Technology Skills in the Workplace: Information Professionals' Current Use and Future Aspirations

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ABSTRACT

Information technology serves as an essential tool for today's information professional, and ongoing research is needed to assess the technological directions of the field over time. This paper presents the results of a survey of the technologies used by library and information science practitioners, with attention to the combinations of technologies employed and the technology skills that practitioners wish to learn. The most common technologies employed were email, office productivity tools, web browsers, library catalog- and database-searching tools, and printers, with programming topping the list of most-desired technology skill to learn. Similar technology usage patterns were observed for early and later-career practitioners. Findings also suggested the relative rarity of emerging technologies, such as the makerspace, in current practice.

INTRODUCTION

Over the past several decades, technology has rapidly moved from a specialized set of tools to an indispensable element of the library and information science (LIS) workplace, and today it is woven throughout all aspects of librarianship and the information professions. Information professionals engage with technology in traditional ways, such as working with integrated library systems, and in new innovative activities, such as mobile-app development or the creation of makerspaces.[1] The vital role of technology has motivated a growing body of research literature, exploring the application of technology tools in the workplace, as well as within LIS education, to effectively prepare tech-savvy practitioners. Such work is instrumental to the progression of the field, and with the rapidly-changing technological landscape, requires ongoing attention from the research community.

One of the most valuable perspectives in such research is that of the current practitioner. Understanding current information professionals' technology use can help in understanding the role and shape of the LIS field, provide a baseline for related research efforts, and suggest future

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directions. The practitioner perspective is also valuable in separating the hype that often surrounds emerging technologies from the reality of their use and application within the LIS field. This paper presents the results of a survey of LIS practitioners, oriented toward understanding the participants' current technology use and future technology aspirations. The guiding research questions for this work are as follows:

1. What combinations of technology skillsets do LIS practitioners commonly use?
2. What combinations of technology skillsets do LIS practitioners desire to learn?
3. What technology skillsets do newer LIS practitioners use and desire to learn as compared to those with ten-plus years of experience in the field?

LITERATURE REVIEW

The growth and increasing diversity of technologies used in library settings has been matched by a desire to explore how these technologies impact expectations for LIS practitioner skill sets. Triumph and Beile examined the academic library job market in 2011 by describing the required qualifications for 957 positions posted on the ALA JobLIST and ARL Job Announcements websites.[2] The authors also compared their results with similar studies conducted in 1996 and 1988 to see if they could track changes in requirements over a twenty-three-year period. They found that the number of distinct job titles increased in each survey because of the addition of new technologies to the library work environment that require positions focused on handling them. The comparison also found that computer skills as a position requirement increased by 100 percent between 1988 and 2011, with 55 percent of 2011 announcements requiring them.

Looking more deeply at the technology requirements specifically, Mathews and Pardue conducted a content analysis of 620 jobs ads from the ALA JobList to identify skills required in those positions.[3] The top technology competencies required were web development, project management, systems development, systems applications, networking, and programming languages. They found a significant overlap of librarian skill sets with those of IT professionals, particularly in the areas of web development, project management, and information systems. Riley-Huff and Rholes found that the most commonly sought technology-related job titles were systems/automation librarian, digital librarian, emerging and instructional technology librarian, web services/development librarian, and electronic resources librarian.[4] A few years later, Maceli added to this list with newly popular technology-relating titles, including emerging technologies librarian, metadata librarian, and user experience/architect librarian.[5]

Beyond examining which specific technologies librarians should be able to use, researchers have also pondered whether a list of skills is even possible to create. Crawford synthesized a series of blog posts from various authors to discuss which technology skills are essential and which are too specialized to serve as minimum technology requirements for librarians.[6] He questioned whether universal skill sets should be established given the variety of tasks within libraries and the unique backgrounds of each library worker. Crawford also questioned the expectation that every librarian

will have a broad array of technology skills from programming to video editing to game design and device troubleshooting. Partridge et al. reported on a series of focus groups held with 76 librarians that examined the skills required for members of the profession, especially those addressing technology.[7] In the questions they asked the focus groups, the authors focused on the term "library 2.0" and attempted to gather suggestions on skills that current and future librarians need to assist users. They concluded that the groups identified that a change in attitudes by librarians was more important to future library service than the acquisition of skills with specific technology tools. Importance was given to librarians' abilities to stay aware of technological changes, be resilient and reflective in the face of them, and to communicate regularly and clearly with the members of their communities.

Another area examined in the studies is where the acquisition of technology skills should and does happen for librarians. Riley-Huff and Rholes reported on a dual approach to measure librarians' preparation for performing technology-related tasks.[8] The authors assessed course offerings for LIS programs to see if they included sufficient technology preparation for new graduates to succeed in the workplace. They then surveyed LIS practitioners and administrators to learn how they acquired their skills and how difficult it is to find candidates with enough technology preparation for library positions. Their findings suggest that while LIS programs offer many technology courses, they lack standardization, and graduates of any program cannot be expected to have a broad education in library technologies.

Further research confirmed this troubling lack of consistency in technology-related curricula. Singh and Mehra assessed a variety of stakeholders, including students, employers, educators, and professional organizations, finding widespread concern about the coverage of technology topics in LIS curricula.[9] Despite inconsistencies between individual programs, several studies provided a holistic view of the popular technology offerings within LIS curricula. Programs commonly offered one or more introductory technology courses, as well as courses in database design and development, web design and development, digital libraries, systems analysis, and metadata.[10,11,12]

As researchers have emphasized from a variety of perspectives, new graduates could not realistically be expected to know every technology with application to the field of information.[13] There was widespread acknowledgement that learning in this area can, and must, continue in a lifelong fashion throughout one's career. Riley-Huff and Rholes reported that LIS practitioners saw their own experiences involving continuing skill development on the job, both before and after taking on a technology role.[14] However, literature going back many decades suggests that the increasing need for continuing education in information technology has generally not been matched by increasing organizational support for these ventures. Numerous deterrents to continuing technology education were noted, including lack of time,[15] organizational climate, and the perception of one's age.[16] While studies in this area have primarily focused on MLS-level positions, Jones reported on academic library support staff members and their perceptions of technology use over a ten-year period and found that increased technology responsibilities added

to workloads and increased workplace stress.[17] Respondents noted that increasing use of technology in their libraries has increased their individual workloads along with the range of responsibilities that they hold.

METHOD

To build an understanding of the research questions stated above, which focus on the technologies currently used by information professionals and those they desired to learn, we designed and administered a thirteen-question anonymous survey (see appendix) to the subscribers of thirty library-focused electronic discussion groups between February 25 and March 13, 2015. The groups were chosen to target respondents employed in multiple types of libraries (academic, public, school, and special) with a wide array of roles in their libraries (public services librarians, systems staff members, catalogers, and so on). We solicited respondents with an email sent to the groups asking for their participation in the survey and with the promise to post initial results to the same groups. The survey included closed and open-ended questions oriented toward understanding current technology use and future aspirations as well as capturing demographics useful in interpreting and generalizing the results. The survey questions have been previously used and iteratively expanded over time by the second author, first in the fall of 2008, then spring of 2012, with summative results presented in the last three editions of the *Neal-Schuman Library Technology Companion*. We obtained a total of 2,216 responses to the question, "Which of the following technologies or technology skills are you expected to use in your job on a regular basis?" Of these responses, 1,488 (67 percent) of the respondents answered the question regarding technologies they would like to learn: "What technology skill would you like to learn to help you do your job better?" We conducted basic reporting of response frequency for closed questions to assess and report the demographics of the respondents. To analyze the open-ended survey question results in greater depth, we conducted a textual analysis using the R statistical package (https://www.r-project.org/). We used the tm (text mining) package in R (http://CRAN.R-project.org/package=tm) to calculate frequency, correlation of terms, generate plots, and cluster terms.

