in the Workstation, Digital, and Reference access categories, Science & Engineering undergraduate students use the library less than their peers in other majors, whether science-related or not. About the same proportion of Science & Engineering undergraduates check out library items as peers in Biological Sciences and Health Sciences, but a lower proportion than non-science students, and lower than Food, Agriculture, and Natural Resource students in the Spring 2012 semester. Science & Engineering students ranked about in the middle in the Instruction access category.

College Group	Count		Workstation (%)		Digital (%)		Reference (%)		Circulation (%)		Instruction (%)		Any Library Use (%)	
	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
Biological Sciences	1806	1702	39.9	40.3	70.1	75.3	1.8	3.2	16.8	17.2	6.4	9.5	81.5	85.2
Food, Agriculture & Natural Resource	1954	1894	40.9	41.6	67.6	68.5	2.4	2.5	17.9	27.4	15.6	18.2	79.8	83.3
Science & Engineering	5049	4653	29.1	27.0	46.8	51.0	1.4	1.9	17.9	17.5	9.6	11.7	62.1	64.9
Health Sciences	616	578	30.0	31.7	74.8	83.2	0.7	3.8	17.7	17.1	8.4	4.3	84.7	89.5
Non-Science	21455	20277	33.0	33.2	66.2	67.2	2.6	3.9	24.5	24.3	9.5	11.7	77.5	77.9

Table 7. Percentage of undergraduates using the library, by science/non-science category.

We wondered whether year in school would affect whether students in Science & Engineering used the library. Unfortunately, the dataset does not include year in school or any other indicator of the student's progress through his or her program. Science & Engineering does, however, include indicators for students who have not yet moved into the Upper Division (typically spring of the sophomore year and above[11]). Table 8 shows Lower Division students are more likely to receive instruction, but a higher percentage of Upper Division students used digital resources and checked out items.

Access Category	Lower Division (%)		Upper Division (%)	
	Fall N=2153	Spring N=1362	Fall N=2893	Spring N=3291
Workstation	29.1	27.5	29.1	27.3
Digital	44.1	43.6	48.8	54.1
Reference	1.8	2.3	1.1	1.8
Circulation	14.5	12.4	20.3	19.6
Instruction	14.9	20.3	5.7	8.1
Any Library Use	59.4	61.0	64.1	66.5

Table 8. Percent of Science & Engineering undergraduates using the library, Lower Division vs. Upper Division.

Finally, we investigated whether student use of library resources differed by the student's field of study. We grouped students by department (with some departments covering multiple majors) in Table 9. Note that students in the College of Science & Engineering are not classified by department until they enter the Upper Division.

Overall use by department varied greatly, from a low of 39.6 percent (Aerospace Engineering & Mechanics, Spring 2012) to a high of 91.3 percent (Earth Sciences, Fall 2011). Note that the Earth Sciences department is significantly smaller than the others, magnifying individual changes: The percentage of library users dropped to 68.8 percent in Spring 2012 as the number of students in the department increased. The count of students using the library remained about the same. The next highest use percentage is Chemistry, at 89.3 in Spring 2012.

