

Lab-Integrated Librarians: Engagement with Unreachable Researchers

Mr. Alexander J. Carroll, North Carolina State University

Alex Carroll is the Research Librarian for Engineering and Biotechnology at the NCSU Libraries, where he works with the College of Textiles and the College of Engineering in areas that intersect with human and animal health. He has an M.S. from the School of Information and Library Science at the University of North Carolina at Chapel Hill, and a B.A. from James Madison University.

Bertha P. Chang, North Carolina State University

Bertha Chang is currently a Research Librarian for Engineering at the NCSU Libraries. She holds an M.S. from the Graduate School of Library and Information Science at the University of Illinois in Urbana-Champaign, and an S.B. and Ph.D. from the Department of Materials Science and Engineering at the Massachusetts Institute of Technology.

Mrs. Honora N. Eskridge, North Carolina State University

Honora Nerz Eskridge is currently Director, Centennial Campus Research Services with North Carolina State University where she leads library services to the Colleges of Engineering and Textiles. Eskridge has a Master of Library and Information Science from the Catholic University of America and a Bachelor of Engineering from Manhattan College.

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Abstract

Subject liaison librarians are working at the crossroads of the practical and emerging needs of researchers, seeking to connect with them throughout the research life-cycle rather than at the beginning when literature reviews are conducted or at the end when a scholarly publication emerges. In STEM disciplines, where research is oftentimes conducted in secure lab facilities, engagement is particularly challenging. In 2016, librarians at North Carolina State University embarked on a project to overcome this difficulty by joining selected research groups and attending regular lab meetings. This paper's findings will suggest that lab-integrated services present the opportunity to support the research enterprise as well as the teaching mission of universities simultaneously, and will challenge the notion of research support for faculty and information literacy instruction for students as separate and distinct library services. The paper will close with a discussion of the lessons learned from this pilot project and a discussion of the long-term sustainability of this type of program.

Institutional Context

North Carolina State University (NC State) is a land grant university located in Raleigh. NC State has approximately 34,000 students enrolled across twelve colleges representing all major academic fields of study. Part of the 16-campus University of North Carolina (UNC) System, NC State is the flagship institution for STEM teaching and research in the UNC System. The College of Engineering is thus one of the larger colleges at NC State, with over 10,000 students.

Between 1984 and 1987, NC State acquired a 1,000-acre tract of land to expand upon, and created a master plan for this new campus, which was named the Centennial Campus in honor of the 100th anniversary of the University. Centennial Campus is one mile from NC State's historic main campus and is home to academic departments and centers, as well as a growing number of corporate and government partners. Two colleges have relocated to Centennial Campus – the College of Textiles moved to Centennial Campus in 1991, and the College of Engineering began moving its many departments and centers in 1989, and continues to this day. At present, the engineering move is about 75% complete.

Library support at NC State is fairly centralized for a university of its size, with two major research library buildings (one on the historic main campus and one on Centennial Campus) and three small branch libraries. The library on Centennial Campus, the James B. Hunt Jr. Library, is a recent addition to the University, opening in 2013. Thus, for most of its existence, Centennial Campus had no central library and NC State has never had a dedicated library for engineering students and faculty.

Evolution of a Service Model

In 1998, subject librarians for engineering and textiles began to work on a model for delivering library services to engineering – a large, diverse community without a library, that was (and still is) located on two different campuses, and that has been slowly but steadily relocating from the main campus to Centennial Campus every few years as new buildings have been constructed. This model would also address differences in engineering curriculum and research

practices that tend to reduce engineer's use of and reliance on libraries compared with other disciplines.

The resulting service model was:

- *engagement-centered* to show engineers the value proposition that libraries bring to their teaching and research as well as to provide the opportunity for continuous learning about these users' needs;
- *location-independent* with librarians traveling to where the users were and where no service was tied to a specific location or service point;
- *responsive* to the unique information needs of engineers;
- *strategic* in approaching outreach to this large and diverse community of users as well as the management of liaison librarians' responsibilities. For example, our three librarian unit shares responsibilities to provide coverage at the College level for engineering and textiles, rather than serving specific departments.

This service model was implemented in 1999-2000 and continues to the present day. In more recent years, opportunities have developed to collaborate with researchers at multiple points in the research life cycle, particularly as they find, collect, manage, and communicate large sets of data. These opportunities represent a promising new approach to engagement that fits with the existing service model. One obstacle exists, however: that most of our researchers work in lab environments that are inaccessible to outsiders. Even for those that don't work in secure labs, the interactions between a principle investigator (PI) and his/her students occur in a setting librarians do not typically have access to; in order to continue to develop services that meaningfully support engineering and textiles researchers, it was necessary to get behind the "closed doors" of the research lab.

