Chapter 4

Professional Education for a Digital World

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Introduction

Professional education for library and information work is subject to the same social, technological, economic and political forces as other university activities. Key drivers and trends in higher education in the 21st century include the internationalisation of educational programmes, as institutions compete in the global marketplace; growth in postgraduate provision, as individuals seek a competitive edge in the job market; development of interdisciplinary programmes, as new specialisms emerge at the boundaries of established professions; demand for flexible delivery, as workers need or want to combine study with employment; and the impact of information and communication technologies on both curriculum content and delivery modes. The digital environment has influenced programme and module content, the learning and research resources available to students and the methods of interaction and delivery for both on-campus and distance learners. National education and skills policies have also affected academic provision, reinforcing the importance of employability, connecting education to the workplace and promoting the need for lifelong learning. This chapter reviews developments in initial professional education in relation to practice in university libraries, with particular reference to the impact of technology on content and delivery.

Professional Education in the Information Society

Education for librarianship has evolved in response to changes in professional thinking and practice, employment patterns and market demand, as well as being subject to the requirements of academic institutions, professional bodies and government agencies responsible for quality assurance and assessment. Within the UK, the two key professional and academic reference points are the Body of Professional Knowledge (BPK) published by the Chartered Institute of Library and Information Professionals (CILIP 2004) and the subject benchmark statement for Librarianship and Information Management (LIM) published by the Quality Assurance Agency for Higher Education (QAA 2007). Both documents indicate the specialised subject knowledge and understanding that programmes in the field are expected to cover, along with more generic skillsets that are also important, though not unique, to the discipline. The CILIP BPK is central to the professional accreditation of educational programmes and thus potentially a significant influence on course content. The QAA benchmark is also intended to guide academic institutions in the design of their courses, but in addition is seen as potentially relevant to prospective students and employers. (The current benchmark formally covers only bachelor's degrees, but in practice also serves as the reference point for master's programmes; the academic community plans to produce a master's statement in 2010–11.)

Although the presentation styles of the CILIP (2004) and QAA (2007) statements are quite different, their interpretations of the domain are broadly similar. Both statements were developed with input from practitioners and academics, but their value as a current delineation of the nature and extent of the discipline is limited because they provide only high-level descriptions of the subject field. However, some indication of how the field has developed is shown by the fact that information literacy is more prominent in both statements than in the equivalent previous documents produced by both organisations; for example, the previous benchmark statement contained only a bullet point related to the need for information skills and information literacy, whereas the current statement uses the term as the heading for a section containing three points on the subject (QAA 2000; QAA 2007). The main headings used for the subject-specific knowledge and understanding and the generic skills and abilities sections of the QAA (2007) benchmark statement are shown in Table 4.1.

Other political, economic and social factors have been instrumental in the shift that has been evident as a global phenomenon over the past four decades from professionally-accredited courses in librarianship/library science provided by 'library schools' to a situation where such courses represent only a small minority among a multiplicity of other programme titles that are now typically offered by schools based on broader groupings of academic/professional disciplines, usually with 'information' in their collective title, although other disciplinary links are also evident (notably with business schools in UK universities). Within the UK, the most common library-related degrees now are the MSc in Information and Library

Table 4.1 Subject knowledge and generic skills for library and information management

Subject knowledge and understanding	Skills
• Information resources and collection management • Information retrieval and knowledge organisation • Information literacy and user support • Information services and intermediary roles • Information agencies and professional institutions • Information environment and policy context	• Knowledge acquisition and study • Management and organisational behaviour • Communication and interpersonal skills • Information and communications technology

Management and MSc in Information and Library Studies, followed by the MA in Library and Information Management or Studies; only two universities (Sheffield and City University London), offer specific Masters in Librarianship or Library Science. In the US, a higher proportion (around one-third) of professionally-accredited programmes have retained the Library Science title, but the most common degree is Library and Information Science (LIS). However, the more significant point is that in many cases the majority of programmes offered by the school where LIS is taught may not be accredited by a library association or equivalent body.