RESULTS

The following section will first present an overview of survey responses and respondents, and then explore results as related to the stated four research questions. The LIS practitioners who responded to the survey reported that their libraries are located in forty US states, eight Canadian provinces, and forty-three other countries. Academic libraries were the most common type of library represented, followed by public, school, special, and other (see table 1).

Library Type	Number of Respondents	Percentage of All Respondents
Academic	1,206	54.4
Public	545	24.6
School	266	12
Special	138	6.2
Other	61	2.8

Table 1. The types of libraries in which survey respondents work

Respondents also provided their highest level of education. A total of 77 percent of responding LIS practitioners have earned a library-related or other master's degrees, dual master's degrees, or doctoral degrees. From these reported levels of education, it is likely that more respondents are in librarian positions than in library support staff positions. However, individuals with master's degrees serve in various roles in library organizations, so the percentage of graduate degree holders may not map exactly to the percentage of individuals in positions that require those degrees. Significantly fewer respondents (16 percent) reported holding a high school diploma, some college credit, an associate degree, or a bachelor's degree as their highest level of education.

Another aspect we measured in the survey was tasks that respondents performed on a regular basis. The range of tasks provided in the survey allowed for a clearer analysis of job responsibilities than broad categories of library work such as "public services" or "technical services." Some respondents appeared to be employed in solo librarian environments where they are performing several roles. Even respondents who might have more focused job titles such as "reference librarian" or "cataloger" may be performing tasks that overlap traditional roles and categories of library work. The tasks offered in the survey and the responses to each are shown in table 2.

Task	Number of Respondents	Percentage of Respondents
Reference	1,404	63.4
Instruction	1,296	58.5
Collection development	1,260	56.9
Circulation	917	41.4
Cataloging	905	40.8
Electronic resource management	835	37.7
Acquisitions	789	35.6
User experience	775	35
Library administration	769	34.7
Outreach	758	34.2
Marketing/public relations	722	32.6
Library/IT systems	672	30.3
Periodicals/serials	659	29.7
Media/audiovisuals	566	25.5
Interlibrary loan	518	23.4
Distance library services	474	21.4
Archives/special collections	437	19
Other	209	9.40%

Table 2. Tasks performed on a regular basis by survey respondents

While public services-related activities lead the list, with reference, instruction, collection development, and circulation as the top four task areas, technical services-related activities are well represented; the next three in rank are cataloging, electronic resource management, and acquisitions. The overall list of tasks shows the diversity of work LIS practitioners engage in, as each respondent chose an average of six tasks. The results also suggest that the survey respondents are well acquainted with a wide variety of library work rather than only having experience in a few areas, making their uses of technology more representative of the broader library world.

The survey also questioned the barriers LIS practitioners face as they try to add more technology to their libraries, and 2,161 respondents replied to the question, "Which of the following are barriers to new technology adoption in your library?" Financial considerations proved to be the most common barrier, with "budget" chosen by 80.7 percent of respondents, followed by "lack of staff time" (62.4 percent), "lack of staff with appropriate skill sets" (48.5 percent), and "administrative restrictions" (36.7 percent).

What Combinations of Technology Skillsets do LIS Practitioners Commonly Use?

Responses from survey question 8, "Which of the following technologies or technology skills are you expected to use in your job on a regular basis?," were analyzed to build an understanding of this research questions. A total of 2,216 responses to this question were received. Survey respondents were asked to select from a detailed list of technologies/skills (visible in question 8 of the appendix) that they regularly used. The top answers respondents chose for this question were: email, word processing, web browser, library catalog (public side), and library database searching. The full list of the top twenty-five technology skills and tools used is detailed in figure 1, with the list of the bottom fifteen technology skills used presented in figure 2.

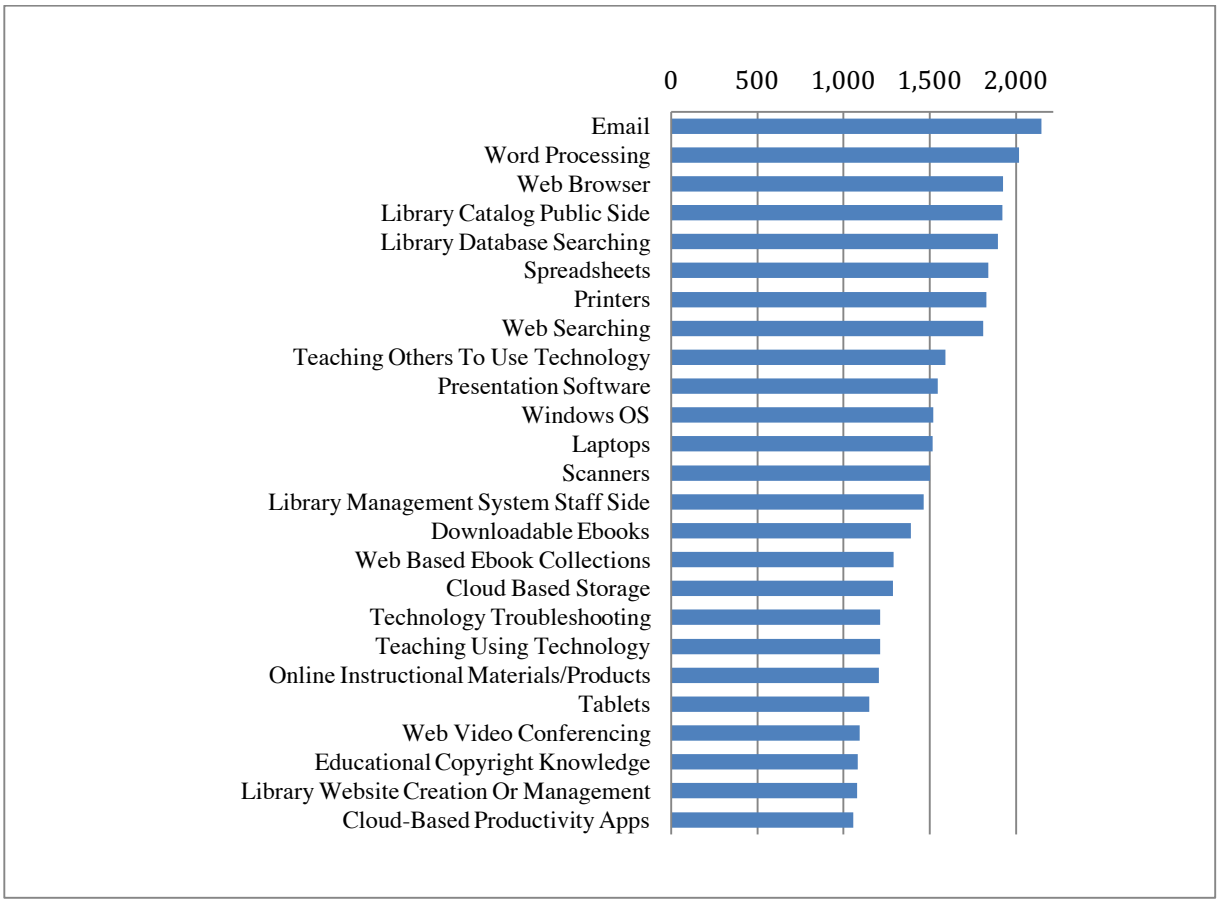

Figure 1. Top twenty-five technology skills/tools used by respondents (*N* = 2,216)

