Future LIS Education and Evolving Global Competency Requirements for the Digital Information Environment: An Epistemological Overview

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In the context of an evolving digitally-oriented library and/or information science (LIS) discipline and framed by Andrew Abbott's Chaos of Disciplines theory, this article presents an epistemological overview of evolving competency requirements for a global digital information environment and the implications of this for future LIS education. In doing so it draws from both an international case study of ongoing research by the IFLA BSLISE (Building Strong LIS Education) Working Group into the development of an international framework for the assessment of quality standards in LIS education and a national (South African) case study involving the compilation of an LIS competency index in a highly digitally oriented information environment. The Chaos of Disciplines theory was originally conceptualized to demonstrate the evolution of disciplines in the social sciences. Its core principles of the interstitial character of a discipline and fractal distinctions in time are employed as a heuristic tool to connect the empirical evidence from these two purposively selected case studies to the inherent nature of the LIS discipline and the implications of this for competency requirements for professional practice in a highly digitized global information environment and for future LIS education responding to these competency exigencies.

Keywords: digital information environment, library and information science (LIS), LIS competencies, LIS education

An evolving digitally oriented library and/or information science (LIS) discipline is reflected in statements such as, among others, the following:

- "LIS . . . is currently navigating through a protracted period of change fuelled by rapid technological change" (Singh & Vorbach, 2017, p. 94).
- "The information landscape continues to change at a rapid rate, with new technologies emerging and ever more information being produced . . . ubiquitous and immediate access to information and the proliferation of mobile devices . . . and user-centred technologies [that] allow patrons to be creators rather than just receivers of content" (Saunders, 2015, p. 427).

This evolving and increasingly digital information context has, for the library and information services profession, raised questions of professional identity, workplace knowledge and skills requirements, and LIS education curricular responses to this rapidly evolving, technology-driven information landscape (Raju, 2017a, p. 740). In this context, Andrew Abbott's (2001) Chaos of Disciplines theory serves as a useful theoretical tool to undertake an epistemological overview of evolving competency requirements for a global digital information environment and the implications of this for future LIS education. Hence, the purpose of this article is to use two core principles from the Chaos of Disciplines theory as a heuristic tool to connect the empirical evidence from two purposively selected case studies with the inherent nature of the LIS discipline. It is thus important to ascertain the implications of doing so both for competency requirements for professional practice in a highly digitized global information environment and for future LIS education responding to these competency exigencies.

The two case studies are, first, an international case study of ongoing research by the IFLA BSLISE (Building Strong LIS Education) Working Group (2018) into the development of an international framework for the assessment of quality standards in LIS education and, second, a national (South African) case study involving the compilation of an LIS competency index in a highly digitally oriented information environment.

KEY POINTS:

- Library and Information Science (LIS) occupies interstitial spaces between other disciplines and is therefore in perpetual conflict with other disciplinary spaces such as information technology, information systems, computer science, and media studies.
- The interdisciplinary nature of LIS, as well as its capacity for reconceptualization of traditional knowledge and skills areas in new technology-oriented forms, presents epistemological opportunities to reposition the LIS discipline in an extended or broadened disciplinary space.
- Future LIS education and its scholars and academics have a critical role to play in this repositioning, as a broadened LIS disciplinary space would need to reflect itself in the competency requirements for this technology-driven disciplinary extension, which in turn would need to be pedagogically embedded in LIS curriculum design and development.

Theoretical framing

The Chaos of Disciplines theory (Abbott, 2001) was originally conceptualized to demonstrate the evolution of disciplines in the social sciences. It

has been applied to research in Library and Information Science (LIS), also a social science discipline. For example, Bonnici, Subramaniam, and Burnett (2009) used the theory to analyze how distinct a departure the iSchool movement is from traditional LIS education in North America. In an earlier study (Raju, 2015), I used the Chaos of Disciplines theory to examine if LIS education in the digital age on the African continent is in crisis or if it is presented with an opportunity to broaden its disciplinary domain. I used it again in 2017 as theoretical support for an inquiry into the extent of IT knowledge and skills required by academic librarians in the digital library environment (Raju, 2017a).