Department	Count		Workstation (%)		Digital (%)		Reference (%)		Circulation (%)		Instruction (%)		Any Library Use (%)	
	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
Lower Division*	2153	1362	29.1	26.5	44.1	43.6	1.8	2.3	14.8	12.4	14.9	20.3	59.4	61.0
Aerospace Engineering & Mechanics	153	187	20.9	18.2	30.1	22.5	2.0	2.1	19.0	11.8	0.7	3.2	45.8	39.6
Biomedical Engineering	159	228	30.2	25.4	66.7	73.3	1.9	2.2	18.9	18.4	7.6	11.8	79.9	84.2
Bioproduct & Biosystems Engineering	53	57	37.7	43.9	67.9	64.9	1.9	1.8	28.3	31.6	1.9	5.3	79.3	75.4
Chemical Engineering & Materials Science	366	478	35.0	35.2	68.3	74.9	1.9	2.1	25.7	26.6	1.1	24.7	79.2	86.0
Chemistry	146	179	39.7	40.2	81.5	81.6	0.7	2.2	24.7	20.1	13.7	22.9	89.0	89.3
Civil Engineering	265	292	22.6	20.2	49.4	49.7	1.1	1.7	15.5	15.4	1.1	0.7	63.0	62.3
Computer Science	441	440	15.0	16.6	34.7	37.1	0.5	1.1	14.1	14.1	1.4	3.6	44.4	46.8
Earth Sciences	23	32	30.4	15.6	87.0	65.6	0.0	0.0	43.5	12.5	0.0	3.1	91.3	68.8
Electrical Engineering	324	327	35.8	29.4	50.9	52.9	0.6	2.8	15.7	17.7	5.9	4.9	65.7	64.8
Mathematics	299	321	50.2	50.5	38.5	47.0	0.7	1.9	36.1	36.5	4.0	6.2	67.9	71.7
Mechanical Engineering	565	634	20.5	17.0	39.3	50.6	1.6	1.4	14.2	12.6	15.2	1.7	56.8	60.3
Physics & Astronomy	95	112	41.1	32.1	48.4	48.2	0.0	0.9	30.5	29.5	0.0	4.5	74.7	64.3

Table 9. Percent of Science & Engineering undergraduates using the library during the Spring 2012 semester, by primary department affiliation (major).

*The College of Science & Engineering does not classify Lower Division students by major.

Although use is fairly consistent from one semester to the next for most departments, a few departments had higher use in one semester than the other.

When compared to graduate students and faculty, a lower percentage of Upper Division undergraduates in most departments use library resources, as shown in Figure 1. Aerospace Engineering & Mechanics shows the widest disparity, with only about 39.5 percent of undergraduates using the library in Spring 2012, compared to 76.5 percent of Masters students, 85 percent of PhD students, and 89.5 percent for faculty members.

There are exceptions, however. A higher percentage of Chemical Engineering & Materials Science undergraduates (86.0 percent) used the library than their faculty 75.7 percent). Mathematics undergraduates (71.7 percent) outpaced Mathematics Masters students (57.4 percent).