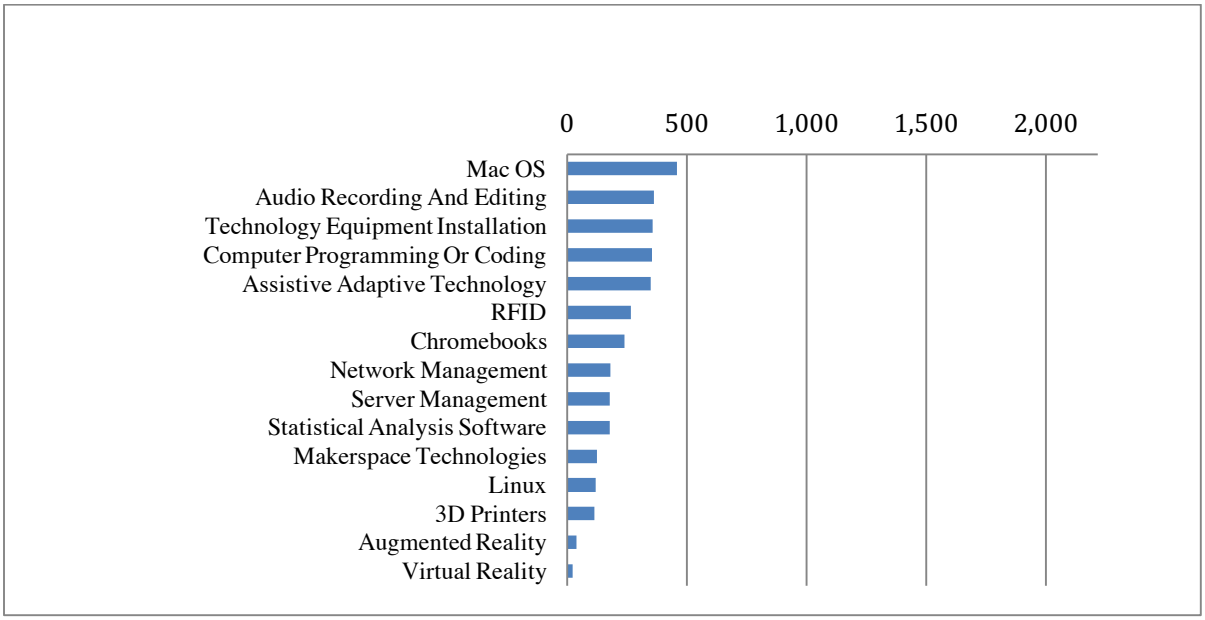

Figure 2. Bottom fifteen technology skills/tools used by respondents (*N* = 2,216)

Text analysis techniques were then used to determine the frequent combinations of technology skills used in practice. First, a clustering approach was taken to visualize the most popular technologies that were commonly used in combination (figure 3). Clustering helps in organizing and categorizing a large dataset when the categories are not known in advance, and, when plotted in a dendrogram chart, assists in visualizing these commonly co-occurring terms. The authors numbered the clusters identified in figure 3 for ease of reference. From left to right, the first cluster is focuses on communication and educational tools, the second emphasizes devices and software, the third contains web and multimedia creation tools, the fourth contains office productivity and public-facing information retrieval tools, and the fifth cluster has a diverse collection of responsibilities including systems-oriented responsibilities (from operating systems to specific hardware devices), working with ebooks, teaching with technology, and teaching technology to others.

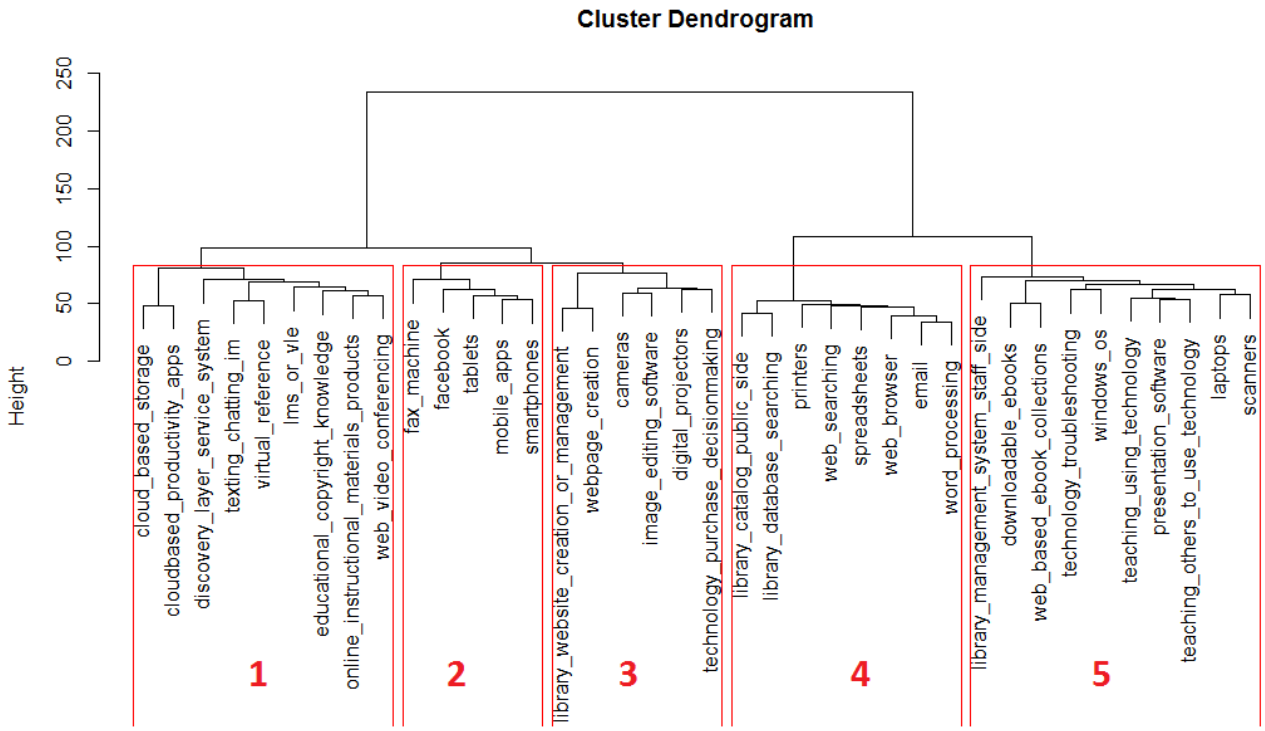

Figure 3. Cluster analysis of most frequent technology skills used in practice, with red outlines on each numbered cluster

Notably, the list of top skills used (figure 1) falls more on the end-user side of technology; skills more oriented toward systems work (e.g. Linux, server management, computer programming, or coding) were less frequently mentioned, and several were among the lowest reported (figure 2). Of the 2,216 respondents, 15 percent used programming or coding skills regularly in their job (which is of interest as programming or coding was the skill most desired to learn by respondents; this will be discussed further in the context of the next research question).