Literature Review

Engineers' reticent use of libraries has received a thorough examination throughout the literature. In previous studies, students from STEM disciplines consistently report lower usage of libraries than students from the humanities and social sciences, and Tenopir suggests that engineers who do use libraries are reluctant to ask for assistance when looking for information.¹⁻⁶ While Chang and Eskridge suggest that engineers during their undergraduate and graduate training are inducted into a culture of non-library use by their instructors and faculty mentors,⁷ even among engineers that make use of the libraries, physical visits and direct interaction with librarians have dwindled since the ascension of easy to use full-text search engines.⁸ Hemminger et al. found that as early as 2007, the wide availability of electronic resources had transformed the information seeking behaviors of academic scientists, who increasingly reported nearly exclusive use of web-based resources and fewer visits to physical libraries; Niu et al. corroborated these findings via a nationwide survey in 2010.⁹⁻¹⁰ While the proliferation of online resources may have exacerbated non-use of libraries by engineers, concerns about STEM students' use of the library and faculty members' perceptions of the library has attracted the attention of librarians for decades. As early as 1979, Davis and Bentley suggested that librarians could form meaningful relationships with disciplinary science faculty and improve perceptions of librarians by getting involved "in the teaching process" and through "attendance at departmental meetings."¹¹ In the subsequent decades, engineering librarians have taken that advice; the literature abounds with examples of engineering librarians impacting the engineering curriculum through partnerships

with engineering faculty.¹²⁻²⁰ But while engineering librarians have made remarkable gains in shaping the education of engineers by integrating information literacy into engineering curriculums, meeting with students a handful of times in a lecture setting cannot overcome the dominant culture of library non-use that exists within engineering disciplines. Likewise, meeting with faculty members once or twice a year through attendance at department meetings or instruction planning sessions will not transform faculty information seeking behavior, either.

The literature enumerates numerous additional reasons that engineers may not use physical libraries, ranging from the practical (having to travel some distance compared to the convenience of remotely accessing online resources) to the psychological (the phenomenon of library anxiety).²¹⁻²⁷ To overcome this, the scholarly record reflects numerous innovative efforts by STEM liaison librarians to reach these hermetic students and researchers. Previous initiatives recorded in the literature include reorganizing staffing at service points to provide subject specialists with more time for advanced research questions,²⁸ revamping libraries' web presence to make subject specialists more visible,²⁹ launching satellite reference services within academic buildings,³⁰⁻³² creating workshops and services that cater to the needs of STEM students and faculty throughout the research lifecycle,³³⁻³⁴ as well as developing fun extra-curricular programming to encourage STEM students and researchers to visit the physical library.³⁵⁻³⁶ While getting engineers into the library remains a challenge, studies continue to confirm that graduate students and faculty in science and engineering frequently use online library resources,³⁷⁻³⁸ and Soria determined that undergraduate students conducting research or pursuing careers in science, technology, or health affairs were more likely than their peers to view having access to a world-class library as important to their success.³⁹

Consequently, we suspect that engineers' and scientists' low use of physical libraries does not reflect a lack of information needs; rather, we hypothesize that these low usage rates indicate that physical libraries do not integrate well with the work flows of engineers in the academy. To overcome this challenge, one possible service model that engineering libraries can look to for inspiration is that of the clinical medical librarian or informationist, which health science and medical libraries have used for decades in order to meet the information needs of clinicians and other health care workers.⁴⁰⁻⁴² The role of the informationist arose as a response to the increasingly challenging problem of making "the critical link between the huge body of information hidden away in the medical literature and the information needed at the point of care," or what became known as the "literature-practice gap."⁴³ To help bridge this gap, librarians began accompanying clinical teams during rounds. While these services started with humble "evidence carts," the effectiveness of this service has increased with digital resource access, and studies have shown that making evidence quickly available "increased the extent to which evidence was sought and incorporated."⁴⁴ While seemingly similar to the satellite reference service model that has been employed as a method of outreach to engineers elsewhere, the crucial difference is that an informationist service does not attempt to recreate a traditional reference service in a different location. Rather, the librarian becomes a functional member of the team, and provides information at the time of need rather than waiting for information requests to be presented at a later time.⁴⁵⁻⁴⁷ Engaging with researchers through outreach initiatives to research groups⁴⁸ and targeted information literacy instruction to students working in research groups⁴⁹⁻⁵⁰ are ideas that have received some sparse attention within the literature. However, these previous iterations of outreach to research groups seem not to have considered

adopting the longitudinal, team-based approaches utilized by informationists in clinical settings and implementing them within non-clinical research settings.

