Issues in Science and Technology Librarianship

Science Library Trends at ARL Institutions

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Abstract

This study uses qualitative and quantitative data to identify science library trends at Association of Research Libraries (ARL) member institutions. Our recent count found 69% of all ARL academic institutions have at least one science library. Comparing our data to a 2010 study of American ARL institutions, the number of science libraries at American ARL institutions is down 17%. Our analysis shows this decrease is due in large part to a continuing trend of departmental libraries (e.g., mathematics, chemistry, and physics) merging into multidisciplinary science libraries. We also surveyed ARL science libraries and found that their primary focus is on providing comfortable, inviting study space and promoting student and/or faculty collaboration. Both datasets from this study can be used to support the ongoing management of science libraries, including collections, facilities, and services.

Introduction

In 1988 Richard Dionne wrote that science libraries were at a crossroads due to "large increases in journal prices and the ever-expanding capabilities of automation." He noted it was not unusual for large universities to have more than five science libraries, but he saw this was changing as the debate was shifting from decentralization to consolidation (Dionne 1988). Since then, many science librarians have written of their own experiences in downsizing, closing, and rethinking library services. However, the literature has focused on one subject (Garritano 2007) or one university (Winterman and Hill 2010; Twiss-Brooks 2005; Lewin 2011; Sandy et al 2014) and is missing the data needed for librarians, managers, and administrators to understand the overall trends of science libraries today. Therefore, our goal in this paper is to expand and update the data available beyond individual universities to all Association of Research Libraries (ARL) science libraries.

Literature Review

Library Closures and Consolidations

Libraries have been closing and consolidating since the 1940s due to "budget constraints, space needs, and the increase of interdisciplinary research," and now with "economic, political, and technological changes…this trend has accelerated" (Winterman and Hill 2010). Budget stressors were noted in the late 1980s, as the prices of journals, especially in the sciences, grew well beyond inflation (Lewis 2016) and were exacerbated during the 2007 – 2009 recession (Crocamo et al. 2015; Lowry 2010). Additional reasons for closures and consolidations include librarian retirements, costs of maintaining older buildings (Lewin 2011; Winterman and Hill 2010), reconfiguring librarian roles (Miller and Pressley 2015; Marcum 2015), installing automated retrieval systems (a.k.a. bookBots), and opening high-density storage facilities (Roderer et al 2015; Lewis 2016).

Not all of the reasons for consolidations and closures are bad. In fact, there are many benefits to consolidating libraries. Andrea Twiss-Brooks (2005) noted centralizing libraries unified collections and created a "collegial atmosphere for subject specialist librarians." Jeremy Garritano's (2007) survey indicated consolidated libraries enabled the library to increase the hours of service available, provide upgraded technology, offer new services, and improve visibility on campus. Heather Lewin (2011) found "unanticipated positives" to a closure of a reading room were the savings in reducing duplicate collections and student workers.

Successful Branch Libraries Today

Steve Hiller (2004) studied branch libraries at the University of Washington and determined successful branch libraries support departments that are heavy users of print collections, provide collaborative space for students, and work "with the primary user community to develop and implement services that emphasize delivery of information and specialized support within the space of the academic unit." Andrea Twiss-Brooks (2005) found additional characteristics for predicting success: "proximity to research laboratories, familiarity with the subject specialist librarian, 24-hour key entry, operational flexibility, and small size."

The "library as place" concept is driving the planning for renovations today to enhance what is valued by researchers, expand the library's role, and provide opportunities for the library to connect with departments (Doan et al 2015; Sandy et al 2014; Lewis 2016). Lewis (2016) describes how "reimagining of the library as place" can be created by "providing a variety of spaces," recognizing both the social and private aspects of learning, providing a "contemplative oasis," and helping researchers "feel more scholarly." These authors also note from their experiences and observations that plans for library renovations include creating student-centered spaces and flexible, multifunctional areas for faculty and students. Facilities added during renovations these days include active learning classrooms, makerspaces, and GIS labs (Lewis 2016; Head 2016)

