Information Professional or IT Professional? The Knowledge and Skills Required by Academic Librarians in the Digital Library Environment

Jaya Raju

**abstract:** As library and information science (LIS) becomes an increasingly technology-driven profession, particularly in the academic library environment, questions arise as to the extent of information technology (IT) knowledge and skills that LIS professionals require. The purpose of this paper is to ascertain what IT knowledge and skills are needed by academic librarians in the digital library environment. Grounded in pragmatist epistemology and using ideas from sociologist Andrew Abbott’s *Chaos of Disciplines*, the study draws empirical evidence from LIS job advertisements and a national online survey of academic libraries in South Africa. It concludes that 70 to 75 percent of job advertisements in the academic library sector stipulate requirements for advanced IT skills. The author recommends that the LIS discipline seize the opportunity presented by what Abbott calls its “interstitial character” and its tendency toward “fractal distinctions in time” to stake an intellectual claim on this technology-driven extension of its disciplinary domain.

**Introduction**

The library and information science (LIS) profession has become increasingly technology-driven, particularly in academic libraries, where rapidly evolving technologies have gained considerable traction. In this changing environment, LIS professionals may wonder about the extent of information technology (IT) knowledge and skills they might require. Janie Mathews and Harold Pardue, in a study of...
IT skill sets mentioned in librarian position advertisements, found that “librarians are incorporating a significant subset of IT professionals’ skill sets,” including Web development, systems development, and systems applications.\(^1\) Betha Gutsche, too, observed that an increasing number of library positions “tilt ever closer to the entirely technical end of the scale.” Particularly in larger organizations, such as academic libraries, she reported, “Technology competencies comprise an ever-growing piece of the performance pie.”\(^2\) In Helen Partridge, Julie Lee, and Carrie Munro’s focus group study, respondents acknowledged that “the boundaries between IT professional and LIS professional were rapidly narrowing.”\(^3\) Jacquelyn Erdman, commenting on the “education for a new breed of librarian” in academic libraries, remarked, “Librarians are not getting the education needed to enter a field where the line between librarian and computer tech is blurred more and more.”\(^4\) Jaya Raju intimated at this blurring of boundaries when she found that technology-related skill sets received high frequency counts in her study of the requirements listed for academic library professional positions. She suggested that future studies should probe the extent of the need for technical skills involving digital library architecture and software, technical and quality standards, HTML [hypertext markup language] coding, web mark-up languages such as SGML [standard generalized markup language] and XML [extensible markup language], and possibly even some skills in programming and scripting languages.\(^5\)

This situation poses challenges in the following areas:

1. The professional identity of librarians, where Mathews and Pardue say the “current intersection between the skill sets of librarians and the skill sets of IT professionals . . . has serious implications for the very definition of our profession”;\(^6\)
2. LIS workplace knowledge and skills requirements, and whether LIS graduates are adequately “prepared to take on serious technology roles in academic libraries”;\(^7\) and
3. LIS education curriculum review and revision; if librarian roles incorporate significant IT skill sets, then this has implications for curriculum revision in LIS education. Should LIS educators partner with cognate disciplines in teaching IT skills? Should the LIS discipline stake an intellectual claim on this technology-driven extension of traditional skill sets and assume this role itself? Or should LIS educators leave employers to hire IT people for the more technical aspects of LIS services?

These are critical questions for which more research needs to be undertaken. The purpose of this paper is to begin by ascertaining the extent of IT knowledge and skills required by academic librarians in the digital library environment in South Africa.

The library and information science (LIS) profession has become increasingly technology-driven, particularly in academic libraries, where rapidly evolving technologies have gained considerable traction.
Research Approach

This study is part of a wider research project funded by the National Research Foundation of South Africa spanning a three-year period (2014–2016). The study’s primary aim is to develop a national LIS professional competency index for the higher education sector in South Africa. Such an index would provide an objective framework against which LIS employers and employees might ascertain existing knowledge and skills as well as identify areas for further knowledge and skills acquisition. Importantly, such a competency index would also inform curriculum review and revision in LIS education in South Africa, where academic libraries are a major employer of LIS graduates.