Abbott (2001) used a framework for the analysis of the development of social science disciplines which consists of a set of core principles. Of these, two are relevant to undertaking an epistemological overview of evolving competency requirements for a global digital information environment and the implications of this for future LIS education:

1. the interstitial character of a discipline: "[a] discipline [that] is not very good at excluding things from itself . . . a discipline of many topics" (pp. 5–6); and
2. fractal distinctions in time, which refers to social science disciplines "rediscovering the wheel" (p. 17); that is, over time a good idea resurfaces but presents itself in a new guise, thus appearing to be different from the old idea.

With respect to the principle 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 (p. 6). When applied to LIS, this core principle of the Chaos of Discipline theory translates to a discipline that has a natural interstitial nature. That is, like sociology, gender studies, and other interdisciplinary social sciences, LIS occupies spaces between other disciplines (hence "interstitial") and is therefore in perpetual conflict with other disciplinary "spaces"—in the case of LIS, this would include information technology, information systems, computer science, media studies, and so on. It is also in constant conflict within itself. Hence it is not surprising that LIS has a long history in the literature and there are continuing debates around its disciplinary identity. This includes nomenclature arguments around "Library Science", "Librarianship", "Library Studies," "Information Science," or "Information Studies," as well the more recent intense discourse around whether the iField or iSchool concept is a genuine paradigm shift from LIS or merely a symbolic one (Bonnici et al., 2009; Chu, 2010; Golub, Hansson, & Selden, 2017; King, 2006; Mezick & Koenig, 2008).

As for the notion of fractal distinctions in time, a "fractal" is a mathematical figure where each part has the same statistical character as the whole (Soanes & Stevenson, 2004, p. 562). Hence if one applies Abbott's (2001, p. 17) context of disciplines, a new context (such as a digital

library) presents an "old idea" (for example, the traditional LIS principles of cataloging and classification in information organization) in new language (such as metadata management using metadata standards and protocols such as RDA and Dublin Core). That is, traditional skills have been reconceptualized with the use of new technologies. Gutsche (2010, p. 29) captures this cogently when she explains that 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."

These two principles from Abbott's (2001) Chaos of Disciplines theory have relevance to an epistemological overview of evolving competency requirements for a global digital information environment and the implications of this for future LIS education.

Literature review

There is an abundance of literature at global, regional, and national levels on LIS and related knowledge, skills, and attributes for the digital information environment. However, this article focuses on literature that speaks to evolving digital environment competency requirements in terms of the "interstitial" nature of the LIS discipline, the theoretical concept of fractal distinctions in time, and epistemological implications of these trends for the LIS discipline generally and consequently for future LIS education.

A number of studies address the influence of technology on traditional library and information practice. Henry (2015, p. 847) identifies "eight main skill areas" that "interconnect (and overlap)" traditional librarianship and its practice in a "technology-centred work environment":

> metadata; integrated library system (ILS) and related content-providing counterparts; data management and curation; assessment and analytics; privacy and security; copyright and open access; accessibility and user experience; and digital content creation and curation.

Hence she views these as "baseline technology competencies" in which practicing LIS professionals should have a solid foundation, and "not necessarily to be an expert" (p. 848). In this spirit she suggests that some librarians take up "coding and programming" for less dependence on institutional IT departments and greater in-house support in a library ecosystem where "technology practice [now] informs every aspect of librarianship" (p. 848). Raju (2017a, p. 739) recognizes this encroaching into other disciplinary spaces as the aforementioned "interstitial character" of the LIS discipline. Cognizant of Abbott's (2001, p. 17) observation that the encroaching takes place from both sides, in a spirit similar to that of Henry, Raju (2017a, pp. 739, 754) recommends that the LIS discipline "stake an intellectual claim on this technology-driven extension of its disciplinary domain" before "other better-resourced and more

established disciplines . . . move in." In a context of emerging evidence of LIS employers hiring individuals with IT and not LIS qualifications, Raju (2017a) argues that "LIS schools have a significant role to play in repositioning the LIS discipline such that the emerging library IT knowledge and skills sets, identified in . . . [her] study and in many others, are pedagogically embedded in LIS curriculum design and development" (p. 754).