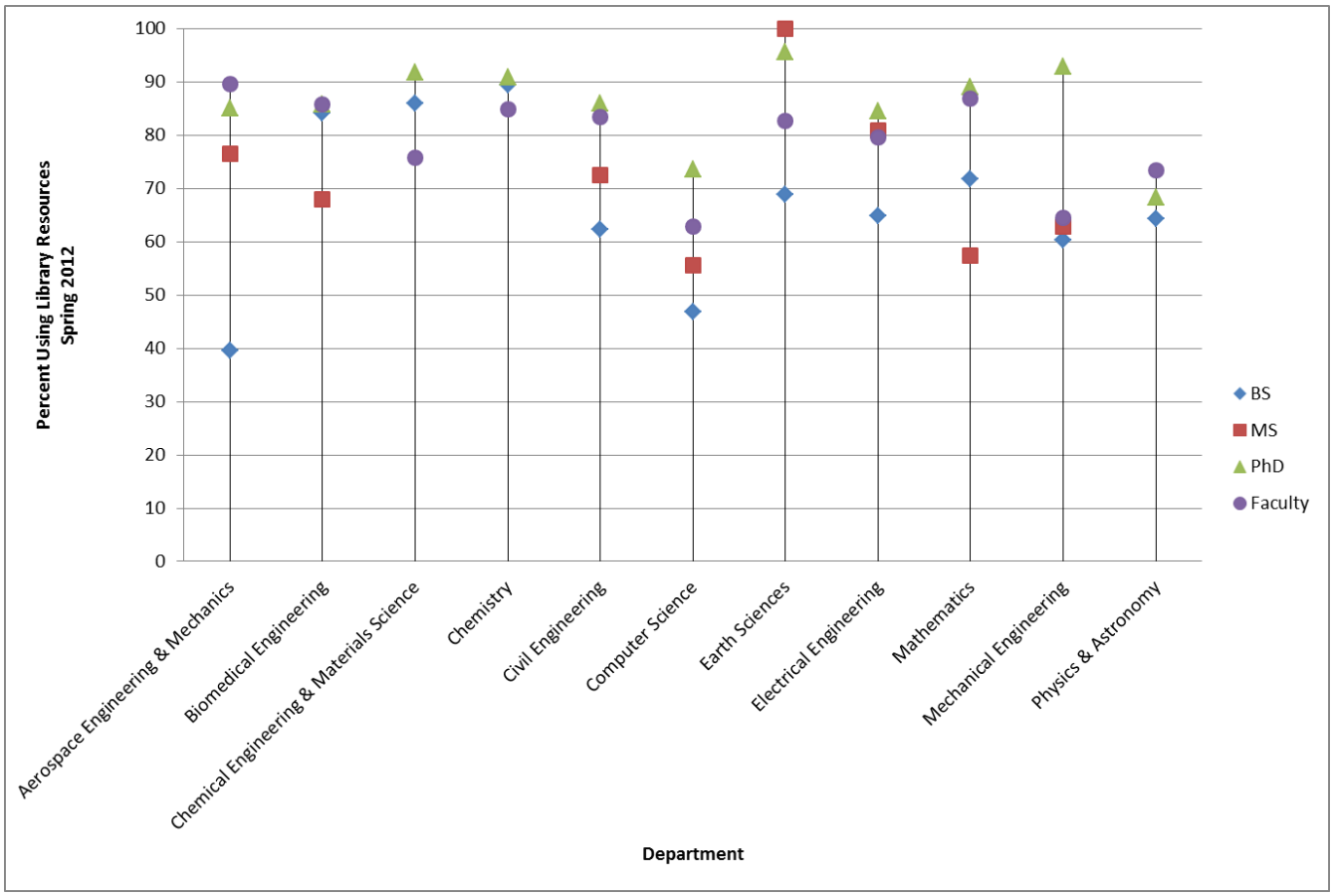

Figure 1. Any Library Use: Faculty, PhD, and MS students.

First Year Students: Success Measures

In the academic institutional research field, it is common to treat first-time, first-year students as a separate group when investigating the influence of specific variables on academic performance. Many factors influence grades and retention at every level, but the factors over which a university has control are much easier to determine with this group.

We have previously analyzed the relationship between library use and success measures for the entire 2011-12 first-year cohort; for this analysis, we included only students who were admitted to the College of Science & Engineering. We investigated four measures of success:

- Cumulative grade point average (GPA) at the end of Spring semester.
- Retention to Fall 2012.
- Student's experience with Scholarship, as measured by the Student Experience in the Research University (SERU) survey for this cohort.
- Student's experience with Academic Engagement, as measured by the SERU survey for this cohort.

In the analysis, we controlled for other demographic factors that can influence student success, including gender, race/ethnicity, and international status. We also controlled for whether students had received Pell grants, were first-generation college students, and had military veteran status. Academic preparedness is also a potential factor in success. We used ACT composite scores and number of AP credits transferred to control for preparedness.

For each success measure, we used regression analysis to check for significant differences in measures for library users vs. non-library users. We then checked individual library access points to look for relationships between frequency of use and the success measure.

Previous analysis using the entire first-year cohort (all colleges) showed significant and positive correlations between library use and all four of the measures listed.

GPA

Analysis shows a statistically significant and positive relationship between library use and GPA. In the model, GPA increased by .188 while holding other variables constant. When we investigated library access points, the model predicted a .12 increase in GPA for each item checked out, a .01 increase in GPA for each e-journal use, and a .005 increase in GPA for each workstation use.

Retention

Of the 894 students in the first-year cohort, only 69 (7 percent) were not retained. No statistical correlation to library use was found. There was a statistically significant negative relationship between use of reference and retention, but the numbers are small enough to have little practical meaning: 26 students used reference services, and 23 of those students returned in Fall 2012.