Plotting the correlations between the more advanced technology skillsets can provide a picture of the work such systems-oriented positions are commonly responsible for, particularly as they are less well represented in the responses as a whole. Figure 4 plots the correlated terms for those tasked with "server management." It is fair to assume someone with such responsibilities falls on the highly technical end of the spectrum.

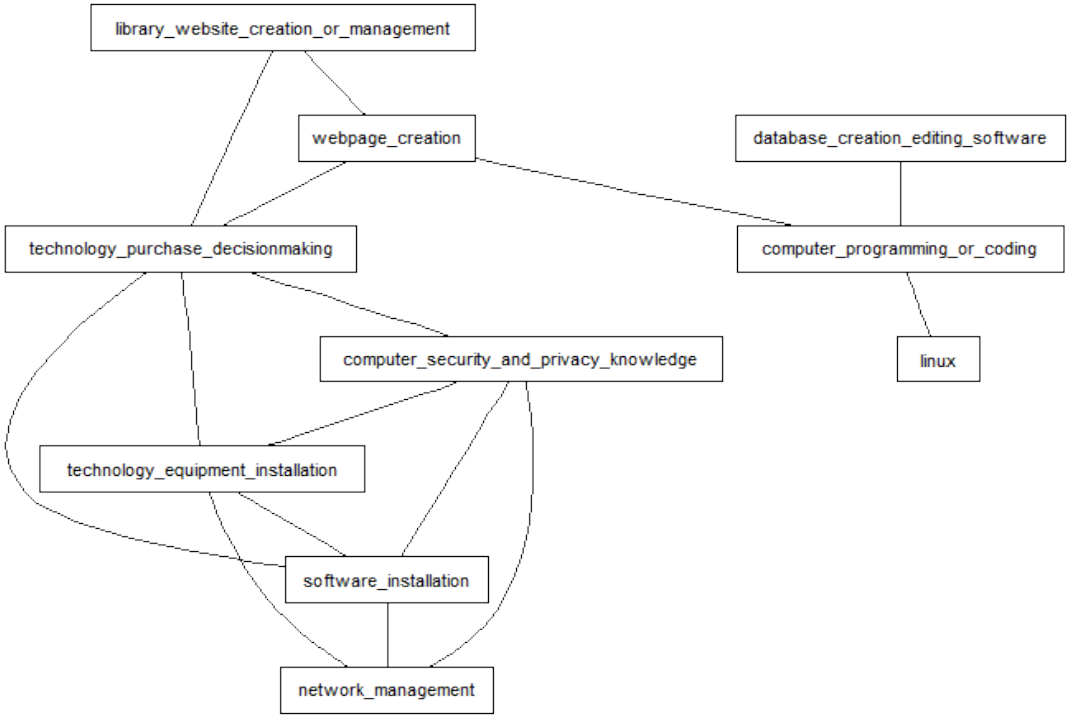

Figure 4. Terms correlated with "server management," indicating commonly co-occurring workplace technologies for highly-technical positions

The more common task of "library website creation or management," which fell to those with a broad level of technological expertise, had numerous correlated terms. Figure 5 demonstrated a wide array of technology tools and responsibilities.

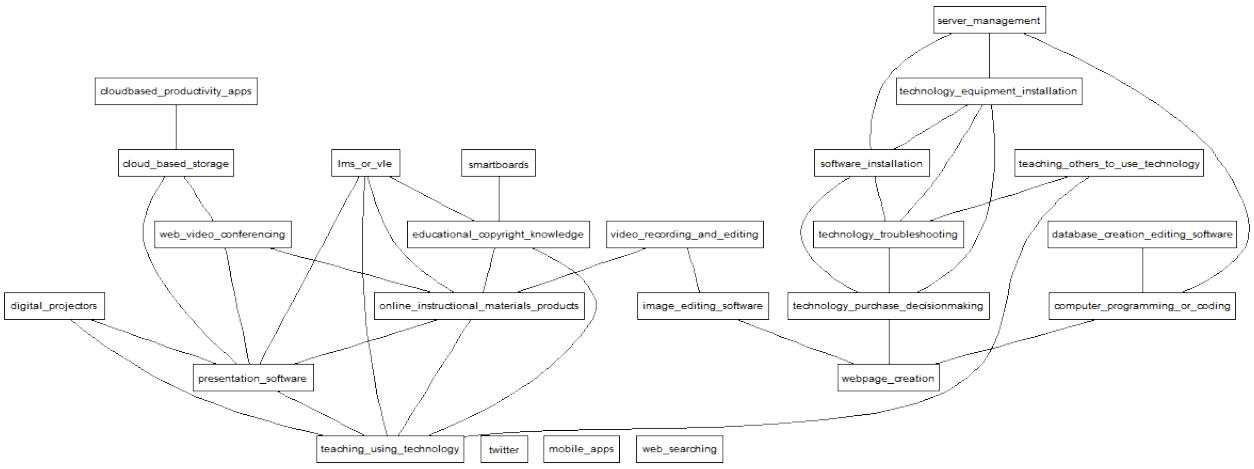

Figure 5. Terms correlated with "library website creation or management," indicating commonly co-occurring technologies used on the job

And lastly, teaching using technology and teaching technology to others is a long-standing responsibility of librarians and library staff. The following plot (figure 6) presents the skills correlated with "teaching others to use technology."

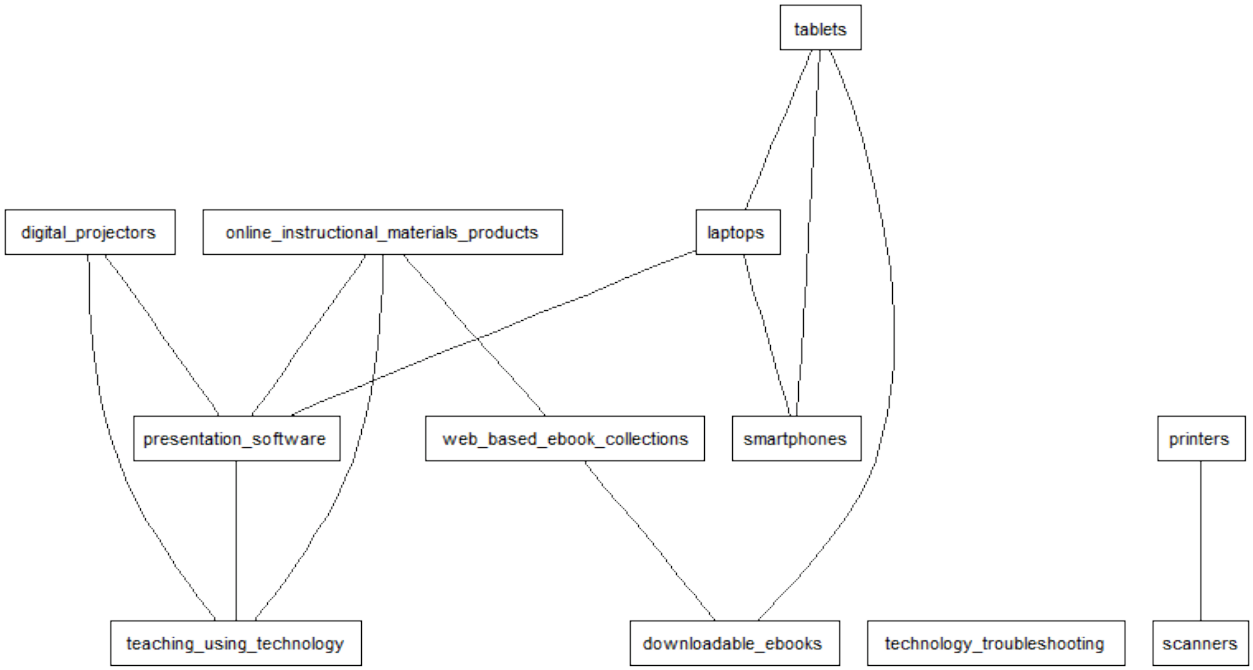

Figure 6. Terms correlated with "teaching others to use technology," indicating commonly co-occurring technologies used on the job