Defining Science Libraries

A branch library is defined by the Association of College & Research Libraries (ACRL) as a library "with collections and staff, which is physically separate or divided from other library service units" to serve the needs of one or two departments and/or several related subject areas (Association of College and Research Libraries 1991). Other terms often used interchangeably

with branch library are departmental, unit, stand-alone, reading room, main divisional, multi-subject, and subject library (Croneis and Short 1999; Hurd 1996; Shkolnik 1991; Zdravkovska 2011). In their 1999 ARL survey Croneis and Short expanded the definition of a branch library to include "'discrete collections' housed in main libraries." ARL surveys conducted in 1983 and 1999 exclude law, medical, government documents and special collections because of the different reporting structures and accrediting agencies (Association of Research Libraries 1983; Croneis and Short 1999). While some of the definitions recognize that a library can have an online presence, the expectation in all branch library definitions is that the branch has a physical presence. Some definitions also note that staff must be present in a branch library (Zdravkovska 2011), but ACRL and ARL do not specifically list staff presence as a part of the definition of a branch library.

Historical Data

ARL and ACRL have surveyed and documented the trends, totals, and changes of academic libraries for many years (Association of Research Libraries 1983; Hurd 1996; Croneis and Short 1999). The ARL survey also tracked the total number of new branches, closed branches, and mergers. After these large-scale surveys by ARL and ACRL, others sought to update portions of the data. Garritano (2007) focused on the current number of chemistry libraries and future consolidations. Zdravkovska (2011) counted the number of ARL academic branch libraries in the United States. Zdravkovska was also one of the first authors to use the internet to identify branch libraries, and, as a result, did not have to rely on survey responses to get an accurate count. One other ARL survey on evolving service models in all academic libraries included some respondents' comments about science library closures, but, unfortunately, no totals were provided (Vyhnanek and Zlatos 2011). As far as we are aware, no other recent count of science libraries is available in the library literature.

Methods

Our research consists of two parts: (1) an online survey, and (2) a count of science libraries at ARL institutions. We focused on the 2017 ARL members at universities and colleges in Canada and the United States. Consistent with the methodologies of previous studies, we excluded the ten ARL members that are state, public, or national libraries, leaving us with a sample size of 114 member institutions.

Online Survey Methodology

In designing our survey we used portions of the branch library survey questionnaire written by ARL and last published in 1999 (Association of Research Libraries 1983; Croneis and Short 1999). We also expanded upon the survey template to record trends. The University of Alabama's Science & Engineering Library succinctly defined the "library as place" in a way we felt we could measure, so we adapted this concept into the last two questions of our survey (Sandy et al. 2014). The qualitative results from this portion of the survey were analyzed using established social sciences methodologies. We organized the responses using the cutting and sorting technique, working together to check reliability, seeking consensus, and establishing the major themes and representative examples (Bernard 2013; Bernard and Ryan 2010).

To locate survey respondents we identified one librarian per university to contact via email. Primarily, we contacted branch librarians, department heads, or subject librarians covering

multiple science departments. We emailed a link to our 9-question, online survey (Appendix 1), provided a one-month deadline, and followed up with reminders. Librarians were permitted to answer the survey with colleagues or forward the questionnaire to someone else. In our initial letter to librarians, we wrote:

> We are interested in learning about any science or technology library located on the primary campus, excluding medical and other professional libraries. We do not set a limit on collection size, staffing numbers, or services provided. For this survey, we are using the criteria and the definitions in the 1999 ARL SPEC Kit about branch libraries: "A typical branch is outside of the main campus library, but still within proximity to the department, school, or college that it serves. Branch libraries most often house subject-based collections. This excludes law, medical, government documents, and special collections."

Library Count Methodology

We counted libraries by examining library web pages and identifying the science branch libraries listed on each site. We used the same definitions and exclusions defined by ARL (Croneis and Short 1999), including the following criteria when examining web pages:

- Include libraries with the following names: science library, engineering library, science & technology library, branch library, reading room, departmental library, and subject library. (Further details about specific subjects recognized and counted as science libraries can be found in Table 3 of the 1983 SPEC Kit.)
- Include science branch libraries in a main library if they either have a separate name or a separate service desk.
- Exclude professional libraries following the ARL 1983 guidelines with names such as medical, public health, veterinary medicine, and optometry library.
- Exclude libraries miles away from the main campus, such as marine lab libraries that are often in a separate town from the main university (Croneis and Short 1999). We recognize today's universities can be sprawling, so we counted libraries located on campuses in the same town that are either within walking distance or a quick university bus ride to the main campus, especially in areas commonly named north, east, or south campus.