Empirical evidence was drawn from a content analysis of academic library job advertisements in South Africa for three years (2014–2016) as well as from quantitative data drawn from a 2015 national online survey of 23 university libraries in South Africa. Grounding the study in pragmatist epistemology—that is, focusing on what works in responding to the research question rather than on the methods used or on the paradigms underlying the methods—the researcher found philosophical justification for use of mixed methods research. The pragmatist paradigm allows for use of both quantitative and qualitative philosophical assumptions in addressing a research problem. According to John Creswell, with exploratory sequential mixed methods, “The researcher first begins with a qualitative research phase . . . The data are then analyzed, and the information used to build into a second, quantitative phase . . . The qualitative phase may be used to build an instrument that best fits the sample under study . . . in the follow-up quantitative phase.” In the broader study mentioned earlier, the researcher began with exploratory qualitative collection of data via semi-structured interviews with purposively selected academic LIS professionals and content analysis of relevant job advertisements. Based on the findings in this exploratory phase, reported in an earlier paper, the researcher designed a data collection approach, discussed in the “Methodology” section, for a subsequent quantitative study responding to the research question “What is the extent of IT knowledge and skills required by academic librarians in the digital library environment?”

Theoretical Support

Andrew Abbott’s Chaos of Disciplines, a sociological analysis of academic fields, provides theoretical support for this inquiry into the extent of IT knowledge and skills required by academic librarians in the digital library environment. Abbott’s theory, emanating from the social sciences, has been applied to LIS disciplinary issues previously. Laurie Bonnici, Manimegalai Subramaniam, and Kathleen Burnett used ideas from Abbott’s Chaos of Disciplines to analyze how distinct a departure the iSchool movement is from traditional LIS education in North America. Jaya Raju used the Chaos of Disciplines theory to examine if African LIS education in the digital age has an opportunity to broaden its disciplinary domain.

Abbott’s analysis of the development of social science disciplines used a framework that consisted of a set of core principles. Of these, two principles were applied to the research problem regarding the extent of IT knowledge and skills required by academic
Information Professional or IT Professional?

librarians in the digital library environment: (1) what Abbott calls the “interstitial character” of a discipline, referring to a discipline that is “not very good at excluding things from itself . . . a discipline of many topics”; and (2) what he calls “fractal distinctions in time,” which refers to social science disciplines “rediscovering the wheel”—that is, over time, good ideas resurface but present themselves in a new guise that makes them appear different from the old ideas.

In the case of the interstitial character of a discipline, Abbott explains that some social science disciplines have an inherent tendency to “acquire” topics and no “intellectually effective way” of denying them. A discipline such as LIS has a natural interstitial position that, like sociology, gender studies, and other fields of study, occupies spaces between other disciplines. LIS is therefore in perpetual conflict with other disciplinary “spaces,” such as information technology, information systems, and computer science, and also within itself. These conflicts produce the long history of debates in the literature, still continuing, around the disciplinary identity of LIS, including nomenclature issues around “library science,” “librarianship,” “library studies,” “information science,” or “information studies,” and the more recent addition of the iSchool concept to these debates.

In fractal distinctions in time, a “fractal” is a mathematical figure where each part has the same statistical character as the whole. Hence in Abbott’s context of disciplines, a new context (for example, a digital library) presents an “old idea” (for example, the traditional LIS principles of cataloging and classifying information) in new language, such as metadata management using metadata standards and protocols. In other words, LIS has reconceptualized traditional skills using new technologies. As Gutsche explains, while “the schism between traditional library practices and new experimental technologies gapes . . . in reality, there is strong continuity, with the future building on the past, not splitting sharply from it.”

The principles of the interstitial character of a discipline and fractal distinctions in time from Abbott’s Chaos of Disciplines have relevance to the research question of ascertaining the extent of IT knowledge and skills required by academic librarians in the digital library environment. Therefore, the principles were used to gain understanding of this aspect of social reality under investigation.

Literature

The literature abounds globally in studies on the increased demand for computer and IT skills in LIS services, many of which are traditional services now delivered or enhanced...
via the use of evolving digital technologies.\textsuperscript{21} This growing demand for IT skills shows evidence of the LIS discipline’s interstitial character and its fractal distinctions in time.

Mzwandile Shongwe conducted a content analysis of newspaper LIS job advertisements from 2009 to 2012 in South Africa and found an “increasingly essential nature of IT knowledge and skills in the LIS job market in South Africa.” He explains that complex IT systems are used to process information and hence libraries “are actively recruiting personnel who are skilled in IT.”\textsuperscript{22} The skills being sought, Shongwe relates, include Web development, computer networking, institutional repository development, and database design and development, which are skill areas related to computer science, information systems, information technology, and even computer software engineering. He observes that this increased demand for IT skills has led to new job titles, such as “e-resources librarian,” “systems librarian,” “repository librarian,” “Web application librarian,” and “library technology specialist.” The qualifications sought are not just LIS qualifications but IT-related qualifications as well.