What Combinations of Technology Skillsets do LIS Practitioners Desire to Learn?

We analyzed responses to survey question 10, "What technology skill would you like to learn to help you do your job better?," to explore this research question. As summarized in Burke[18]—and consistent with the prior year's findings—coding or programming remained the most desired technology skillset, mentioned by 19 percent of respondents. The raw text analysis yielded a fuller list of the top terms mentioned by participants (table 3 and visualized in figure 7).

Technology Term	Number of Respondents	Percentage of Respondents
Coding or programming (combined for reporting)	292	19.59
Web	178	11.96
Software	158	10.62
Video	112	7.53
Apps	106	7.12
Editing	105	7.06
Design	85	5.71
Database	76	5.11

Table 3. Terms mentioned by 5 percent or more of survey respondents

Figure 7. Wordcloud of responses to "what technology skill would you like to learn to help you do your job better?"

We then explored the deeper context of responses and individually analyzed responses specific to the more popular technology desires. First, we assessed the responses mentioning the desire to learn coding or programming. Of these responses, the most common specific technologies mentioned were HTML, Python, CSS, JavaScript, Ruby, and SQL, listed in decreasing order of interest. Although most participants did not describe what they would like to do with their desired coding or programming skills, of those that did, the responses indicated interest in

- becoming more empowered to solve their own technology problems (e.g., "I would like to learn the [programming languages] so I don't have to rely on others to help with our website," "I'm one of the most tech-skilled people at my library, but I'd like to be able to build more of my own tools and manage systems without needing someone from IT or outside support.");
- improving communication with IT (e.g., "how to speak code, to aid in communication with IT," "to better identify problems and work with IT to fix them");
- creating novel tools and improving system interoperability (e.g. "coding for app and API creation"); and
- bringing new technologies to their library and patrons (e.g., "coding so that I can incorporate a hackerspace in my library").

Next, we took a clustering approach to visualize the terms commonly desired in combination. Figure 8 describes the clustered terms that we found within the programming or coding responses. The terms "programming" and "coding" form a distinct cluster to the right of the diagram, indicating that many responses contained only those two terms.

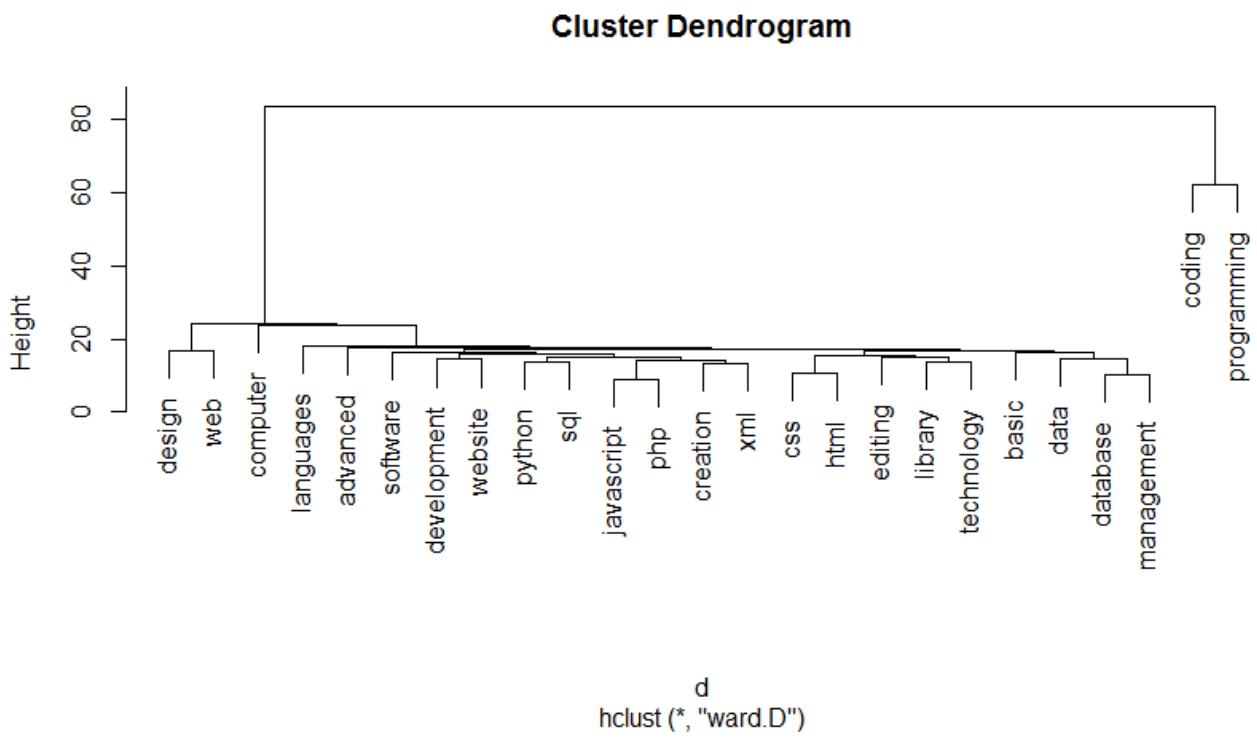

Figure 8. Clustering of terms present in responses indicating the desire to learn coding or programming

The remaining portion of the diagram begins to illustrate the specific technologies mentioned for those respondents that answered in greater detail or expanded on their general answer of programming or coding. Other related desired technology-skill areas become apparent: database management, HTML and CSS (as well as the more general "web design," which appeared in the top terms in table 3), PHP and JavaScript, Python and SQL, and XML creation, among others. The bulleted list presented in the previous paragraph illustrates some of the potential applications participants envisioned these skills being useful in, but the majority did not provide this level of detail in their response.

Editing was another prominent term that appeared across participant responses and was largely meant in the context of video editing. Because of the vagueness of the term "editing," a closer look was necessary to determine other technology desires. Looking at terms highly correlated with "editing" revealed both video and photo editing to be important to respondents. Several of the top-appearing terms were used more generally: "database" and mobile "apps" were mentioned without specifying the technology tool or scenario of use, such that a more contextual analysis could not be conducted. These responses can be particularly difficult to interpret as the term "databases" can have a technical meaning (e.g., working with SQL) or it can refer to the use of library databases from an end user perspective.