We counted libraries twice, once in January 2017 and again in October 2017. The second count, which we conducted after the survey, enabled us to check our original numbers and identify a few additional branches within main libraries.

Results

Library Count

Prior to the emergence of the modern Internet and the explosion of the number of websites on the World Wide Web, surveys were the most efficient way to count libraries. As a result, response rates were critical to achieving an accurate count. The 1983 SPEC Kit collected responses from 90% of academic ARL libraries (94 out of 104) (ARL 1983). Hurd's (1996) survey of ARL academic science and technology libraries achieved a response rate of 69% (75 out of 108). The 1999 SPEC Kit collected data from 44% of ARL libraries (54 out of 122) (Croneis and Short 1999). The poor post-1983 response rates affect our ability to make valid statements about the

degree to which science libraries have changed over time. As a result, will only compare our library count results to those of the 1983 ARL survey.

We identified 182 science branch libraries at the 114 ARL academic institutions. A complete list is available in Dataverse (Doty and Majors 2018). By our count, almost a third of all ARL universities do not have a science library, and close to that same number have only one (Figure 1). Thirty years ago Dionne (1988) noted it was common for large universities to have many branches, but our 2017 library count found only 7 ARL universities (6%) with five or more science libraries.

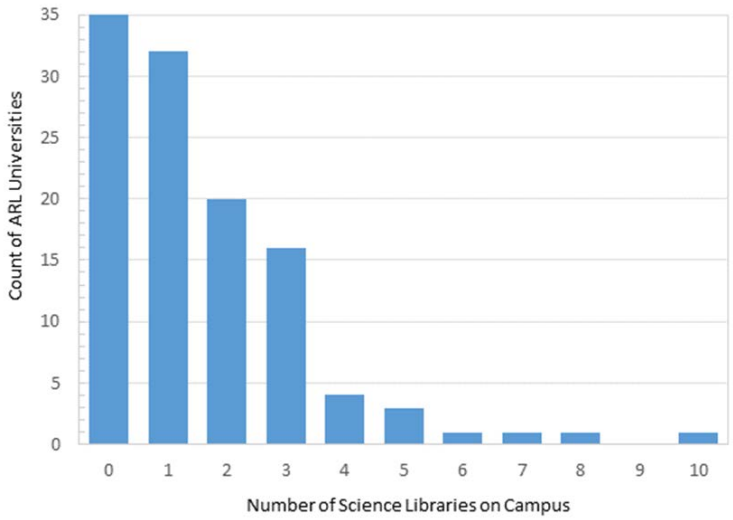

Figure 1. Distribution of number of science libraries at ARL universities in 2017.

Despite its excellent response rate, the 1983 ARL survey has limitations. For example, the data ARL compiled on branch libraries was reported in a three-page table prefaced with the following note: “The table contains many duplicate listings, and for that reason, has no totals” (ARL 1983). Going through the table line-by-line, eliminating duplicates, and making educated guesses, we arrived at a total of 328 science and technology branches reported by the 94 colleges and universities that responded to the survey; only 288 of these branches were administered by the library. Our study identified 182 science libraries; a decrease of 45% compared to the total number of branches reported in 1983 and 37% compared to the number of those branches that were administered by the library.

Although it is possible to estimate a total count of all science libraries from the 1983 ARL report, it is not possible to do so for individual disciplines. Fortunately, in a separate table the ARL authors included branch count totals for the 11 most frequently reported branch types. This table was adapted by Zdravkovska (2011) in her study of the changes in academic branch libraries at ARL institutions in the United States. Six of the 11 branches in the original table were science disciplines (chemistry, engineering, geology, mathematics, physics, and sciences), and Zdravkovska added a seventh: “science & engineering.” We can use the data from these tables to look at how the number of science branch libraries has changed over time (Table 1). Our findings show that these seven types of disciplinary libraries have decreased in number by 36% since 1983, almost identical to the 37% decrease we calculated for all library-administered science libraries. This decrease occurred even as the number of ARL university members increased by 10% during the same time period. Since 2010, there has been a 17% decrease in these libraries in the United States (Table 1).