Program Description

Admittedly, the information needs and workplace environments of clinicians ostensibly look quite different from those of an engineer in the academy, perhaps explaining why the informationist approach has not been implemented extensively within traditional academic research settings. However, we hypothesize that clinicians' and engineers' information needs may share a number of important features. In both cases, the information needs of these professionals are unpredictable: they vary substantially from day to day, occur unexpectedly during the course of routine work, may require immediate answers, and increasingly rely upon interdisciplinary expertise. When compared to the information needs of humanities and social sciences scholars, for whom information needs are comparatively predictable and often less time sensitive, it makes sense why the reference desk model of information retrieval may not work as well for engineers.

While engineering faculty and students are associated with a campus department, the research group is the primary organizational unit that researchers operate within on a daily basis. A research group is typically led by a faculty member and generally consists of graduate students and post-doctoral scholars. Other members may include research faculty members, visiting scientists, and undergraduate students. Although practices vary by group, many research groups often meet on a regular basis, with Crede and Borrego finding that weekly meetings were the most common.⁵¹ Various called lab, group, or research team meetings, the structure of these meetings can vary greatly and depends on the PI's style. For example, group meetings can serve as a venue for all members to provide updates on their research, for formal presentations by one or two individuals, for discussions of literature, or for various combinations thereof.

To test our hypothesis that a model similar to the informationist approach would be effective with engineers, we set out to become embedded members into several research groups in order to learn more about their research practices, data collection procedures, social norms, and their information seeking behaviors within their work environments. We also hoped that upon gaining an in-depth understanding of the group's research interests, as well as becoming enculturated into the research group's social dynamics, that we would be able to use our expertise as information specialists to deliver on-demand information services to these communities at the time of need.

A preliminary approach was developed for supporting research groups, in which each engineering/textiles librarian in our department planned to work with one or two research groups. Because we recognized that this type of support would be difficult to scale, we also planned that after a semester, the librarians would rotate off these groups and join new research groups. This rotation approach would allow us to gain exposure to and serve multiple groups and departments over time, while keeping each librarian's time investment constant.

In late Fall 2015 we identified potential research groups to join within both the Colleges of Engineering and Textiles, and requested permission from department heads to approach their faculty members with this proposed service. The PIs of these groups were then presented with a description of this pilot program: engineering/textiles librarians would attend their group

meetings, allowing us to better understand the nature of their work and in turn, be able to provide tailored support to their group members. By December 2015, five groups had agreed to let us to join them at their group meetings.

Our engagement with these groups began in January 2016. At the end of the 2016 spring semester, each librarian felt that extending the time with our initial groups would be beneficial. We continued working with these groups, first to the end of 2016, and then into the 2017 spring semester. During this time, one additional research group was added.

Program Assessment

Whether in clinical or research settings, the literature notes the difficulties librarians have encountered when trying to evaluate the impact of embedded librarian services. Previous reviews of clinical librarian services have discussed the challenge of identifying direct impacts, suggesting that forming casual links between information services and impacts on major outcomes such as improved patient care is “difficult if not impossible.”⁵² However, Brettle et al.’s systematic review of the effectiveness of clinical librarian services concludes that clinical librarians have created a satisfactory service model for their user community by “saving health professionals’ time,” providing literature searches that “are relevant and useful,” and “contributing to better informed decisions.”⁵³ While we do not anticipate that future assessments of our service will demonstrate a statistically significant improvement in research productivity or student success, we believe that creating a service that saves our researcher’s time by providing high-quality, real time information will represent a noteworthy achievement in its own right.

Evaluators of clinical librarian programs suggest using robust, qualitative mixed-methods approaches that capture both “performance and impact outcomes,” such as surveys, focus groups, and interviews.⁵⁴ Because this initiative was designed in part to de-mystify the inner workings of academic research groups without burdening our researchers with surveys and interviews, we are using ethnography to capture the impact of our service. Each embedded librarian uses a standardized form (see Appendix A), which describes who was in attendance at the meeting, the length of the meeting, and what happened during the meeting. In addition to ethnographically capturing the activities of our researchers, our methodology also uses critical incident technique by logging specific incidences of information use or when the librarian’s expertise was beneficial during the meeting (see Appendix B).⁵⁵ Both of these instruments were reviewed and approved for use by NC State’s Institutional Review Board.