Mathews and Pardue, in a content analysis study of 100 job advertisements from the online \textit{JobList} of the American Library Association (ALA) over a five-month period in the United States, found a need for Web development, systems development, and systems application in librarian positions. These listings suggest “that librarians are incorporating a significant subset of IT professionals’ skill sets.” For these authors, one a librarian and the other a computer scientist, “This trend poses challenging questions for [librarians’] identity and profession.”\textsuperscript{23} Mathews and Pardue point out that the development of digital collections requires traditional collection development skills as well as new skills such as server setup and maintenance. Such new skills, they claim, are commonly associated with disciplines such as computer science, information systems, information technology, and computer software engineering, as also mentioned by Shongwe.\textsuperscript{24} Hence they sought to ascertain the “magnitude of the intersection between the skill sets of librarians and the skill sets of IT professionals”\textsuperscript{26}—similar to this paper, which seeks to ascertain the extent of IT knowledge and skills required by academic librarians in South Africa. While job advertisement studies by Shongwe and others provide evidence of the increasing demand for IT skill sets in librarian and LIS-related positions,\textsuperscript{27} only a few (including Mathews and Pardue and the Raju study reported in this paper) have attempted to investigate the extent of the intersection between the skill sets of librarians and those of IT professionals. Mathews and Pardue found “significant intersection between the skill sets of librarians and the skill sets of IT professionals,” with 72 percent of the 100 librarian job advertisements analyzed.
Information Professional or IT Professional?

requiring at least one IT skill. Among these IT skills were Web development, systems development, systems application, and computer networking. Interestingly, according to Mathews and Pardue, “Programming languages were not in high demand by employers [of librarians].” Katherine Howard had a similar finding in a survey of Australian academic librarians and LIS educators on knowledge and skills required in a digital library environment. She observed that “programming languages were particularly low ranked” by survey respondents. Howard interpreted this finding as perhaps the result of academic libraries being part of universities supported by well-established IT departments with the necessary programming expertise.

Debra Riley-Huff and Julia Rholes, in their study, recognized that LIS is an “increasingly technology-driven profession” with library administrators “increasingly seeking librarians with a wider range of Information Technology (IT) skills.” To ascertain if LIS graduates are adequately “prepared to take on serious technology roles in academic libraries,” they collected data by inspecting course catalogs and website curriculum pages of ALA-accredited LIS programs in the United States for inclusion of technology-related courses. They also conducted a “targeted survey” of “librarians with significant technology roles”—that is, librarians whose job titles contained IT-related nomenclature, such as “systems,” “Web,” or “digital.” One of the conclusions of their study was that both academic library “information technology job candidates” as well as administrators involved in hiring decisions indicated “a need for additional [IT] courses at a more advanced level” in LIS education. This conclusion clearly speaks to Mathews and Pardue’s finding that the skill sets of librarians and those of IT professionals intersect significantly. While Riley-Huff and Rholes do refer to Mathews and Pardue’s study, they conclude that “more research is still needed to identify key technology skills needed” in academic libraries.

Various other studies have deliberated, directly or indirectly, on the encroachment of technology into the knowledge and skill requirements of librarians, particularly in academic libraries. Raju in her analysis of advertisements for academic library jobs in South Africa (2012–2013) found that “technology associated with LIS applications” achieved a high frequency count. She called that result “not surprising given the impact of technology on the academic library of the digital era.” In her 2016 follow-up study of academic library job advertisements (2014–2016), triangulated with data from a national online survey of 23 academic libraries in South Africa, technology again featured strongly in desired LIS professional knowledge and skill areas such as “scholarly electronic information resources,” “library ICT [information and communications technology]/systems applications,” “integrated library systems,” and “digital repository, discovery and preservation activities.” Technology also featured prominently in the generic skills category, where “general computer proficiency” achieved the second highest frequency score, just 1 percentage point less than the top scoring “management” generic skill. In a focus group study among Australian LIS professionals on the knowledge, skills, and attributes required by LIS professionals in a “Web 2.0 World (and beyond),” technology ranked among the eight themes that “emerged as being critical to ‘Librarian 2.0.’” However, the participants in the 14 focus groups “generally acknowledged that technology was a means to an end and not an end in itself.” There was “general consensus across all focus groups that while IT is important within the context of Library 2.0 and
Librarian 2.0, it is not the dominant or main aspect.” The general view of the focus group respondents was that successful librarians “need to be aware of, and have some fundamental understanding of the emerging technology . . . but they do not need to be IT professionals per se.”  

On the other hand, Goutam Biswas, writing in the Asian context, claims that “information technology is playing a crucial role in restructuring of the libraries” because of the shift from human dependent operations to machine dependency, mechanization (data processing) to knowledge processing, stand alone system to network computing, local LAN [local area network] to wireless access protocol systems [and] library automating (in-house) to web-enabled services (WAN [wide area network] access).  