Part of the explanation for this overall decrease in science libraries is the consolidation of single subject departmental libraries into multidisciplinary science libraries. “Science” and “science & engineering” libraries now make up 43% of branch libraries – a much higher percentage than in 1983 (11%). The change in multidisciplinary libraries from 2010 to 2017 is not as dramatic, but it represents a continued increase in multidisciplinary science libraries at the expense of single subject departmental libraries. In 2004 Hiller predicted future branch library mergers and closures would target those branches that possessed “substantial electronic resources” and served disciplines “heavily dependent on information in serial format.” This observation could serve as the beginning of an explanation for the differing closure rates between 1983 and 2017 for physics (79%), chemistry (70%), geology (58%), and mathematics (50%) libraries.

Table 1. Number of ARL science libraries over time, by selected disciplines

Discipline	U.S. & Canada		U.S. only	
	1983[a]	2017	2010[b]	2017
Mathematics	44	22	27	21
Engineering	39	23	27	20
Physics	38	8	15	7
Chemistry	37	11	20	10
Geology	31	13	12	12
Science	23	26	17	24
Science & Engineering	n/a	32	21	22
Total	212	135	139	116

[a] Data obtained from Table 4 on page 5 in Association of Research Libraries (1983).
[b] Data obtained from Table 2.1 in Zdravkovska (2011).

Online Survey

Forty-four libraries completed our online survey, giving us a response rate of 39%. Respondents included 32 public U.S. and Canadian universities and 12 private U.S. universities, with good geographical representation throughout the United States and Canada. To better understand the trends of mergers and closures, we compared our survey results to the 1983 and 1999 ARL SPEC Kits. Unfortunately, we cannot compare the 1983 study to the 1999 study. The 1983 study reported the number of universities impacted (Table 2), whereas the 1999 study reported the number of branch libraries affected (Table 3). Each table contains the actual number of universities or branches affected and, in parentheses, the percentage, to account for the differing number of responses. The most striking trend is the increase in the number of closures. The 2017 survey data shows science libraries continue to be built, but the ratio of additions to closures and mergers in 2017 is half of what it was in 1983, and a third of what it was in 1999.

Table 2. Changes by number (and percentage[a]) of universities impacted, 1983 and 2017.

Type of Change	Previous 5 years		Planned Changes	
	1983[b]	2017	1983[c]	2017
Additions	4 (4.3%)	2 (4.5%)	5 (5.3%)	2 (4.5%)
Closures	5 (5.3%)	11 (25%)	2 (2.1%)	n/a
Mergers	14 (15%)	8 (18%)	19 (20%)	4 (9.1%)

[a]The total number of survey respondents – 94 in 1983 and 44 in 2017 – was used to calculate the percentage of universities impacted.
[b] Data obtained from Table 6 on page 6 in Association of Research Libraries (1983).
[c] Data obtained from Table 7 on page 6 in Association of Research Libraries (1983).

Table 3. Changes by number (and percentage[a]) of branches impacted, 1999 and 2017.

Type of Change	Previous 5 years		Planned Changes	
	1999[b]	2017	1999[c]	2017
Additions	3 (1.8%)	2 (3.1%)	5 (3.1%)	2 (3.1%)
Closures	11 (6.7%)	21 (32%)	5 (3.1%)	n/a
Mergers	4 (2.5%)	8 (12%)	22 (13%)	5[d] (7.7%)

[a] The total number of science branch libraries reported by respondents – 163 in 1999 and 65 in 2017 – was used to calculate the percentage of branches impacted.
[b] Data obtained from question 8 on page 17 in Croneis and Short (1999).
[c] Data obtained from question 16 on page 20 in Croneis and Short (1999).
[d] Estimate based on our analysis of the four universities that noted a merger in the survey

The survey question and time frame concerning planned changes is different in our 2017 survey compared to the 1983 and 1999 surveys. We asked if the library was "in the process of building or consolidating science libraries." We did not ask about planned closures, so those cannot be compared over the three surveys. It is tempting to look at the "Planned Changes" columns of Tables 2 and 3, however, and wonder if science libraries are approaching a steady-state. The greatest challenge to this is most likely to come from those schools that still have a large number of science libraries. By our count, the following 11 schools have 62 science libraries – one third of the total for ARL universities: Pennsylvania State University, University of Illinois Urbana-Champaign, University of Notre Dame, University of Virginia, Cornell University, Ohio State University, University of Texas at Austin, University of California, Berkeley, University of Toronto, Harvard University, and University of Wisconsin–Madison. In fact, one of these schools is currently "rethinking" their libraries, including 6 of their science libraries (University of Wisconsin—Madison Libraries 2018).