The iSchools movement is the latest manifestation of this trend towards expanding the disciplinary field and has typically extended subject groupings beyond library/information management and information systems/technology to computer science. The formal iSchools organisation was founded in 2005 by 'a collective of Information Schools dedicated to advancing the information field in the 21st Century'.[1] Its website explains that these schools and departments 'have been newly created or are evolving from programs formerly focused on specific tracks such as information technology, library science, informatics, and information science' and that they 'share a fundamental interest in the relationships between information, people, and technology'. Originally a US-based association, the membership of 27 now includes a few institutions in Europe (for example, the University of Sheffield) and Asia. Key membership criteria include a substantial track record in sponsored research and an active doctoral programme. LIS programmes are thus now offered alongside Masters in Information Management and/or Information Systems, in addition to more specialised variants typically offered in collaboration with other schools, such as Sheffield's MA in Multilingual Information Management and the dual Law (Doctor of Jurisprudence) and Master of Library Science (MLS-JD) at Indiana University Bloomington.

1 http://www.ischools.org/site/about/.

Some academic and professional commentators have viewed the emergence of iSchools and moves to define a new 'iField' as a threat to the library world, but others see these developments as a chance to re-brand and reposition a profession with a low profile and an image problem. In the United States, there has been a strange antipathy to the association of librarianship with information science, which pre-dates the arrival of the iSchools, typified by Gorman's (2004, p. 377) assertion:

> What we used to call library schools have, perforce, become hosts to information science and information studies faculty and curricula. These disciplines (if they exist at all) are, at best, peripheral to professional library work and, at worst, inimical to it.

However, examination of the activities and programmes of the iSchools reveals that despite the near-universal absence of the word 'library' from their names and the widely-publicised closure of a few well-known MLS degrees, most iSchools continue to offer library science degrees and to promote library education on their websites (Wallace 2009). While the iSchools do have an explicit interest in information technologies and their application, the movement is concerned to promote an interdisciplinary approach and the primary focus is on information, specifically on 'the uses and users of information', with 'a core commitment to concepts like universal access and user-centered organization of information'. A key issue here is the position of librarianship within the larger group: some library educators have expressed concern about forced alliances with other disciplines that have progressively led to librarianship becoming 'nothing more than a discipline stream, or even just a single course, within a school within a faculty' (Hallam and Calvert 2009, p. 292). This can restrict the scope for developing electives on library specialties, as reported by Middleton and Hallam (2001) in their review of the situation in Australia; however, it can also widen the choice of electives in other subjects that may be of interest and relevance to LIS students (e.g. modules with a focus on information systems or technology).

Connecting Professional Education with Library Practice

From a university library perspective, these developments in information schools generally parallel the movement within the information services sector that has brought many academic libraries closer to academic computing and information technology services, where cross-functional working and multi-professional teams in academic services correspond to the interdisciplinary interests and multi-disciplinary expertise that characterise contemporary information schools. The convergence of library, information technology, media and related services over the past two decades is well documented across multiple dimensions, including the formulation of integrated information strategies, evolution of new organisational

models, creation of technology-rich learning spaces, discussion of changing professional roles and investigation of extended hybrid skillsets (Abbott 2003; Allen and Wilson 1996; Bennett 2009; Corrall and Lester 1996; Hanson 2005). The landscape has continued to change as institutions experiment with different service configurations, notably in relation to supporting learners, with specialist tutors and educational developers becoming other likely partners, in addition to or instead of information technologists (McKnight 2010).

The skillset needed by academic librarians in contemporary digital learning environments also continues to expand, demanding a breadth and depth of knowledge beyond the requirements assumed in the early days of hybrid libraries. Several practitioners note the need to blend librarianship expertise with both technological and pedagogical competencies (Allen 2005; Biddiscombe 2002; Bell and Shank 2007). Other commentators confirm the continuing importance of partnerships with IT services in addition to the development of collaborations with other agencies such as university presses and research offices in relation to emergent library roles in publishing peer-reviewed work (journals and books) and managing research data (Hahn 2008; Lewis 2010). The blended skillsets identified for roles in research data management are particularly challenging, with domain expertise/subject knowledge highlighted in addition to library and information science expertise, more advanced technical skills, personal and managerial abilities (Gabridge 2009; Henty 2008).