In this context of IT pervasiveness, Biswas stresses the need for academic librarians to acquire new skills to develop and manage digital libraries as the “empowerment of library and information professionals with IT skills is aimed at providing services that are expected . . . in the new environment.” These apparently conflicting views reiterate the need to conduct research on the extent of IT knowledge and skills required by academic librarians.

On the greater African continent, the IT factor in LIS services has also been acknowledged in one way or another. While the rise of information technology offers opportunities for African university libraries to embrace the digital age, it also presents challenges relating to funding, human resource training, Internet connectivity, and communications infrastructure. Notwithstanding these challenges, Penninah Musangi encourages Kenyan academic libraries to incorporate, as their counterparts in the developed world are doing, Web 2.0 tools such as blogs, wikis, YouTube, Facebook, and Twitter into their service provision. In this way, academic libraries can follow “netGen” (Internet generation) users “into their social spaces by allowing [them] to participate in the creation of content, keeping [them] constantly updated and building services based on their feedback.”  

This is a further example of traditional LIS services being delivered and even enhanced using new IT platforms. In a systematic review of current literature, Emmanuel Baro and Vara Godfrey investigate the extent to which Web 2.0 tools have been used to render library services in Africa and, specifically, the challenges associated with the use of this second-generation Web-based and Internet information technology by librarians. Along with recommendations for African academic librarians to “fully utilise Web 2.0 tools as their counterparts in developed countries [do],” Baro and Godfrey urge “training of librarians . . . to overcome the challenge of technical know-how regarding new technologies.” They also call for an investment by university libraries in alternative power sources to ensure a regular supply of electric power for the use of information technology.
Globally, academic libraries in particular have witnessed an increasing incorporation of IT skill sets into LIS professional positions. Many studies show an encroachment into the jurisdictional spaces of other disciplines and a resulting blurring of disciplinary boundaries between LIS and such fields as information technology, information systems, computer science, and even its subdiscipline of software engineering. Despite challenges confronting the adoption of IT in academic library services in the developing world, including Africa, libraries still desire to embrace the digital age through electronic acquisition, organization, preservation, discoverability, and scholarly communication of digital resources and services in response to user needs. In the developing world, too, despite challenges, the interstitial nature of the LIS discipline, together with its fractal distinctions in time, play themselves out.

While the literature reflects many studies that focus on this proliferation of information technology in LIS services, few studies have concentrated on the extent of IT incorporation into the knowledge and skills required by LIS professionals in academic libraries. The study reported in this paper hopes to make a contribution to this gap in the literature by focusing on this research question in the specific context of academic libraries in South Africa, with theoretical support from Abbott’s *Chaos of Disciplines*.

**Methodology**

The secondary research question—the extent of IT knowledge and skills required by academic librarians in the digital library environment—formed part of a wider mixed methods study on developing a national LIS professional competency index for the higher education sector in South Africa. The researcher conducted a content analysis of academic library job advertisements in South Africa for the period 2014 to 2016. Content analysis is a commonly used descriptive technique for determining what words or concepts are present in a document to discover features and trends. Content analysis of job advertisements is a well-established method of researching workplace requirements in a particular sector.

The author examined a total of 96 advertisements using the *Mail & Guardian* weekly newspaper of Johannesburg, South Africa, as well as the mailing list of the Library and Information Association of South Africa (LIASA), the country’s LIS professional body, and institutional websites referred to by the *Mail & Guardian* or *LiasaOnline* and its related e-mail lists. She searched for all advertisements to fill professional positions requiring a LIS qualification. This report includes job advertisements collected from January 2014 up to July 2016. At the time of the study, there were 23 universities in South Africa with well-established academic libraries, with 3 more new universities being established. Thirty-two advertisements were examined for 2014, 31 for 2015, and 33 for the seven-month period of January to July 2016 (96 professional position academic library job advertisements in total). The large number in the last seven-month period possibly indicated an increasing number of academic library positions due to academic libraries responding to a higher education environment increasingly characterized by digital scholarship.

To investigate the extent of IT knowledge and skills required by academic librarians, the author compiled a list of advanced IT skill sets relating to the academic library environment drawn from the literature, both local and international. The 96 advertise-
ments were then qualitatively reviewed to iteratively adjust the list of advanced IT skill sets compiled from the literature to more accurately reflect job requirements in the advertisements. For a fuller picture for comparison purposes, basic IT skills derived from the advertisements were also added to the list (see Table 1). The aspects of the job advertisements focused on were job titles, requirements, and recommendations. Due to the highly specific nature of the skill set to be investigated (IT skills) and the relatively small number of documents being examined, the researcher did not consider it necessary to use data mining software as she had done in previous studies. Data mining “by hand” allowed for the capture of finer nuances in the data, such as overlap in skill sets, which could have been lost in software application of data mining. The 96 advertisements were then reviewed for a second time, this time quantitatively, with simple coding to determine frequency counts and relative frequency percentages for the IT skill sets. This quantitative analysis appears in Table 1.