Preliminary Findings

Table I summarizes the groups we have worked with to date, along with details of each group’s meeting schedule and demographics. Several of these groups met on a weekly basis although the characteristics of the meetings varied. The Materials Science & Engineering (MSE) group meeting was used exclusively for regular research updates from all group members, with half of the group presenting each time; however, undergraduates were not included in this meeting. On the other hand, the main focus for the two Biomolecular Engineering (BME) groups varied, rotating between items such as an in-depth research update from one graduate student or post-doctoral scholar; multiple updates from all of the undergraduate students; a journal club-style article discussion; or presentations from speakers from outside of the group. The Textile Engineering, Chemistry and Science (TECS) group combined elements of both of the above, in

which each meeting consisted of a scheduled presentation by one group member, roundtable updates, and discussions of journal articles.

In contrast, the two research groups from the Textile and Apparel, Technology and Management (TATM) department, did not hold regular meetings with the entire group. Instead, the PIs met with graduate students individually on a weekly basis. For these groups, the librarian liaison sat in on the one-on-one meetings. It should be noted that PIs of the other research groups may also have had one-on-one meetings with individual members, but we were not involved with these meetings.

Table I. Demographic and meeting details of research groups

Group ID	Dept.	PI Rank	Group Demographics	Meeting Frequency*	Length	Notes
1	BME	Asst. Professor	Post-Docs: 2 G Students: 4 UG Students: 11 Staff**: 0	Weekly	60-75 min	
2	MSE	Professor	Post-Docs: 1 G Students: 8 UG Students: 2-4 Staff: 4	Weekly	90-120 min	
3	BME	Asst. Professor	Post-Docs: 0 G Students: 4 UG Students: 5 Staff: 1	Weekly	60 min	
4	TATM	Assoc. Professor	Post-Docs: 0 G Students: 1 UG Students: 0 Staff: 0	None	60 min	Weekly 1:1 between PI and student
5	TATM	Professor	Post-Docs: 0 G Students: 2 UG Students: 0 Staff: 0	None	60 min	Weekly 1:1 between PI and student
6	TECS	Assoc. Professor	Post-Docs: 1 G Students: 4 UG Students: 2 Staff: 0	Weekly	60 min	

*Meeting frequency of entire research group

**Staff includes research professors, visiting scientists, and technical staff.

Although this was a new setting for us, we found that in some ways, the types of needs we were able to support were very similar to the types of questions and requests that often come through our normal reference channels, such as literature searching and document delivery. However, we also realized that these were questions that likely would not have made it to a librarian had we not been present; in this setting, information was not only provided, but in a timely fashion at the point of need. Being present was also important in having the opportunity to provide immediate context to discussions and questions related to scholarly communication (e.g., impact factor, predatory journals). In addition, library services that the researchers were not aware of, such as Data Management Plan (DMP) reviews, were able to be offered.

Table II summarizes some of the services we have provided to our research groups so far. Key aspects of our pilot phase experience has been the ability to provide targeted services at times of need and the opportunity for engagement at multiple points of the research lifecycle. Woven throughout were occasions to teach information literacy skills. Thus, Table II also represents our interpretation of how traditional liaison roles can be reimagined within the research group context, where the focus is on what the researchers *do* and finding ways to meet their specific needs.

Table II. Provision of traditional subject liaison services in a research group setting

Traditional Liaison Services	Lab-Integrated Liaison Service example
Literature searching	Finding literature on a specific animal model to support a study design
Ready reference and document delivery	Finding a specific article relevant to a graduate student's current research project
Scholarly communication and research impact workshops	Correcting misunderstandings in real time during journal club discussions, e.g., providing journal level and article level impact metrics; explaining retractions and peer review fraud; differentiating between open access and "predatory journals"
Graduate student orientations	Targeted, sophisticated, time of need information literacy training for graduate students
One-shot information literacy instruction	Point-of-need information literacy instruction for undergraduates in a workplace context
Large-scale "push" outreach	Researcher-specific services and focused community building
Data management planning support	Provide targeted, point of need DMP reviews and consultations
Data visualization workshops	Showing discipline specific, appropriate ways to visualize data for more effective communication

Lessons Learned and Next Steps

Critical incidents we have captured thus far include literature searching services, invitations to attend oral examinations, and leading discussions during lab group meetings, among others. We hypothesize that using ethnography and tracking critical incidents will demonstrate our impact on these groups, while also tracking how a librarian's role within a research group can change

and grow over time. Our full results generated through these methods will be shared at a later date.