She goes on to postulate that IT affecting LIS "should be firmly embedded within 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" (p. 754).

Saunders (2015, p. 427) cogently points out that "as libraries evolve and innovate to keep pace with transformations in the field, it is incumbent on library schools to ensure that they are developing curricula that effectively prepare graduates for the workplace." She explored those core competencies and foundational areas of knowledge that applied across "all information settings and job functions," as well as those that are "specialized enough to be relevant to certain positions" only (Saunders, 2019, pp. 3–4). The outcome that "LIS programs might have fewer core courses" and need to focus more on "developing tracks or areas of specialization" (Saunders, 2019, p. 22) is a likely indication of the evolution of the LIS discipline and associated practice in response to the influence of rapidly changing technology that is affecting information environments. In her 2015 study, Saunders (2015, p. 427) explains that in many cases, as a result of technology-driven transformation in the field, there has been restructuring of traditional LIS jobs and the development of new roles and responsibilities that require "a host of different skills and competencies." She engaged LIS employers and practitioners in focus-group discussions for their input on curricular emphases and required competencies, and she also addressed philosophical issues such as the relationship between the curriculum and the workplace and the balance between theory and practice in LIS programs. The study found that LIS graduates needed a wide range of technical skills (web development, coding languages, database management, and so on), a foundation of content knowledge, well-developed interpersonal and communication skills, and practical experience (Saunders, 2015, pp. 444, 447). Transformation in LIS education as a result of a shifting discipline responding to global information technology trends is also reported in a literature review study by Wyman and Imamverdiyev (2018) that covers LIS programs from both developed and developing world countries. They report that, "globally, LIS programs . . . have made extraordinary changes due . . . to the phenomenon of the internet and the use of various mobile devices . . . the changes have moved the [LIS] discipline . . ." (p. 221).

The LIS discipline's natural propensity for "fractal distinctions in time" (Abbott, 2001, p. 10) is demonstrated in Golub et al.'s (2017) "Cult

of 'I'" study in which they analyze three "recently become" iSchools (in Denmark, Norway, and Sweden), the latter being part of an international expansion of the iSchool movement outside of North America. Despite differences and challenges among the three schools themselves, the study concluded that with all three schools there was "no immediate iSchool identity . . . discernible from the curricula" of the schools and that for all three Scandinavian schools, the symbolic association with the iSchool concept was of major importance (p. 72). This is an example of presenting the "old" in a new guise, that is, re-branding in an iField for greater visibility, international contacts, and to attract research, funding, and students. In a digital context of big data, digital humanities, and new patterns of scientific inquiry and scholarly communication enabled by high-performance computing, the iSchool brand, using Abbott's concept of "fractal distinctions in time," may be seen as an opportunity to present the traditional LIS discipline in a reconceptualized form. Such a presentation, however, would need to drill down to the level of curricula genuinely responding to the exigencies of the digital information environment and not be merely a symbolic or ideological presentation. Saunders (2012, p. 401), like Gutsche (2010), reiterates this possibility when she points out that "traditional competencies are not necessarily being replaced but only added to, as technology and other changes in the field demand new skills and areas of knowledge."