Cognizant of Susan Myburgh and Anna Maria Tammaro’s caution about overreliance on job advertisements alone to determine required “competencies” of librarians in the digital age, the IT skills list generated via quantitative data mining of job advertisements was triangulated with relevant findings from a national online survey. The survey was conducted in 2015 as part of the national LIS professional competency index research project mentioned earlier. The survey questionnaire aimed to collect data to be used in developing a national LIS competency index for the higher education LIS sector in South Africa. Senior LIS professionals in 23 of South Africa’s 26 university libraries were targeted (three newly established universities were excluded because libraries were still being established for those institutions). Twenty-two of the 23 universities responded to the survey, providing from 5 to 15 responses each. The library directors were asked to select senior LIS professional staff, for example, senior librarians, to complete the questionnaire. Of the 207 potential respondents identified by the university libraries and to whom an online questionnaire using SurveyMonkey was sent, 140 responded (68 percent return rate). Selected findings from this survey that speak to the extent of IT incorporation into the knowledge and skills required by LIS professionals in academic libraries were triangulated with the findings from the quantitative analysis of library job advertisements described earlier. Findings are presented and discussed in the next section.

Findings and Discussion

Table 1 captures findings from the content analysis of the 96 job advertisements. At the broad level, IT skill sets categorized as “advanced” for the purposes of this study collectively attained a relative frequency percentage of 74 percent. Basic IT skill sets attained a relative frequency percentage of 26 percent. This South African finding correlates with that by Mathews and Pardue in the United States, where 72 percent of the 100 librarian job advertisements analyzed required at least one advanced IT skill from a list of six broad categories of advanced IT skill sets. At the broad level, the LIS discipline seems to have made inroads into IT disciplinary space, demonstrating its interstitial character.

This study chose a more granular level in its presentation of IT skill sets, compared to Mathews and Pardue, who elected to use broad IT categories, such as systems de-
Table 1.
IT knowledge and skills requirements in professional academic library positions

<table>
<thead>
<tr>
<th>Advanced IT skill sets</th>
<th>Frequency</th>
<th>Relative frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated library systems—e.g., Innovative Interface, Unicorn, SirsiDynix, ALEPH (Automated Library Expandable Program), INNOPAC (Innovative Online Public Access Catalog), and Millennium—and metadata standards—e.g. OPAC (online public access catalog), MARC (machine-readable cataloging) 21, OCLC (Online Computer Library Center), RDA (resource description and access), and Dublin Core*</td>
<td>32</td>
<td>20.51%</td>
</tr>
<tr>
<td>Advanced computer skills (including advanced Internet skills)</td>
<td>18</td>
<td>11.34%</td>
</tr>
<tr>
<td>Digital repository software (e.g., DSpace open source software)</td>
<td>17</td>
<td>10.90%</td>
</tr>
<tr>
<td>Content management systems (e.g., e-journal management platforms; repository content management/preservation systems such as Islandora or Fedora)</td>
<td>15</td>
<td>9.62%</td>
</tr>
<tr>
<td>Open source publishing software—OJS (Open Journal Systems), OMP (open multiprocessing), etc.</td>
<td>14</td>
<td>8.97%</td>
</tr>
<tr>
<td>Digital curation and preservation management (including research data curation/management)</td>
<td>9</td>
<td>5.77%</td>
</tr>
<tr>
<td>Digitization processes and practices</td>
<td>8</td>
<td>5.13%</td>
</tr>
<tr>
<td>Systems development (database creation and management, including skills in software such as Oracle, MySQL [my structured query language], PHP [hypertext preprocessor])</td>
<td>7</td>
<td>4.49%</td>
</tr>
<tr>
<td>Web design/development—including skills in Web hypertext markup languages such as HTML (hypertext markup language), XML (extensible markup language), and SGML (standard generalized markup language)</td>
<td>6</td>
<td>3.85%</td>
</tr>
<tr>
<td>Computer networking (including skills in software platforms such as Linux, DuraSpace, Sun Solaris, SharePoint)</td>
<td>6</td>
<td>3.85%</td>
</tr>
<tr>
<td>Systems application/implementation (software installation, upgrading software, maintenance, installation and troubleshooting hardware, systems maintenance and backup)</td>
<td>5</td>
<td>3.21%</td>
</tr>
<tr>
<td>Programming (including use of scripting and programming languages such as JavaScript, Java, Python,</td>
<td>5</td>
<td>3.21%</td>
</tr>
<tr>
<td>Advanced IT skill sets</td>
<td>Frequency</td>
<td>Relative frequency (%)</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------------</td>
<td>-----------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Perl, and SQL [structured query language]</td>
<td>5</td>
<td>3.21%</td>
</tr>
<tr>
<td>Software packages, e.g., Flash, Corel Draw, Photoshop, Adobe Acrobat, SAP [Systemanalyse und Programmentwicklung, system analysis and software development]</td>
<td>5</td>
<td>3.21%</td>
</tr>
<tr>
<td>IT architecture / infrastructure</td>
<td>5</td>
<td>3.21%</td>
</tr>
<tr>
<td>IT standards, including technical and quality standards—e.g., OAI-PMH (Open Archives Initiative Protocol for Metadata Harvesting), CMIS (Content Management Interoperability Services), etc.</td>
<td>2</td>
<td>1.28%</td>
</tr>
<tr>
<td>Information/IT security</td>
<td>1</td>
<td>0.64%</td>
</tr>
<tr>
<td>Graphic design</td>
<td>1</td>
<td>0.64%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>156</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