Getting into research groups was surprisingly easy – in each case it simply involved asking the principal investigator, explaining why we wanted to do it, and what we were hoping to learn. Given the ease of securing invitations to attend, we were surprised by how long it could take to actually begin attending meetings. In some cases, it took a PI a few weeks after the start of a new semester to get meetings scheduled, perhaps a consequence of trying to accommodate their students' class schedules. We also found that a group's timeline may not align with the academic calendar; rather than coinciding with the start and end of classes, research groups often continue to meet throughout the summer and during breaks and intersessions. Important dates for the group may reflect grant deadlines and conference deadlines, rather than final exams. While we planned to spend one semester with each group, we realized that it took several weeks to settle into a group, learn about its research, and get to know the students, leading us to continue on with our groups (at the time of submission, we have been embedded within our current groups between 6 and 18 months). However, we have yet to determine exactly how long a librarian needs to meet with a research group to reach the point of being truly "embedded," or at what point a librarian can scale back their involvement in order to prevent diminishing returns.

For the first round of the pilot, we selected faculty who were in our existing network of contacts, but going forward we will target groups that are working on projects of strategic priority to the College of Engineering. The faculty leading these new groups may or may not be in our network of contacts. We have learned that groups that hold regular weekly meetings are best for our purposes, and this will be a requirement as we choose new groups. Some more things to keep in mind are: that this type of program may be far more challenging to implement in groups without a principal investigator who values engaging with literature and respects the expertise of the embedded librarian, and that research groups working on highly confidential research, or research that is subject to a non-disclosure agreement, may be less amenable to outsiders observing informal updates and progress reports.

Each research group we participated in had a unique character and style, which may reflect the personality of the PI. There was variation in everything from the regularity of meetings, how meetings were conducted, who attended and the level of participation. These different cultures will of course affect the opportunities for the librarian to participate. Our initial findings suggest that a librarian may have more of an impact in research group meetings that feature participatory discussions where insights from all the group's members are not just welcomed, but encouraged by the PI. The potential for a librarian to impact information literacy skill development may be dependent on the participation level of junior level students, whose professional information seeking behaviors are still relatively nascent. Lastly, the individual librarian's personality may align with certain groups better than others. More data is required before we can assert which of these characteristics, if any, are most important to consider when embedding into a group.

One major takeaway from this experience was that for PIs, research and teaching are not separate enterprises – they overlap and happen simultaneously. While librarians tend to think of teaching and research separately, in research groups the two are happening in concert; faculty are training their students to become researchers. In this sense, research groups are not just a work space, but also a pedagogical space that provides an experiential learning environment, which

complements the instruction they receive in classroom settings. Within this space, PIs teach not just the fundamentals underlying their discipline, but also the professionalism required to become an academic scientist, from communicating results clearly to keeping a lab space clean. Research groups are a unique environment where primary literature and raw research data is engaged with routinely and in meaningful ways, making them an incredibly valuable venue for a librarian to demonstrate their expertise and contribute to the research enterprise of the university. Consequently, for subject specialist librarians this type of program provides a concrete way to engage in more parts of the research life cycle and to identify more areas where researcher's needs and library services intersect. Simply by being in the room, we can correct misconceptions about libraries or information before they become established "facts" within the group. Being present during the early stages of research means we can provide help at the true point of need which is often earlier than a student realizes; for example, we can advise students on how to manage or visualize their data as they begin to collect it, as opposed to the end of the cycle when they are getting ready to publish it. We can present information literacy skills in context and have the potential to impact the information seeking skills of our researchers.

One question that many will ask is, does a program like this scale? The answer is that it doesn't, because it isn't meant to. We do not see this program as a service -- library services (instruction, access services) attempt to scale to the whole campus population. Embedding in research groups is more akin to statistical sampling or user research methods, a means of getting some data on what users are doing that can help inform decisions and policy on library collections and services. Viewing this initiative as a needs assessment, rather than a service, informed our decision to use ethnography for capturing our impact. While our ethnographic methodology does not provide empirical measurements of whether we are altering our researchers' information seeking behavior, it captures how services can be offered through this model of engagement, while also providing us with authentic needs assessments of our communities without subjecting our users to time-consuming forms or surveys.

In any case, the primary goal of this effort has always been community building, which involves developing relationships one-by-one. To put it more plainly, relationships don't scale.

Conclusion

Joining research groups gives engineering librarians access to a part of the process they would not otherwise be exposed to. This approach can be used by librarians who wish to move from a "push" model of outreach to one of building community with researchers where they are. Although this framework moves in the opposite direction of the larger-scale outreach or resources that libraries offer in order to maximize support (e.g., library presentations at orientation sessions, workshops), we have seen that providing lab-integrated liaison services has given these researchers tailored and more in-depth assistance. In turn, librarians can benefit by gaining a better understanding of the needs and challenges faced by campus researchers and by shifting from surface transactional interactions to deeper relationship building. This is knowledge that can be used to fine-tune broader scale outreach efforts to increase their effectiveness.