What Technology Skillsets do Newer LIS Practitioners Use and Desire to Learn as Compared to Those with Ten-Plus Years Experience in the Field?

Of the 2,216 survey responses, 877 stated they had worked in libraries for ten or fewer years. We analyzed these responses separately from the remaining 1,334 respondents who had worked in libraries for more than ten years. Of this group, 644 had worked in libraries for twenty-plus years (figure 9). A handful of participants did not answer the question and were omitted from the analysis.

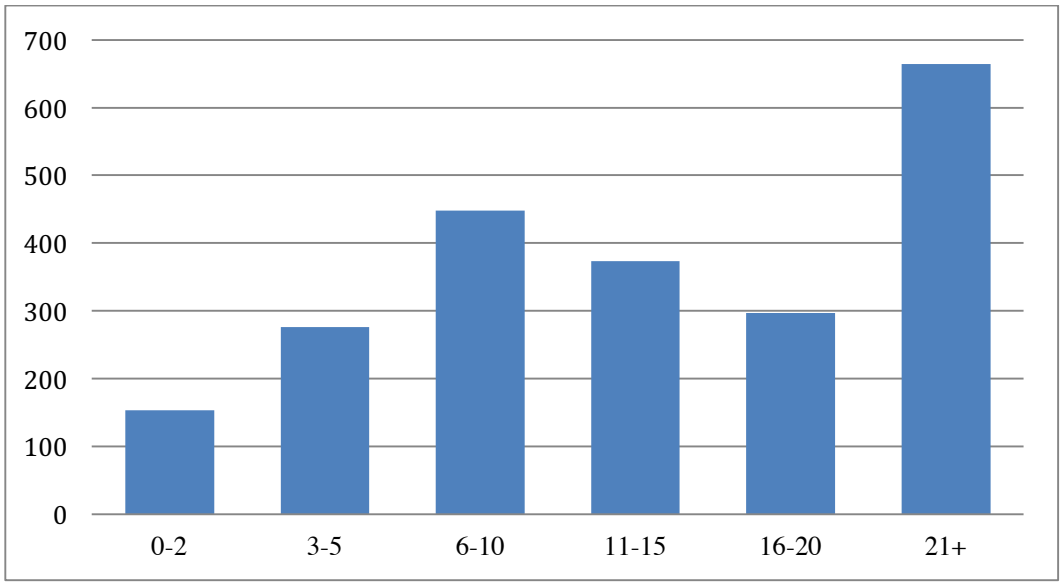

Figure 9. Number of survey responses falling into the various categories for number of years working in libraries

The top technology skills used in the workplace did not differ significantly between the different groups. The top skills, as discussed earlier and presented in figure 1, were well represented and similarly ordered. A few small percentage points of difference were noted in a handful of the top skills (figure 10). Those newer to the field were slightly more likely to teach others to use technology, use cloud-based storage, and use cloud-based productivity apps. More experienced practitioners regularly used the library management system (on the staff side) more than those that were newer to the field.

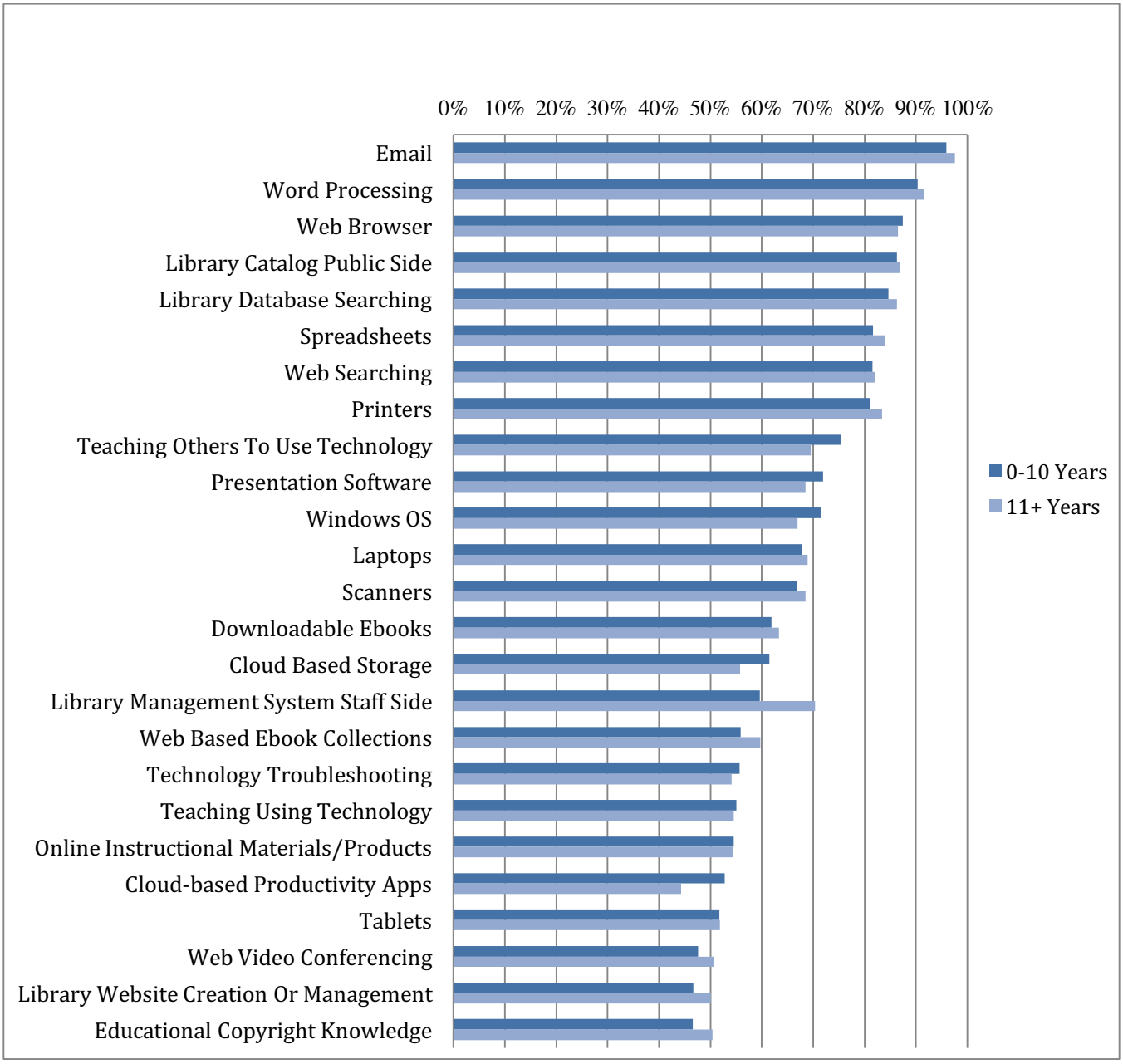

Figure 10. Top twenty-five technology skills used by respondents in the zero to ten years' experience (dark blue) and eleven-plus years experience (light blue) groups

For the question regarding technologies they would like to learn, 69 percent of the participants with zero to ten years' experience answered the question compared to a slightly smaller 65 percent of the participants with more than ten-years' experience. Top terms for both groups were very similar, including coding or programming, software, web, video, design, and editing. These terms were not dissimilar to the responses taken as a whole (table 3), indicating that respondents were generally interested in learning the same sorts of technology skills regardless of how long they had been in the field.