*The Dublin Core is a small set of vocabulary terms that can be used to describe Web resources, including video, images, and Web pages, as well as physical resources such as books or CDs, and objects like artworks.*

<table>
<thead>
<tr>
<th>Basic IT skill sets</th>
<th>Frequency</th>
<th>Relative frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General computer skills/high level of computer proficiency</td>
<td>30</td>
<td>53.57%</td>
</tr>
<tr>
<td>MS [Microsoft] Office skills (e.g., Word, Excel, etc.)</td>
<td>18</td>
<td>32.14%</td>
</tr>
<tr>
<td>Basic Internet skills</td>
<td>6</td>
<td>10.71%</td>
</tr>
<tr>
<td>E-mail skills</td>
<td>2</td>
<td>3.57%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>56</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Combined advanced and basic IT skill sets</th>
<th>Frequency</th>
<th>Relative frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced IT skill sets</td>
<td>156</td>
<td>73.58%</td>
</tr>
<tr>
<td>Basic IT skill sets</td>
<td>56</td>
<td>26.42%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>212</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
development, systems application, Web development, networking, and the like. At the more granular level, the high- and middle-range scoring advanced IT skill sets, in terms of frequency counts, with the odd exception, are those related to LIS discipline-specific knowledge and skills (see Table 1). These skill sets include integrated library systems and metadata standards, repositories, content management, open publishing, digital curation, and digitization. The literature makes clear that the adoption of technology is simply an extension of traditional LIS principles and practices. For example, Gutsche explains, “Cataloguers have been riding the technology rails for years, learning new . . . systems and new tools for enhancing access to the collection.” Mathews and Pardue remind us that “librarians have been early adopters of technology” and that “technology has greatly increased . . . [their] ability to provide services.” Mathews and Pardue also say that the skill sets of librarians have been “evolving along with that technology.” It is natural for librarians to adopt IT skill sets to enhance traditional LIS skills of organizing and providing access to information in all formats. For example, traditional cataloging has become database management, which in the IT discipline is a core skill, demonstrating not only the LIS discipline’s interstitial character—its encroachment into other disciplinary spaces—but also its tendency toward fractal distinctions in time—presenting the old as new.

The notion of LIS skill sets evolving with technology as reflected in the high- to middle-range frequency distributions in Table 1 is supported by responses in the 2015 online survey of university libraries in South Africa. Senior librarians were asked what IT-related services the modern academic library needed to embrace in view of changing higher education pedagogies and the rise of eScience, large-scale projects that use grid computing and collaboration via the Internet with scientists worldwide, and eResearch, the application of information and communication technologies to the practice of research. Of the 116 respondents to this question, 89 percent selected digitization, 77 percent chose open-source publishing, 85 percent picked digital curation, and 77 percent selected research data curation. In the same online survey, in a range of weighted average or mean calculations from 3.82 to 4.66 for an item with 115 respondents, technology know-how associated with LIS applications scored 4.64. This higher mean score indicates the importance senior librarian respondents attached to technology. On a more specific level, 87 of 100 senior librarian respondents rated knowledge of and familiarity with LIS-related systems software—for example, integrated library systems such as ALEPH [Automated Library Expandable Program], Millennium, and SirsiDynix—to be important or very important. Eighty percent of 99 respondents judged creation of digital content to be important or very important, and 87 percent of 101 respondents considered curation of digital content (including metadata creation and management) to be important or very important. Eighty-three percent of 100 respondents rated research data services (including collection, metadata creation and management, and storage of data for future use) to be important or very important.
The literature, too, offers examples of technology being used to extend traditional LIS services. For example, while repositories are relatively new to academic library services, the academic library’s traditional role in scholarly communication makes it a natural home for a repository carrying an institution’s scholarly output. However, explain Natasha Simons and Joanna Richardson, while repository staff may require understanding of libraries, they “may also require . . . familiarity with domains outside their immediate areas of expertise.”