Appendix A: Research Group / Lab Meeting Notes Form

Lab:

Date:

Start Time:

End Time:

Attendance #s:

PI:

Post-docs:

Graduate Students:

Other Research Faculty / Staff:

Undergraduate Students:

What happened in today's meeting?

What teaching moments occurred? (Content / Delivery Process)

What unmet needs did you identify?

What did you (librarian) do in today's lab meeting?

Appendix B: Interaction Form

Lab:

Date:

Start Time:

End Time:

Lab Member Status (postdoc, grad student, etc.):

Where did this interaction occur? (in the library, via email, etc.)

What service did you provide?

References

1. Laurie M. Bridges, "Who Is Not Using the Library? A Comparison of Undergraduate Academic Disciplines and Library Use," *Portal: Libraries and the Academy* 8, no. 2 (April 2008): 187–96.
2. Alexander J. Carroll et al., "E-Book Perceptions and Use in STEM and Non-STEM Disciplines: A Comparative Follow-Up Study," *Portal: Libraries and the Academy* 16, no. 1 (February 18, 2016): 131–62, doi:10.1353/pla.2016.0002.
3. Shane Nackerud et al., "Analyzing Demographics: Assessing Library Use Across the Institution," *Portal: Libraries and the Academy* 13, no. 2 (April 14, 2013): 131–45, doi:10.1353/pla.2013.0017.
4. Lloyd A. Kramer and Martha B. Kramer, "The College Library and the Drop-Out," *College & Research Libraries* 29, no. 4 (July 1, 1968): 310–12, doi:10.5860/crl_29_04_310.
5. Ellen Collins and Graham Stone, "Understanding Patterns of Library Use Among Undergraduate Students from Different Disciplines," *Evidence Based Library and Information Practice* 9, no. 3 (September 6, 2014): 51–67.
6. Carol Tenopir and Donald W. King, *Communication Patterns of Engineers*, 1 edition (Hoboken, NJ: Wiley-IEEE Press, 2004).
7. Bertha P. Chang and Honora N. Eskridge, "What Engineers Want: Lessons Learned from Five Years of Studying Engineering Library Users," Paper presented at 2015 ASEE Annual Conference & Exposition, Seattle, Washington, (June 2015).
8. Steve Coffman and Susan McGlamery, "The Librarian and Mr. Jeeves," *American Libraries* 31, no. 5 (May 2000): 66.
9. Bradley M. Hemminger et al., "Information Seeking Behavior of Academic Scientists," *Journal of the American Society for Information Science and Technology* 58, no. 14 (December 1, 2007): 2205–25, doi:10.1002/asi.20686.
10. Xi Niu et al., "National Study of Information Seeking Behavior of Academic Researchers in the United States," *Journal of the American Society for Information Science and Technology* 61, no. 5 (May 1, 2010): 869–90, doi:10.1002/asi.21307.
11. Jinnie Y. Davis and Stella Bentley, "Factors Affecting Faculty Perceptions of Academic Libraries," *College & Research Libraries* 40, no. 6 (November 1, 1979): 527–32, doi:10.5860/crl_40_06_527.
12. P. J. Armstrong and Robert Niewoehner, "The CDIO Approach to the Development of Student Skills and Attributes," in *4th International CDIO Conference, Hogeschool Gent, Belgium, 2008*, 16–19, <http://www.cdio.org/files/document/file/m2-armstrong2008aeroqubusna.pdf>.