Seeking to further understand library consolidations and closures, question 7 of our survey asked how libraries are supporting departments after closing or consolidating libraries. The majority of libraries reported that they are redirecting services to the main library or another branch library. Some libraries reported that they are providing office hours within departments. In the space provided for free-text responses, librarians explained how they are redirecting services, attending faculty meetings, redesigning spaces, improving their web sites, and buying digital backfiles.

Question 8 of our survey asked librarians to rank how they prioritize collections, facilities, and various services in their primary science library. Specifically, respondents were asked about promoting student and/or faculty collaboration; integrating the library with departmental activities and events; providing a physical collection; providing advanced technologies and services; and providing a comfortable, inviting study space. Two items stood out: providing a comfortable, inviting study space and promoting student and/or faculty collaboration. The same number of respondents felt that these services were their highest priority, and double the number of any of the other services. However, very few respondents (9%) selected "promoting student and/or faculty collaboration" as their second priority, whereas "providing a comfortable, inviting space" was the second priority for 35% of respondents. The three remaining services we asked respondents to rank were more frequently ranked as low priority (4 or 5).

Similar findings have been documented by previous researchers. For instance, Allison Head's (2016) study of renovation and construction trends at academic libraries corroborates these results, as she found the primary focus of renovations and new spaces is supporting collaborative learning and individual study. In addition, Steve Hiller (2004) predicted "surviving branch libraries will be those…that provide space that supports student work in a collaborative teaching and learning environment." Head concludes by encouraging libraries to "embrace the originality of library learning space designs;" cautioning them that "one size does not fit all academic libraries" and "designs will, and should be, different on every campus;" and imploring them to remain flexible so that they can evolve in response to the "seismic changes happening in pedagogy and curricular programs."

Question 9 asked librarians to explain how their main science library is improving the services in the five areas listed in question 8. We provide a summary of the key themes identified from each question here. An anonymized list of responses is available in Dataverse (Doty and Majors 2018).

1. Providing a comfortable, inviting space was the topic respondents elaborated on the most. The majority of the respondents stated they are adding quiet study spaces and group studies, creating collaborative workspaces, renovating spaces with new furniture and seating options, and adding more power outlets. Some libraries are seeking input from students and faculty while others are using consultants to assist with the planning and designing. Representative responses include:
    - "Improved study areas, renovating to provide a special study area for graduate students, and adding new furniture."
    - "Providing a variety of different types of study spaces that cater to a wide range of patrons - quiet, individual spaces to collaborative spaces, some with monitors and computers, some without; rolling whiteboards, smart boards and markers. We also have actual group study rooms equipped with dual monitors and white boards. We're adding MediaScape collaborative spaces."
    - "Our renovation committee is working on improving student space in the science library right now! It will involve better study spaces (e.g., sound proofing and white boards) and more study spaces, furniture with outlets, and more..."

2. Survey respondents wrote they promote student and/or faculty collaboration by implementing changes to spaces and offering new services, including displaying student posters either digitally or in print, highlighting digital projects, and hosting faculty presentations. Representative responses include:

- "The libraries are actively working to increase collaboration with faculty and students such as hosting faculty presentations and panels, including a STEM speaker series and scholarly communications events."
- "We are displaying student projects on a large screen."

3. Librarians had varying responses about the physical collection. Some commented they are actively reducing the print collection and buying more e-collections, whereas a few librarians wrote they are using their physical collection to bring in more people by highlighting their science textbook collection with new shelving and adding a popular science collection and reading nook. Representative responses include:
   - "Seeking feedback from faculty on collection weeding decisions to free up more space for student study space."
   - "We are moving towards a digital collection in all locations."
   - "We still have physical collections, but for the most part, we try to be pretty smart about what parts of the print collection we keep onsite."