As reflected in Table 1, repository staff may need expertise in specific repository software, metadata standards and interoperability protocols, technical and quality standards such as OAI-PMH (Open Archives Initiative Protocol for Metadata Harvesting), Web hypertext markup languages such as HTML and XML, and even programming languages. These provide further examples of the LIS discipline incorporating skill sets from information technology as part of its interstitial nature. In research data and other digital curation services, LIS professionals need to reach into the spaces of cognate disciplines for knowledge and skills. As Jeonghyun Kim, Edward Warga, and William Moen explain, the knowledge required includes operating systems such as UNIX and Linux; programming and scripting languages such as Java, PHP (hypertext preprocessor), and Perl; HTML and other Web-related markup languages; relational databases such as MySQL (my structured query language) and Oracle; desktop productivity software (for example, Flash, Corel Draw, and the like); and graphics software.

All of these appear in Table 1 as a reflection of IT knowledge and skills gleaned from the 96 academic library job advertisements forming the empirical basis of this study.

While these more technical skills (systems development, Web design, networking, systems application, programming, IT infrastructure, technical and quality standards, and the like) display relatively low frequency counts in Table 1, their requirement as knowledge and skill sets in a digital era academic library is not to be underestimated. Technical skills are critical to the delivery of the newer digital library services, such as repositories, digitization, and curation of research data and other digital content. As academic libraries grow their digital services, and in view of the interstitial nature of the LIS discipline, future studies will likely reveal an increase in frequency counts for these technical skills in advertisements for open positions for academic library professionals. Testimony to this emerging trend is the upward trajectory in percentage scores when senior librarians were asked, in the 2015 online survey of South Africa university libraries, to rate itemized technical knowledge and skills in view of the role of the modern academic library in the creation, organization, and preservation of digital content. In terms of being rated important or very important, and with
the number of respondents ranging between 98 and 101, digital library architecture and software scored 79 percent. Technical and quality standards—for example, OAI-PMH, CMIS (Content Management Interoperability Services), and the Dublin Core, a standardized vocabulary used to describe both Web resources and physical resources—scored 81 percent. HTML coding achieved 64 percent. Database development and management scored 73 percent. Web markup languages such as SGML and XML obtained 60 percent, and Web development and design scored 77 percent.

The word clouds represented in Figures 1 and 2 capture job titles with IT-related nomenclature and IT-related qualification requirements, respectively, that emerged from the analysis of the 96 academic library professional position advertisements. The size of each word indicates its frequency or importance. As evident in Table 1 (and discussed earlier), LIS-specific knowledge and skills areas show markedly significant adoption of technology to extend traditional LIS principles and practices. This process demonstrates the LIS discipline’s interstitial nature and its tendency for fractal distinctions in time, also reflected in Figure 1. Many traditional LIS job titles have been adjusted to include nomenclature reflecting an IT orientation—“information librarian e-resources” and “senior librarian: electronic resources and metadata management” are two examples. There are also some novel job titles reflecting the newer digital services made possible by technology adoption—for example, “digital services librarian,” “senior librarian: digital scholarship services,” and “scholarly communications manager.” Interestingly, requirements for the following positions did not require a LIS qualification but were left open to applicants with a “cognate qualification” or a specified IT-related qualification:

- assistant director: library ICT operations
- senior manager: information systems and digitization
- library systems coordinator
- manager: digitization and digital services.

Is this perhaps the beginning of a trend of LIS employers hiring IT people for the more technical aspects of LIS services? Shongwe intimated such a trend. This is a matter for LIS schools to ponder, in view of the picture looming in Figure 2. Content analysis of the 96 job advertisements revealed explicit requests for qualifications in information technology, information systems, computer science, and other cognate disciplines, again a reflection of the LIS discipline’s interstitial nature. While these requirements are currently rare, they will likely grow in number, unless LIS schools decide to aggressively embed the required IT skill sets in their curriculum design and development so that their graduates can take on serious technology roles in the digital age academic library.
Conclusions and Recommendations