13. Rachel Callison, Dan Budny, and Kate Thomes, "Library Research Project for First-Year Engineering Students: Results from Collaboration by Teaching and Library Faculty," *The Reference Librarian* 43, no. 89–90 (2005): 93–106.
14. James B. Clarke and James R. Coyle, "A Capstone Wiki Knowledge Base: A Case Study of an Online Tool Designed to Promote Life-Long Learning through Engineering Literature Research," *Issues in Science and Technology Librarianship*, no. 65 (2011): 7.
15. Kate Manuel, "Generic and Discipline-Specific Information Literacy Competencies: The Case of the Sciences," *Science & Technology Libraries* 24, no. 3–4 (2004): 279–308.
16. Craig Milne and Jennifer A. Thomas, "Are Your Foundations Sound? Information Literacy and the Building of Holistic Professional Practitioners," 2008, <http://eprints.qut.edu.au/16899/>.
17. Honora Nerz and Lisa Bullard, "The Literate Engineer: Infusing Information Literacy Skills throughout an Engineering Curriculum," in *Proceedings of the 2006 American Society for Engineering Education Annual Conference & Exposition*, 2006.
18. Honora F. Nerz and Suzanne T. Weiner, "Information Competencies: A Strategic Approach," in *Proceedings of the 2001 American Society for Engineering Annual Conference & Exposition. Session*, vol. 2241, 2001, http://depts.washington.edu/englib/eld/fulltext/00510_2001.pdf.
19. Tammy Stitz, "Learning from Personal Experience What's Needed in Information Literacy Outreach: An Engineering Student Returns to Her Alma Mater as an Engineering Librarian," *Science & Technology Libraries* 29, no. 3 (2010): 189–199.
20. Eleanor M. Smith, "Developing an Information Skills Curriculum for the Sciences," *Issues in Science and Technology Librarianship* 37, no. 1 (2003), <http://www.istl.org/03-Spring/article8.html>.
21. Qun G. Jiao and Anthony J. Onwuegbuzie, "Prevalence and Reasons for University Library Usage," *Library Review* 46, no. 6 (September 1, 1997): 411–20, doi:10.1108/00242539710178416.
22. Qun G. Jiao and Anthony J. Onwuegbuzie, "Antecedents of Library Anxiety," *The Library Quarterly: Information, Community, Policy* 67, no. 4 (1997): 372–89.
23. Constance A. Mellon, "Library Anxiety: A Grounded Theory and Its Development," *College and Research Libraries* 47, no. 2 (1986): 160–65.

24. Stuart A. Karabenick and John R. Knapp, "Help Seeking and the Need for Academic Assistance," *Journal of Educational Psychology* 80, no. 3 (1988): 406–8, doi:10.1037/0022-0663.80.3.406.
25. Qun G. Jiao, Anthony J. Onwuegbuzie, and Art A. Lichtenstein, "Library Anxiety: Characteristics of 'at-Risk' College Students," *Library & Information Science Research* 18, no. 2 (March 1, 1996): 151–63, doi:10.1016/S0740-8188(96)90017-1.
26. Heather Carlile, "The Implications of Library Anxiety for Academic Reference Services: A Review of Literature," *Australian Academic & Research Libraries* 38, no. 2 (June 1, 2007): 129–47, doi:10.1080/00048623.2007.10721282.
27. Nahyun Kwon, "A Mixed-Methods Investigation of the Relationship between Critical Thinking and Library Anxiety among Undergraduate Students in Their Information Search Process," *College & Research Libraries* 69, no. 2 (March 1, 2008): 117–31, doi:10.5860/crl.69.2.117.
28. Daureen Nesdill, April Love, and Maria Hunt, "From Subject Selectors to College and Interdisciplinary Teams," *Science & Technology Libraries* 29, no. 4 (December 6, 2010): 307–14, doi:10.1080/0194262X.2010.523308.
29. Matt Torrence, "Services and Resources to Engineers: A Case Study of Outreach and Marketing, Assessment, and Future Directions in a Research Library," *Issues in Science & Technology Librarianship*, no. 79 (Winter 2015), doi:10.5062/F43776Q0.
30. Megan S. Nelson, "Initiating Engineering Outreach Reference Services: Background and Practice," *Reference Services Review* 35, no. 2 (May 15, 2007): 265–84, doi:10.1108/00907320710749182.
31. Irene M. Lubker et al., "Refocusing Reference Services Outside the Library Building: One Library's Experience," *Medical Reference Services Quarterly* 29, no. 3 (2010): 218–228.
32. Jennifer Lee, K. Alix Hayden, and Don MacMillan, "I Wouldn't Have Asked for Help If I Had to Go to the Library': Reference Services On Site," no. 41 (Fall 2004), <http://www.istl.org/04-fall/article2.html>.
33. Brenna Helmstutle, "Taking Research Services to the Next Level: A Case Study of Implementing a Scholarly Impact Outreach Program for Faculty and Graduate Students," *Journal of Library Innovation* 6, no. 2 (September 2015): 96–104.
34. Isaac Gilman and Marita Kunkel, "From Passive to Pervasive: Changing Perceptions of the Library's Role through Intra-Campus Partnerships," *Collaborative Librarianship* 2, no. 1 (2010): 7.