4. Librarians are integrating the library with departmental activities and events by sponsoring STEAM/STEM speaker series, collaborating with local science festivals and museums to host events in the library, and building collaborative classrooms for science departments to use. In addition, a separate theme that stood out from these comments is the way science librarians define their role as a liaison. Respondants stated that they provide instruction and outreach to departments, faculty, students, and campus services, including holding office hours in their assigned academic departments. These findings are consistent with other surveys and articles about library liaisons (Miller and Pressley 2015; Najmabadi 2017). Representative responses include:
   - "Over the last several years there has been increased effort and energy devoted to engagement across campus, with greater assessment, marketing and outreach. [A new focus on digital scholarship] and associated facilities are designed to support/encourage this effort, and are having some effect."
   - "Lots of outreach activities to ensure that students know we're here."
   - "The geology library has coordinated events with the Natural History Museum."
   - "We continue to connect with departments through our liaisons. We identify learning opportunities where we can collaborate to ensure that our users have access to the information they need to support their research and educational endeavors."

5. One-third of all comments for question 9 described how libraries are providing advanced technologies and services. Respondents wrote about makerspaces, 3-D printing, visualization labs, GIS, virtual reality, and mobile app & software development. Representative responses include:
   - "We're experimenting with 3-D printing and scanning, makerspace environments, and visualization labs."
   - "We currently offer 3D printing, GIS workshops, statistical help, and we are in the process of expanding these services."
   - "Adding a GIS lab, maker's space, and 1Button studio to science library"

Conclusion

In this study we found over two-thirds of ARL institutions have at least one science library. Survey respondents note these libraries exist with varying services, management structures, and collections. Our analysis shows the total number of science libraries has decreased by one-third since 1983. As we note in our literature review, many researchers predicted consolidations, mergers, and closures from the 1980s to the early 2000s, and our numbers confirm this. We observe the percentage of multidisciplinary science libraries continues to increase and currently is four times what it was in 1983. Our survey results note the top priority of science libraries is providing comfortable, inviting spaces. In particular, respondents enthusiastically described renovating spaces and adding services around specialized tools and advanced technologies.

Our analysis compares 35 years of library data captured during major transformations and stressors for libraries. As we reflect on these results, we are optimistic about the future of science libraries. Our results document the many ways our peers are adapting science libraries to the changing expectations of students, faculty, and administration.

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Appendix

2017 Survey Questions & Results
(administered via SurveyMonkey)

For additional data see: Doty C, Majors K. 2018. Science Library Trends: Facilities & Services. https://doi.org/10.15139/S3/BWX81E, UNC Dataverse, V2.

1. List the university you represent. (We do not have permission to share this data)
2. How many science libraries are currently open on your main campus? Response rate: 98%.

Total science libraries	Total responses	Percentage
0	8	19%
1	17	40%
2	7	16%
3	6	14%
4	3	7%
5	1	2%
6	0	--
7	0	--
8	0	--
9	1	2%
10	0	--

3. In the last 5 years, how many science libraries on your campus closed and the collection was returned to the main library or a storage facility? Response rate: 96%.

Total science libraries	Total responses	Percentage
0	31	74%
1	6	14%
2	3	7%
3	1	2%
4	0	--
5	0	--
6	1	2%
7	0	--
8	0	--
9	0	--
10	0	--

4. In the last 5 years, how many science libraries on your campus merged or consolidated where the collection remains in a branch library? Response rate: 98%.

Total science libraries	Total responses	Percentage
0	35	81%
1	8	19%

5. In the last 5 years, have you built a new science library? Response rate: 98%.

Response	Total responses	Percentage
Yes	2	5%
No	41	95%

6. Are you in the process of building or consolidating science libraries on your campus? Response rate: 98%.

Response	Total responses	Percentage
Yes, building	2	5%
Yes, Consolidating	4	9%
No	37	86%

7. If you have closed or consolidated science libraries recently, what are you doing to serve these subjects and departments? (Select all that apply) Response rate: 48%. Data provided below is calculated from the sorting analysis.

Response	Total responses	Percentage
Providing librarian office hours within the department(s)	6	29%
Redirecting services to another library	15	71%
Other (please specify)	4	19%

8. Rank how your university's primary science library prioritizes the following 5 options. Response rate: 80%.

Priority	Ranking	Average Score
Promoting student and/or faculty collaboration	2	2.4
Integrating the library with departmental activities and events	4	3.4
Providing a physical collection	3	3.3
Providing advanced technologies and services	5	3.6
Providing a comfortable, inviting study space	1	2.1

9. Explain how your science library(s) is improving the services listed in question 8. Response rate: 74%.