This South African study concurs with findings from the international literature that librarians in the academic library environment, which has seen perhaps the greatest impact of technology compared to other library sectors, require IT knowledge and skills to a significant extent. In fact, based on the empirical findings of this study, from 70 to 75 percent of job advertisements in this sector stipulate requirements for advanced IT skills. This incorporation by the LIS discipline of significant subsets of information technology and related skill sets might be viewed in the context of Abbott’s *Chaos of Disciplines*, particularly the principle of the “interstitial character” of a discipline. Under this principle, the LIS discipline occupies spaces between disciplines and hence has an inherent tendency to be in “conflict” with other disciplinary spaces, such as IT and related fields. The adoption of technology in a greatly digitized higher education environment
has allowed the LIS discipline to present its traditional roles of organizing and providing access to information in new forms with new competency requirements. While the systems and tools have changed, “the intent remains the same” [58]—that is, organizing and providing access to information in all formats. Hence the propensity of the LIS discipline for what Abbott refers to as “fractal distinctions in time”—the “old” resurfacing as something new in a different guise. One can dispel any uncertainty as to whether an academic librarian remains an information professional or is gravitating toward becoming an IT professional. Irrespective of new systems and tools in place, as well as new knowledge and skill sets that may be required, the essential roles and functions of LIS continue to be informed by the philosophy and epistemology of the discipline. While this conclusion responds, in part at least, to the issue of the professional identity of the librarian (more research is required in this area), the question remains of IT knowledge and skills requirements for the LIS workplace and the source of these knowledge and skills.

In response to this issue, this paper returns to the following questions posed at the outset: Should LIS educators partner with cognate disciplines in teaching IT skills? Should the LIS discipline stake an intellectual claim on this technology-driven extension of traditional skill sets and assume this role itself? Or should LIS educators leave LIS employers to hire IT people for the more technical aspects of LIS services? Responses to these questions will likely differ, and more research needs to be done in this area. However, the researcher would like to suggest that the LIS discipline seize the opportunity presented by its interstitial nature (rather than lamenting it) and its tendency toward fractal distinctions in time to stake an intellectual claim on this technology-driven extension of its disciplinary domain. If LIS does not make this claim, other better-resourced and more established disciplines might move in. The interstitial nature of a discipline, according to the Chaos of Disciplines, allows for encroachment from both sides. [59] This study has already shown early evidence of this, with LIS employers beginning to hire people with IT and not LIS qualifications for certain positions. LIS schools have a significant role to play in repositioning the LIS discipline such that the emerging library IT knowledge and skill sets identified in this study and in many others are pedagogically embedded in LIS curriculum design and development. IT knowledge and skill sets should be taught not as stand-alone or IT-serviced courses but should be firmly embedded with LIS epistemology, demonstrating the intellectual claim on this broadened disciplinary space resulting from a natural evolution of the LIS discipline in response to a technology-driven information environment. By all

The adoption of technology in a greatly digitized higher education environment has allowed the LIS discipline to present its traditional roles of organizing and providing access to information in new forms with new competency requirements.

IT knowledge and skill sets should be taught not as stand-alone or IT-serviced courses but should be firmly embedded with LIS epistemology.
means, LIS educators should work with cognate partners, as long as the LIS discipline assumes hegemony in the stewardship of this technology-driven extension of traditional LIS disciplinary space. “Competencies [and] tools may change, but the intent remains the same,”60 and this should inform the basis of our intellectual claim. After all, as emerged from the 14 focus group discussions in Partridge, Lee, and Munro’s study on knowledge, skills, and attributes in a Web 2.0 academic library, “Technology [is] a means to an end and not an end in itself.”61

Acknowledgment

The author wishes to thank the National Research Foundation (South Africa), for supporting the research reported in this paper.

Jaya Raju is an associate professor and head of the Library and Information Studies Centre at the University of Cape Town, South Africa; she may be reached by e-mail at: jaya.raju@uct.ac.za.

Notes

16. Ibid., 5–6.
17. Heting Chu, “Library and Information Science Education in the Digital Age,” in Advances in Librarianship, Volume 32: Exploring the Digital Frontier, ed. Anne Woodsworth (Bingley,


24. Ibid.


29. Ibid., 256.


32. Ibid., 131, 133.

35. Raju, “LIS Education in the Digital Age for an African Agenda,” 163–70.
36. Ibid., 167.
40. Ibid.
44. Ibid., 12–13.
45. W. Lawrence Neuman, Social Research Methods: Qualitative and Quantitative Approaches, 6th ed. (Boston: Pearson, 2006), 44.
47. Raju, “Core Competencies in LIS Education.”
50. Ibid., 255.
52. Gutsche, “Coping with Continual Motion,” 30.