A few noticeable differences between the two groups emerged. The most popular skills mentioned, coding or programming, were mentioned by 28 percent of the respondents with zero to ten years' experience, and by 15 percent of the respondents with eleven-plus years experience. There was slightly more interest (by a few percentage points) in databases, design, Python, and Ruby in the zero to ten years' experience group. Taking a closer look at the different year ranges in the zero to ten years of experience or less group, revealed that those with three to five years of experience were most likely to be interested in learning coding or programming skills.

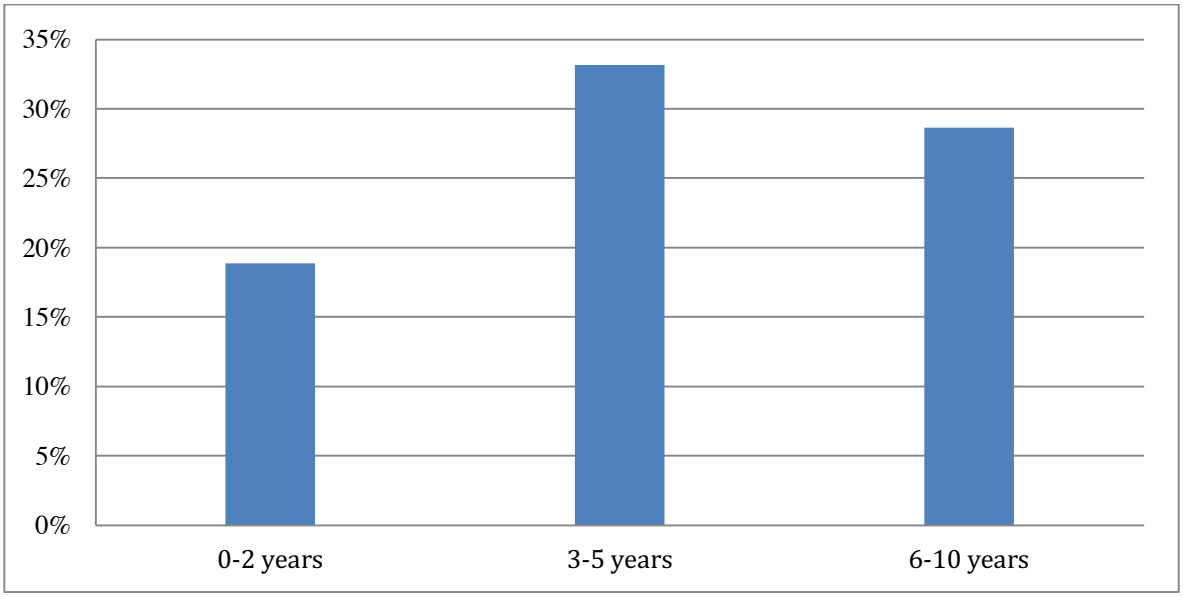

Figure 11. Percentage of respondents interested in learning coding or programming in the groups with ten or fewer years' experience

Of the participants that answered the question at all, several stated that there were no technology skills they would need or like to learn for their position, either because they were comfortable with their existing skills or were simply open to learning more as needed (but nothing specific came to mind). Combined with those who did not answer the question (and so presumably did not have a particular technology they were interested in learning), 28 percent of the zero to ten years' experience group and 31 percent of the eleven-plus years experience group did not have any technologies that they desired to learn at the moment.

DISCUSSION

As detailed earlier, the most common technologies employed by LIS practitioners were email, office productivity tools, web browsers, library catalog and database searching tools, and printers. Generally similar technology usage patterns were observed for early and later-career practitioners and programming topped the list of most-desired technology skill to learn.

The cluster analysis presented in figure 3 suggests that a relatively small percentage of practitioners have technology-intensive roles that would require skills such as programming, working with databases, systems administration, etc. Rather, the cluster analysis showed common technology skillsets focused on the end-user side of technology tools. In fact, most of the top ten skills used—email, office productivity tools (word processing, spreadsheets and presentation software), web browsers, library catalog and database searching, printers, and teaching others to use technology—are fairly nontechnical in nature. A potential exception is that of teaching technology. Figure 6 suggests that teaching others to use technology entails several hardware devices (for example, laptops, tablets, smartphones, and scanners) as well as online and digital resources, such as ebooks. However, most of the popular skills used would be considered baseline skills for information workers in any domain.

As suggested by Tennant, programming and other advanced technical skills do not necessarily need to be a core skill for all information professionals, but knowledge of the potential applications and possibilities of such tools is required.[19] This idea was echoed by Partridge et al., whose findings emphasized the need for awareness and resilience in tackling new technological developments.[20] These skills alone would obviously be too little for LIS practitioners explicitly seeking a high-tech role, as discussed in Maceli.[21] However, further research directed toward exploring the mental models and general technological understanding of information professionals would be helpful in understanding the true level of practitioner engagement with technology, to complement the list of relatively low-tech tools employed.

Programming has been a skill of great interest within the information professions for many years and the respondents' enthusiasm and desire to learn in this area was readily apparent from the survey results, with nearly 20 percent of participants citing either "programming" or "coding" as a skill they desired to learn. In the context of their current responsibilities, 15 percent of respondents overall mentioned "computer programming or coding" as a regular technological skill they employed (figure 2). There was a slight difference between the librarians with fewer than eleven years of experience—19 percent coded regularly—compared to 13 percent of those with eleven or more years of experience. Within the years-of-experience divisions, the newer practitioners were more interested in learning programming, with the peak of interest at three to five years in the workplace (figure 11).

The relatively low interest or need to learn programming in the newest practitioners potentially indicates a hopeful finding—that their degree program was sufficient preparation for the early years of their career. Prior research would contradict this finding. For example, Choi and Rasmussen's 2006 survey found that, in the workplace, librarians frequently felt unprepared in their knowledge of programming and scripting languages.[22] In the intervening years, curriculum has shifted to more heavily emphasize technology skills, including web development and other topics covering programming,[23] perhaps better preparing early career practitioners. Overall,

programming remains a popular skill in continuing education opportunities as well as in job listings,[24] which aligns well with the respondents' strong interest in this area.

The skills commonly co-occurring with programming in practice included working with Linux, database software, managing servers, and webpage creation (figure 4). Taken as a whole, these skills indicate job responsibilities falling toward the systems side, with webpage creation a skill that bridged intensely technical and more user-focused work (as also evident in figure 4).This indicates that, though programming may be perceived as highly desirable for communicating and extending systems, as a formal job responsibility it may still fall to a relatively small number of information professionals in any significant manner.

Makerspace technologies and their implementation possibilities within libraries have garnered a great deal of excitement and interest in recent years, with much literature highlighting innovative projects in this area (such as American Library Association[25] and Bagley[26]). Fourie and Meyer provided an overview of the existing makerspace literature, finding that most research efforts focus on the needs and construction of the physical space.[27] Given the general popularity of the topic (as detailed in Moorefield-Lang),[28] it is interesting to note that such technologies were infrequently mentioned by survey participants, both in those desiring to learn these tools and those who were currently using them. The most infrequent skills used (figure 2) included makerspace technologies, 3D printers, augmented, and virtual reality. Only a small number of respondents currently used this mix of makerspace-oriented and emerging technologies, and only 3 percent of respondents mentioned interest in learning makespace-related skills.