Such new knowledge and skills areas include, among others, geographic information systems (GIS) and services resulting from rapid progression of technology such as advances in GIS software and mobile technologies that make possible the availability of geospatial data for use in commerce, government, academia, and so on (Bishop, Cadle, & Grubesic, 2015, p. 68). In a study on entry-level reference job opportunities, Detmering and Sproles (2012, p. 553) refer to electronic data management, data curation, embedded librarianship, library publishing, and new forms of scholarly communication as technology-related skills areas being sought by LIS employers. Advanced digital scholarship services in academic libraries have increased the need for evaluation (of systems) and assessment (of learning outcomes) skills for application by librarians to units, staff, and users (Applegate, 2016, p. 74). Rapidly changing IT applications for libraries have resulted in nearly all librarians providing some degree of teaching, be it to students, in training sessions for fellow librarians, or in the "development of online learning modules for remote library users" (Turner, 2016, p. 477). Despite this pedagogical need, the literature constantly laments the lack of pedagogical education in the professional preparation of LIS graduates (Goodsett & Koziura, 2016, p. 702; Turner, 2016, p. 477). In a study by Maceli and Burke (2016, p. 35) on technology skills in the LIS workplace in a context in which "information technology serves as an essential tool for today's information professional," coding and programming "topped the list of most-desired technology skill to learn."

Whether it be in the form of GIS applications, publishing, data management, pedagogy, or coding and programming (to mention a few), the increasing interdisciplinary nature of LIS as well as its capacity for the reconceptualization of traditional knowledge and skills areas in new technology-oriented forms are evident in these reports from the literature. This lends credence to what Abbott (2001) describes as certain social science disciplines demonstrating both an interstitial nature and fractal distinctions in time. This inherent nature of the LIS discipline presents epistemological opportunities to reposition the LIS discipline in a broadened or extended disciplinary space in a context of evolving global LIS competency requirements resulting from a rapidly changing digital information environment. Such a repositioning has implications for LIS education, which would need to embrace this disciplinary extension through pedagogical innovation and curriculum design and development.

Two case studies

The epistemological opportunities afforded to the LIS discipline (outlined in the previous section) and arising from the LIS discipline's inherent "interstitial nature" and its tendency for "fractal distinctions in time" (its capacity to reconceptualize traditional competencies with the use of new technologies) may be heuristically explored via two purposively selected case studies, one international and one national.

Case study 1

The Building Strong Library and Information Science Education (BSLISE) Working Group of the International Federation of Library Associations and Institutions (IFLA) is a joint working group of the Standing Committees of Education and Training, and Library Theory and Research, and the LIS Education in Developing Countries Special Interest Group. The BSLISE Working Group is pursuing the development of an international framework for quality assessment of LIS education. In pursuing this goal it strives to be inclusive of local and regional contexts. The BSLISE Working Group, in its first phase of research (2017–2018), conducted an international survey to understand the qualification requirements for library and information professional practice around the world. The outcomes of this first phase of research are captured in its IFLA BSLISE Working Group (2018) White Paper. Six key findings and corresponding recommended actions are presented in the White Paper, and of these, "Key finding 6" has relevance to this epistemological overview of the LIS discipline:

> The library field and the broader LIS field have been, at one time, understood as separate disciplines; however, the evolving nature of librarianship has blurred the boundaries in terms of scopes of practice, skills, and knowledge. (IFLA BSLISE Working Group, 2018, p. 20)

Both the LIS discipline's inherent "interstitial nature" and its tendency for "fractal distinctions in time" are implied in this key finding. Hence the notions of "separate disciplines" morphing into what was referred to earlier in the paper as "broadened or extended disciplinary space," as a result of the "evolving nature of librarianship" and the "blurr[ing] of boundaries in terms of scopes of practice, skills, and knowledge."

Though brief, this single finding from this international case study provides telling empirical evidence of the inherent nature of the LIS discipline and the potential for it to reposition itself in a broadened disciplinary space in response to evolving global LIS competency requirements resulting from a rapidly changing digital information environment. This in turn will have implications for future LIS education, which will need to take cognizance of the disciplinary extension in its pedagogical and curriculum planning and delivery. It is appropriate, then, that the IFLA BSLISE Working Group White Paper's recommended action for "Key finding 6" reads as follows: "Define and understand what the broader LIS field means and its implications for LIS education and professional development" (p. 20). I look forward to the BSLISE Working Group's research on this recommended action in the interest of the epistemological repositioning of the LIS discipline in an extended/broadened disciplinary space and the potential implications of this for future LIS education