Scholarship
In the SERU instrument, Scholarship is measured using students' responses to how often they have:

- Examined how others gathered and interpreted data and assessed the soundness of their conclusions
- Reconsidered your own position on a topic after assessing the arguments of others
- Incorporated ideas or concepts from different courses when completing assignments
- Used facts and examples to support your viewpoint[12]

Analysis shows a statistically significant positive correlation between library use and Scholarship. Of all the variables included in the model, library use was the only variable that showed any significant correlation to Scholarship.

No one library access point had a statistically significant relationship to Scholarship.

Academic Engagement
In the SERU instrument, Academic Engagement is measured using students' responses to how often they have:

- Asked an insightful question in class
- Contributed to a class discussion
- Interacted with faculty during lecture class sessions
- Brought up ideas or concepts from different courses during class discussions
- Had a class in which the professor knew or learned your name
- Talked with the instructor outside of class about issues and concepts derived from a course
- Found a course so interesting that you did more work than was required[13]

The model showed no significant relationship between library use and Academic Engagement.

Discussion

With so much data on both library use and user demographics, we could have conducted hundreds of different analyses. In order to limit the scope of the analysis, we settled on a few research questions that applied to specific groups.

Faculty

What kinds of library use does the Spring 2012 data show for engineering and science faculty? Are there differences among departments?

Data show that a higher percentage (77 percent) of Science & Engineering faculty use the library in a measurable way than faculty in most other colleges. For most departments, overall library usage mirrors digital usage, indicating that if people use any library resource, they use digital resources.

A higher percentage of Mathematics faculty checked out library materials than in other departments. This may reflect a stronger preference for print materials than other departments

have. When paired with the Workstation usage—21 percent of Mathematics faculty members used a library workstation—it may also reflect the fact that Mathematics is the only science and engineering department with a branch library located in the same building as the faculty offices.

In an attempt to determine why digital use (and, by extension, overall use) by the departments of Computer Science & Engineering, Mechanical Engineering, and Physics & Astronomy was so much lower than expected, we looked at actual user counts and access counts for Computer Science & Engineering. The numbers for digital use were even more startling. Of the 35 faculty members in the department:

- Eight people searched databases (ACM Digital Library, IEEE Xplore, Engineering Village, etc.) a total of 25 times.
- Six people looked at e-books a total of 31 times.
- Four people looked at e-journals a total of six times.

We know by talking to the faculty that they are using electronic library resources much more than these numbers indicate. Use by faculty in this department (as well as at least the other two departments) appears to be undercounted because of the way we capture electronic transactions.

Transactions are captured via a "click-thru" script that authenticates and authorizes users. The click-thru script runs whenever the user clicks on a licensed resource link through the library website or uses a bookmark that points to the library-created link. If the user is off campus and not logged in through a Virtual Private Network (VPN), the user is prompted for a user ID and password. The user ID and type of use are then written to a transaction database. If the user is on campus or using a VPN, the user is authenticated through the IP address and usage is not captured. However, if the user has done something else requiring a user ID, such as accessing campus email, the user ID can still be captured and a transaction added to the database.

The Computer Science & Engineering faculty and graduate students do not use the centralized email and calendar servers used by most other departments. Therefore, they have less reason to log in to other resources when working on campus. They also appear to be more likely than others to use a VPN, so they are not prompted for their user ID even when they are working off campus. Finally, they may be going directly to ACM Digital Library for most of their journal reading and searching and using their personal ACM membership logins to gain access.

We believe that unexpectedly low percentages for digital and overall library usage among Computer Science, Mechanical Engineering, and Physics & Astronomy faculty are a result of the methods used to tie digital use to Internet ID. The method seems to be reasonably accurate for faculty in other departments and for students, but there is currently no way to test for accuracy.