Despite many research efforts exploring the particulars of unique makerspaces in a case-study approach (for example, Moorefield-Lang),[29] little data exists on the total number of makerspaces within libraries, and the skillset is largely absent from prior research describing LIS curriculum and job listings. This makes it difficult to determine whether the low number of participants that reported working with makerspace technologies is reflective of the small number of such spaces in existence or simply that few practitioners are assigned to work in this area, no matter their popularity. In either case, these findings provide a useful baseline with which to track the growth of makerspace offerings over time and librarian involvement in such intensely technological work.

Despite the interest and clear willingness to learn and use technology, several workplace challenges became apparent from participant responses. As prior research explored (notable Riley-Huff and Rholes),[30] practitioners assumed they would be continually learning and building skills on the job throughout their career to stay current technologically. As described in the earlier results section, many participants mentioned that, although they were highly willing and able to learn, the necessary organizational resources were lacking. As one participant noted, "I'd like to learn anything but the biggest problem seems to be budget (time and monetary)." Several participants expressed feeling overwhelmed with their current workload. New learning opportunities, technological or otherwise, were simply not feasible. Although the survey results indicated that practitioners of all ages were roughly equally interested in learning new

technologies, a handful of responses mentioned that ageist issues were creating barriers. Though few, these respondents described being dismissed as technologists because of their age.

These themes have long been noted in the large body of continuing-education-related literature going back several decades. Stone's study ranked lack of time as the top deterrent to professional development for librarians, and it appears little has changed.[31] Chan and Auster noted that organizational climate and the perception of one's age may impair the pursuit of professional development, among other impediments.[32] However, research has noted a generally strong drive in older librarians to continue their education; Long and Applegate found a preference in later-career librarians for learning outlets provided by formal library schools and related professional organizations, but a lower interest in generally popular topics such as programming.[33] These findings were consistent with the participant responses gathered in this survey.

Finally, as detailed in the results section, a significant percent of respondents (33 percent) did not answer the question regarding what technologies they would like to learn. As is a limitation with survey research, it is difficult to know what the respondent's intention was in not answering the question, i.e., are they comfortable with their current technology skills? Do they lack the time or interest in pursuing further technology education? And of those that did answer, many did not specify their intended use of the technologies they desired to learn. So a deeper exploration of what technologies LIS practitioners desire to learn and why would be of value as well. These questions are worth pursuing in more depth through further research efforts.

CONCLUSION

This study provides a broad view into the technologies that LIS practitioners currently use and desire to learn, across a variety of types of libraries, through an analysis of survey responses. Despite a marked enthusiasm toward using and learning technology, respondents described serious organizational limitations impairing their ability to grow in these areas. The LIS practitioners surveyed have interested patrons, see technology as part of their mission, and are not satisfied with the current state of affairs, but they seem to lack money, time, skills, and a willing library administration.

Though respondents expressed a great deal of interest in more advanced technology topics, such as programming, the majority typically engaged with technology on an end-user level, with a minority engaged in deeply technical work. This study suggests future work in exploring information professionals' conceptual understanding of and attitudes toward technology, and a deeper look at the reasoning behind those who did not express a desire to learn new technologies.

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Appendix. Survey Questions

1. What type of library do you work in**?**
2. Where is your library located (state/province/country)?
3. What is your job title?
4. What is your highest level of education?
5. Which of the following methods have you used to learn about technologies and how to use them? Please mark all that apply.
    - Articles
    - As part of a degree I earned
    - Books
    - Coworkers
    - Face-to-face credit courses
    - Face-to-face training sessions
    - Library patrons
    - Online credit courses
    - Online training sessions (webinars, etc.)
    - Practice and experiment on my own
    - Web resources I regularly check (sites, blogs, Twitter, etc.)
    - Web searching
    - Other:
6. Which of the following skill areas are part of your responsibilities? Please mark all that apply.
    - Acquisitions
    - Archives/special collections
    - Cataloging
    - Circulation
    - Collection development
    - Distance library services
    - Electronic resource management
    - Instruction
    - Interlibrary loan

- Library administration
- Library IT/systems
- Marketing/public relations
- Media/audiovisuals
- Outreach
- Periodicals/serials
- Reference
- User experience
- Other:

7. How long have you worked in libraries?
    - 0–2 years
    - 3–5 years
    - 6–10 years
    - 11–15 years
    - 16–20 years
    - 21 or more years
8. Which of the following technologies or technology skills are you expected to use in your job on a regular basis? Please mark all that apply
    - Assistive/adaptive technology
    - Audio recording and editing
    - Augmented reality (Google Glass, etc.)
    - Blogging
    - Cameras (still, video, etc.)
    - Chromebooks
    - Cloud-based productivity apps (Google Apps, Office 365, etc.)
    - Cloud-based storage (Google Drive, Dropbox, iCloud, OneDrive, etc.)
    - Computer programming or coding
    - Computer security and privacy knowledge
    - Database creation/editing software (MS Access, etc.)
    - Dedicated e-readers (Kindle, Nook, etc.)
    - Digital projectors

- Discovery layer/service/system
- Downloadable e-books
- Educational copyright knowledge
- E-mail
- Facebook
- Fax machine
- Image editing software (Photoshop, etc.)
- Laptops
- Learning management system (LMS) or virtual learning environment (VLE)
- Library catalog (public side)
- Library database searching
- Library management system (staff side)
- Library website creation or management
- Linux
- Mac operating system
- Makerspace technologies (laser cutters, CNC machines, Arduinos, etc.)
- Mobile apps
- Network management
- Online instructional materials/products (LibGuides, tutorials, screencasts, etc.)
- Presentation software (MS PowerPoint, Prezi, Google Slides, etc.)
- Printers (public or staff)
- RFID (radio frequency identification)
- Scanners and similar devices
- Server management
- Smart boards/interactive whiteboards
- Smartphones (iPhone, Android, etc.)
- Software installation
- Spreadsheets (MS Excel, Google Sheets, etc.)
- Statistical analysis software (SAS, SPSS, etc.)
- Tablets (iPad, Surface, Kindle Fire, etc.)
- Teaching others to use technology

- Teaching using technology (instruction sessions, workshops, etc.)
- Technology equipment installation
- Technology purchase decision-making
- Technology troubleshooting
- Texting, chatting, or instant messaging
- 3D printers
- Twitter
- Using a web browser
- Video recording and editing
- Virtual reality (Oculus Rift, etc.)
- Virtual reference (text, chat, IM, etc.)
- Word processing (MS Word, Google Docs, etc.)
- Web-based e-book collections
- Web conferencing/video conferencing (Webex, Google Hangouts, Goto Meeting, etc.)
- Webpage creation
- Web searching
- Windows operating system
- Other:

9. Which of the following are barriers to new technology adoption in your library? Please mark all that apply.
    - Administrative restrictions
    - Budget
    - Lack of fit with library mission
    - Lack of patron interest
    - Lack of staff time
    - Lack of staff with appropriate skill sets
    - Satisfaction with amount of available technology
    - Other:
10. What technology skill would you like to learn to help you do your job better?
11. What technologies do you help patrons with the most?
12. What technology item do you circulate the most?

13. What technology or technology skill would you most like to see added to your library?