Case study 2

The *LIS Professional Competency Index for the Higher Education Sector in South Africa* (Raju, 2017b) was an outcome of a research project (2014–2016) which had the following objectives, among others:

1. to provide an objective framework against which LIS employers in the higher education sector in South Africa may ascertain existing knowledge and skills as well as identify areas for further knowledge and skills acquisition in their academic libraries in order to efficiently and effectively mediate a rapidly evolving technology-driven higher education library and information environment;
2. to provide an objective framework against which LIS employees (professional LIS practitioners) in the higher education sector in South Africa may ascertain their existing knowledge and skills as well as identify areas for further knowledge and skills acquisition for their professional development in a rapidly evolving digital higher education environment; and
3. to inform curriculum review and revision in LIS education and training, as academic libraries in South Africa are a major employer of LIS graduates.

Research activities that contributed to the compilation of this competency index comprised intensive reviewing of literature, data collection from purposively sampled LIS professional practitioners via semi-structured

interviews, a national online questionnaire survey of all academic libraries in South Africa (23 at the time), and content analysis of over 100 academic library professional position job advertisements for the period 2014–2016.

While the Index (Raju, 2017b) as a whole may be accessed, Table 1 captures the library ICTs and systems operations aspect from the discipline-specific competencies section of the Index.

The following annotation in the Index precedes the extract reproduced in Table 1:

> The competencies relating to library ICTs are provided in more detail than perhaps any other knowledge and skill set in the index. This is a reflection of the center stage ICTs have taken in academic library services particularly, to the extent that they have extended traditional LIS services into new and innovative areas of service delivery. The ubiquitous requirement for advanced technology knowledge and skills in the 21st century academic library is reflected in the research from which this index emanates as well as in the literature generally. It is for this reason that the compiler of the index categorizes LIS-related technology competencies as discipline-specific. (Raju, 2017b, p. 6)

This technological prevalence in LIS professional practice and the assertion that ICTs "have extended traditional LIS services into new and innovative areas of service delivery" (Raju, 2017b, p. 6), in this case study too, foreground the LIS discipline's inherent "interstitial nature" (encroaching on other disciplinary spaces) and its tendency for "fractal distinctions in time" (the "old" re-surfacing as "new" with the use of technology). The competencies reflected in Table 1 demonstrate what Partridge, Lee, and Munro (2010, p. 315) saw as "an increasing number of positions in libraries . . . moving closer to the technical end of the scale" and what Gutsche (2010, p. 30) observed as technology competencies comprising an "ever growing piece of the performance pie, impacting every job in the library."

Other aspects of this LIS professional competency index that also speak to the LIS discipline's inherent "interstitial nature" and its tendency for "fractal distinctions in time" include entries such as the following:

- metadata creation and management (traditionally involving cataloging and classification);
- research support (including metrics analysis of research output and research landscape analysis now possible because of digital applications);
- scholarly communication and open access (including repository services and library publishing);
- digitization and preservation;
- curation of digital content and research data;
- e-resources management;

Table 1: Extract from LIS professional competency index for the higher education sector in South Africa (Raju, 2017b, pp. 9–11)