Because data collection was limited to the fall and spring semesters and did not include breaks or summer, we may be missing a large part of the picture for both faculty and graduate students: Liaison librarians have noted anecdotally that they tend to receive more questions from graduate students during breaks, when they can focus on their research rather than classes they are taking or participating in as teaching assistants. Those time periods should be included in future work to account for these work patterns.

Graduate Students

How does graduate student use compare with faculty members? With undergraduates? Are there differences among departments?

During initial analysis, it became obvious that graduate students were better treated in two groups: those seeking PhD degrees and those seeking Masters degrees. Graduate students generally used the library more than undergraduates, but Masters students appear to be closer to undergraduate levels than PhD levels, particularly in digital use and circulation.

At the University of Minnesota, Masters students in engineering rarely write a thesis. This difference likely accounts for much of the disparity in digital access and in circulation between the PhD students represented in Table 5 and the Masters students represented in Table 6.

A lower percentage of Masters students participated in library instruction than either undergraduates or PhD students. This may be because many Masters students are working full time and rarely on campus for in-person workshops.

Instruction participation is not high for PhD students either, but there are particular semesters that show peaks for certain departments. These peaks are likely directly related to in-class library instruction offered to cohorts of PhD students during those semesters.

Undergraduates

Are there differences in how engineering and science undergraduates use library resources when compared to undergraduates in other colleges? Are there differences among departments?

A smaller proportion of Science & Engineering undergraduates used library workstations, digital resources, and reference services than their peers in both science-related and non-science related majors. Usage of circulating items was similar to that in Biological Sciences and Health Sciences, and instruction participation levels were on par with other colleges.

Among departments, there were great differences in library usage. Some differences were apparent between fall semester and spring semester. In some cases, such as Earth Science, the differences simply reflect shifts in population as students moved from Lower Division to Upper Division. The shift may also reflect when Senior Design classes—a prime opportunity for engineering librarians to work with undergraduates—occurred during the year. Table 10 lists departments that showed a difference between semesters, along with the semester in which a design class and library instruction were offered.

Department	Higher in	Design class offered in	Areas of Increase
Aerospace Engineering & Mechanics	Fall	Fall	Digital, Circulation
Biomedical Engineering	Spring	Spans both semesters. Librarian spoke to the class in the Fall	Digital, Instruction
Chemical Engineering & Materials Science	Spring	Both, but librarian spoke to the class in Spring	Digital, Instruction
Mechanical Engineering	Spring	Spring	Digital (note that Instruction was much higher in Fall)

Table 10. Departments in which usage levels differed from one semester to another, possibly due to Senior Design courses.

First Year Undergraduates

Do student success correlations with library use found for the entire cohort of first year students hold for science and engineering first year students?

When controlling for other factors related to student success, statistically significant positive correlations held for GPA and Scholarship indicators, but not for retention or Academic Engagement indicators.

Conclusions and Next Steps

This study offers library staff the most detailed quantitative view of who is using library resources that has ever been available. And yet it is only one part of a larger story. For each quantitative measure, we can only make guesses about behavior. These theories are based on our knowledge of our subject areas and of the people working in each discipline, the results of surveys of students and faculty, and formal and informal discussions with the users themselves.

The next step for this analysis will be to share the results with the College of Science & Engineering Dean's Office and Directors of Undergraduate Studies in the departments. Particular areas of interest include:

- Use of different types of resources as compared to other colleges
- Variations in use among departments, and between different demographic groups (undergraduate, faculty, graduate student (MS), and graduate student (PhD).
- Areas where great differences may indicate need for more instruction on resources, such as the large difference in library use between Aerospace Engineering undergraduates and graduate students.
- First-year student correlations of GPA and Scholarship to library use.

We are continuing to collect usage data and will be performing the same analysis going forward to both confirm results and to look for changes and their possible causes. For example, the

number of e-books in the library catalog has grown during the past year; we are curious to see whether that growth is reflected in use, and which groups appear to be benefiting most from these new resources. We will, however, be looking carefully at the library access points we are currently collecting to determine whether the information gained is worth the work involved to collect data for each access point.

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