35. Jeanne L. Pfander and Barbara A. Williams, "The Beat of a Different Drum: Using the Arts in Outreach to Science/engineering Students and Faculty," *Issues in Science and Technology Librarianship*, no. 45 (Winter 2006), <http://www.istl.org/06-winter/article3.html>.
36. Mary Axford et al., "Creating a BUZZ: Attracting Sci/tech Students to the Library!," *Issues in Science and Technology Librarianship* 1 (Winter 2006): 45.
37. Tina Chrzastowski and Lura Joseph, "Surveying Graduate and Professional Students' Perspectives on Library Services, Facilities and Collections at the University of Illinois at Urbana-Champaign: Does Subject Discipline Continue to Influence Library Use?," *Issues in Science and Technology Librarianship*, no. 45 (Winter 2006), doi:10.5062/F4DZ068J.
38. Robert Tomaszewski, "Information Needs and Library Services for Doctoral Students and Postdoctoral Scholars at Georgia State University," *Science & Technology Libraries* 31, no. 4 (October 1, 2012): 442–62, doi:10.1080/0194262X.2012.730465.
39. Krista M. Soria, "Factors Predicting the Importance of Libraries and Research Activities for Undergraduates," *The Journal of Academic Librarianship* 39, no. 6 (November 2013): 464–70, doi:10.1016/j.acalib.2013.08.017.
40. M. A. Winning and C. A. Beverley, "Clinical Librarianship: A Systematic Review of the Literature," *Health Information & Libraries Journal* 20 (June 1, 2003): 10–21, doi:10.1046/j.1365-2532.20.s1.2.x.
41. K Cimpl, "Clinical Medical Librarianship: A Review of the Literature.," *Bulletin of the Medical Library Association* 73, no. 1 (January 1985): 21–28.
42. Jocelyn A. Rankin, Suzanne F. Grefsheim, and Candace C. Canto, "The Emerging Informationist Specialty: A Systematic Review of the Literature," *Journal of the Medical Library Association : JMLA* 96, no. 3 (July 2008): 194–206, doi:10.3163/1536-5050.96.3.005.
43. F. Davidoff and V. Florance, "The Informationist: A New Health Profession?," *Annals of Internal Medicine* 132, no. 12 (June 20, 2000): 996–98.
44. David L. Sackett, Sharon E. Straus, and for Firm A. of the Nuffield Department of Medicine, "Finding and Applying Evidence During Clinical Rounds: The Evidence Cart," *JAMA* 280, no. 15 (October 21, 1998): 1336–38, doi:10.1001/jama.280.15.1336.
45. Devon Greyson et al., "'You're Just One of the Group When You're Embedded': Report from a Mixed-Method Investigation of the Research-Embedded Health Librarian Experience," *Journal of the Medical Library Association : JMLA* 101, no. 4 (October 2013): 287–97, doi:10.3163/1536-5050.101.4.010.

46. Rex R. Robison, Mary E. Ryan, and I. Diane Cooper, "Inquiring Informationists: A Qualitative Exploration of Our Role," *Evidence Based Library and Information Practice* 4, no. 1 (January 1, 2009): 4–16.
47. Lin Wu and Misa Mi, "Sustaining Librarian Vitality: Embedded Librarianship Model for Health Sciences Libraries," *Medical Reference Services Quarterly* 32, no. 3 (July 1, 2013): 257–65, doi:10.1080/02763869.2013.806860.
48. Emily MacKenzie, "Academic Libraries and Outreach to the Sciences: Taking a Closer Look at Research Groups," *Science & Technology Libraries* 33, no. 2 (April 3, 2014): 165–75, doi:10.1080/0194262X.2014.914011.
49. Bonnie L. Fong and Darren B. Hansen, "Engaging Research Groups: Rethinking Information Literacy for Graduate Students," *Issues in Science and Technology Librarianship* 71 (2012), http://www.istl.org/12-fall/refereed2.html?a_aid=3598aabf.
50. Arleen N. Somerville and Carol Carr, "Chemistry Librarians as Teachers: New Partnerships for a New Environment," *Science & Technology Libraries* 16, no. 3–4 (1998): 3–30.
51. Erin Crede and Maura Borrego, "Learning in Graduate Engineering Research Groups of Various Sizes," *Journal of Engineering Education* 101, no. 3 (2012): 565–589.
52. Christine Urquhart, "How Do I Measure the Impact of My Service?," in *Evidence-Based Practice for Information Professionals: A Handbook*, ed. Andrew Booth and Anne Brice (London: Facet Publishing, 2003), 210–22.
53. Alison Brettell et al., "Evaluating Clinical Librarian Services: A Systematic Review," *Health Information & Libraries Journal* 28, no. 1 (March 1, 2011): 3–22, doi:10.1111/j.1471-1842.2010.00925.x.
54. Ibid.
55. Alison L. Weightman and Jane Williamson, "The Value and Impact of Information Provided through Library Services for Patient Care: A Systematic Review," *Health Information & Libraries Journal* 22, no. 1 (March 1, 2005): 4–25, doi:10.1111/j.1471-1842.2005.00549.x.