Library ICTs [information and communication technologies] and systems operations

- Assess technology trends impacting academic library services and advise relevant library and related stakeholders accordingly
- Demonstrate knowledge and understanding of the library services platform being used (e.g., SirsiDynix Symphony, Unicorn System, Aleph, Millennium/Sierra, Alma)
  - Understand the workflows of the library services platform (LSP)
  - Undertake periodic evaluations of the LSP and communicate with the vendor on services and any problems
  - Understand operating and database systems used by the LSP
  - Demonstrate understanding of the functions of the software used by the LSP
- Provide library ICT training and support for staff in the use of hardware, software and networks used in the library
- Install, configure and maintain computer hardware (e.g. (personal computers (PCs), Macs, tablets) and peripheral devices (e.g. printers and scanners)
  - Understand functions of computer hardware, internal components, peripherals and external storage drives
  - Perform troubleshooting for computer hardware and peripherals
  - Install and support audio and video equipment
- Ensure that required software is properly installed, licensed and ready to run in various sections of the library
  - Evaluate and select appropriate software applications for both library staff and users
  - Recognize when Software as a Service (SaaS – software distribution model in which software is licensed on a subscription basis and is centrally/cloud hosted) is a more appropriate solution than locally installed software; and develop and maintain effective working relationships with SaaS providers
  - Identify and communicate problems with software applications to relevant library and other staff
  - Understand and manage licensing for all library software applications
  - Understand and provide advice to library staff on open source software options
- Ensure that the library's network (both cabled and wireless) is running smoothly for optimal connectivity
  - Install, configure and maintain the library's local area networks
  - Support the library's telecommunications and wide area networks
  - Assess the library's Internet connectivity needs and liaise accordingly with relevant on-campus agencies for long-term sustainability of high-speed connectivity that meets these needs
  - Understand Internet protocol (IP) authentication for secure network access
  - Understand the principles of identity and access management and integrate the library's need for authentication and authorization with the university's identity management and access system
  - Understand the infrastructure that supports the library's telephony and wide area networks
  - Understand the library's site-specific telecommunication needs and advocate accordingly for increased bandwidth when needed

(*Continued*)

- Install, configure and maintain the library's wireless networks
- Provide support for wireless printing by library patrons using their own devices
- Troubleshoot problems with the library's networks to maintain optimal connectivity for staff and users of the library
- Employ practices in network security for maximum protection of the library systems, and staff and user information

- Configure and maintain the variety of servers relevant to the needs of the library (e.g. email, Web, file, print and database servers)
  - Understand the protocols of the various servers
  - Ensure server security
  - Consider the benefits of cloud-based/remote solutions to storage, hosting, etc. as opposed to locally-based solutions
- Install, configure, maintain and troubleshoot operating systems on library computers, including open source and mobile systems
- Install, configure, maintain and troubleshoot the library's public access computers
- Manage and maintain the library's collection of digital resources
  - Apply standards and best practices to ensure effective organization, access, preservation and delivery of digital content
  - Understand and apply appropriate descriptive, structural and administrative metadata schemas (e.g. Dublin Core Metadata Element Set, Visual Resources Association (VRA) Core Categories, Encoded Archival Description (EAD)) and standards for expressing and storing data about information resources
  - Demonstrate knowledge of multimedia file formats, tools and methods for digital file format conversion, including knowledge of support for these formats via Web browsers on different platforms
  - Possess a working knowledge of best practices, industry standards and services for digitizing text, image, audio and video media
  - Demonstrate knowledge of content management and preservation systems, including open source content management software applications (e.g. Islandora)
  - Contribute to and apply library policies relating to digital resource holdings in areas such as collection of digital resources, digital preservation, rights management, emergency/disaster preparedness and recovery plans, etc.
  - Work in collaboration with institutional content enterprise systems, Web services, e-resource management, etc.
    - Demonstrate a working knowledge of programming languages (and related standards and protocols) relevant to digital resources
      - Extensible Markup Language (XML), Extensible Stylesheet Language Transformations (XSLT) and XML Schema
      - XML-based application programming interfaces (APIs) for integrating systems and services
      - Web-based publishing tools and coding
      - Unix and relational database systems
      - Dublin Core, METS (Metadata Encoding and Transmission Standard) and OAI-PMH (Open Archives Initiative—Protocol for Metadata Harvesting)
      - System monitoring, testing and debugging
      - Semantic Web concepts (e.g. Linked Data)
      - Scripting languages (e.g. Python, Ruby, Perl) for processing textual data and managing system resources

(*Continued*)

- Develop interface services for integrated access to the library's digital resources
  - Drive the integration of discovery and delivery interface systems with the library services platform and other library digital information resources
  - Drive the integration of library digital resources with other systems in use in the university e.g. institutional website, learning management system (LMS), geospatial information system (GIS), etc.
- Demonstrate efforts to strengthen the library's digital resource systems and services
  - Manage a digital asset management infrastructure that supports access to digital content
  - Select and implement systems that are standards-based and that interoperate with the library's existing bibliographic systems as well as with emerging digital storage products and services e.g. cloud-based digital storage
  - Engage in ongoing re-designing of user interfaces based on the generation of objective data for evaluation purposes
  - Remain abreast of new developments in digital library systems and services (e.g. in metadata management, repository software, harvesting protocols, cloud hosted digital services, etc.)

- Evaluate, select, adapt and integrate social media, collaborative and mobile technologies and applications into the library's technology planning program.

- teaching and training skills (including instructional design, methods, and technologies, as well as learning theories, learning styles, and assessment methods); and
- website development and content management.

An interesting observation is that most of these competencies too are technology-oriented, again pointing to the extension of traditional LIS services into new areas of service delivery ("fractal distinctions in time" resulting from technology use), as well as "interstitial" encroachment into other disciplinary spaces (for example, pedagogy [teaching and learning] and publishing).

Epistemological implications for future LIS education

Both case studies offer empirical evidence, through the heuristic use of two core principles of Abbott's (2001) Chaos of Discipline theory, of the LIS discipline's interdisciplinary nature as well as its capacity for the reconceptualization of traditional knowledge and skills areas in new technology-oriented forms. In a context of evolving global LIS competency requirements resulting from a rapidly changing digital information environment, evident in the literature reviewed as well as in the two case studies presented, this inherent nature of the LIS discipline presents epistemological opportunities to reposition the LIS discipline in an extended disciplinary space. As mentioned earlier, this repositioning has implications for future LIS education, which would need to embrace this

disciplinary extension in its curriculum content and delivery. Some of this might have begun in LIS schools already, albeit in an ad hoc manner. Curriculum design and planning need to be taken forward by LIS schools in a more structured manner and in direct response to the nature of the LIS discipline as framed by the Chaos of Disciplines theory (Abbott, 2001). This response should also be cognizant of the epistemological opportunity that the inherent nature of the discipline offers for LIS scholars and educators to stake an intellectual claim on a technology-driven extension of the LIS disciplinary domain. I have made this point elsewhere (Raju, 2017a, p. 754), and once again I caution that if this is not done, then other "interstitially"-oriented and better-established disciplines are likely to move into the LIS domain to fulfill this function.

Conclusion and recommendation

This epistemological overview was located in a context of evolving competency requirements for a global digital information environment. It used Andrew Abbott's (2001) Chaos of Disciplines theory as an epistemological lens to demonstrate the LIS discipline's "interstitial" nature and its propensity for "fractal distinctions in time," both of which could be used to positively to influence a repositioning of the LIS discipline in a broadened disciplinary space. Future LIS education and its scholars and academics have a critical role to play in this repositioning as a broadened LIS disciplinary space would need to reflect itself in the competency requirements for this technology-driven disciplinary extension, which in turn would need to be pedagogically embedded in LIS curriculum design and development.

Hence future research in LIS education will need to address research questions on how LIS-related IT (evident in the case studies presented in this paper) is to be embedded in a curriculum located firmly within LIS epistemology, thus demonstrating an intellectual claim on the extended disciplinary space which may be seen as a natural evolution of the LIS discipline in response to a highly digitized global information environment. I have indicated elsewhere (Raju, 2017a, p. 755) that while it is useful to work with cognate partners from information technology, information systems, and computer science, it is the LIS discipline that should assume hegemony in the stewardship of this technology-driven extension of traditional LIS disciplinary space. After all, the basis for the disciplinary claim to this extended space is the principle that "competencies [and tools in a profession] may change, but the intent remains the same" (Gutsche, 2010, p. 30). The LIS discipline has traditionally been the steward of information/knowledge—it is only the medium or carrier of the content that has changed.

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