The scale and pace of change in the library environment and beyond has presented challenges for library educators, who have been criticised for inadequate coverage of both established subjects and contemporary topics. Gorman (2004) argues that concentration on technology has resulted in topics regarded as central by employers, such as cataloguing, reference work and collection development no longer having a central place in LIS curricula, which is confirmed by Lynch (2008) in her US-based review of developments in professional education. The situation in the UK has moved in the same direction, with most schools teaching these subjects as part of more broadly-based modules, but specific modules on collection management and on cataloguing and classification are provided in around one-third of the relevant programmes. Owens and Leonhardt (2009, p. 551–2) note that interdisciplinarity and the perceived move away from established core subjects has meant more choice for students in North America:

> more electives and fewer required core courses that, along with an increased interdisciplinary approach to LIS education, allow students to tailor programs to suit their individual needs. Information technology and courses addressing the Web and the Internet were identified ... as new clusters of courses that are new to LIS curricula over the past ten years or so.

Similar trends are evident in the UK, with schools such as Sheffield continually expanding their range of modules, but some UK programmes offer few or no electives. Owens and Leonhardt (2009) also note the growth in distance delivery

(synchronous, asynchronous or hybrid) of LIS programmes, with the Web-based Information Science Education (WISE) consortium of 15 universities enabling schools that do not offer their own distance learning programmes to participate in collaborative distance education. WISE is US-led but includes members in Canada, Australia, New Zealand and the UK.[2]

While Lynch (2008) observes that the demotion of cataloguing has been especially hotly contested, inadequate coverage of information literacy has become the current focus for practitioner criticism, particularly in relation to the teaching roles of academic librarians (Dale et al. 2006; Peacock 2001; Walter 2006), a complaint that is repeated in this book. Information literacy is a key area of activity for university libraries that has expanded and diversified with the development of digital learning environments, with teaching now a large part of many liaison librarian jobs (Bewick and Corrall 2010). The current situation is not as unsatisfactory as the anecdotal evidence suggests. A recent survey in North America of ALA-accredited programmes reported 'great strides since the 1970s in acknowledging the importance of information literacy' and that '[elective] classes in information literacy instruction are common at most MLIS programs and had even increased since the last study' (Aproles et al. 2008, p. 207). Mbabu (2009) found 49 out of 57 (86%) programmes offered at least one course dedicated to instruction theory and practice. In the UK, the websites for CILIP-accredited Masters show a mixed picture and suggest that overall coverage is inferior to the US provision. Information literacy is listed among the topics covered by most institutions, but only three universities – Liverpool John Moores, Loughborough and Sheffield – provide core modules with information literacy in the title and only Sheffield offers electives enabling students to specialise in information literacy instruction as part of a generalist librarianship programme.

However, it is worth noting here the significant variation, not only in programme titles, but also in module titles and programme configurations among CILIP-accredited LIS courses, which makes it hard to compare offerings. In addition, the contents of academic programmes and their constituent modules are generally subject to a continuous process of review and renewal, with adjustments made annually to reflect research and developments in the field, as well as feedback and suggestions from students and employers. Such modifications are often not immediately apparent to external observers, if changes are made in the topics covered or delivery methods in ways that do not require amendment of formal unit descriptions, even though cumulatively such developments can amount to substantial change over time. For example, at Sheffield, we have altered the focus, content and delivery of our core module on 'Information resources and information literacy' incrementally over the past five years to such an extent that it is now radically different to what was offered before, but the title and description on our website have stayed the same. The module aims to develop an understanding of information literacy from both theoretical and practical perspectives, in addition

2 http://www.wiseeducation.org/.

to skills in searching for, evaluating and packaging information in response to a query from a client, but now also has a strong focus on preparing students for roles as information literacy educators. The following are examples of new elements:

- 'Search/teach task' – students work in pairs over four weeks to create a short instructional guide to using a specific aspect of a particular database. They also have to provide a list of links to recommended sources of information (guides, tutorials, evaluations) about the database and publish this using a Web 2.0 tool.
- Learning theories – in preparation for the search/teach task, a lecture session introduces students to theories about learning styles and principles of learning design. The session also provides guidelines on designing user documentation to support learning.
- Critical evaluation – following on from the production of their own database guide, students then have to evaluate one of the guides produced by their classmates.
- 'Practitioners' seminar' – students are given the opportunity to work on the development of their teaching skills in a half-day workshop with two expert practitioners. The workshop is modelled on events delivered to practitioners in the field and is currently led by the authors of a leading text on teaching information skills (Webb and Powis 2004).

At Sheffield, students keen to build on their learning from this core module, can take the elective module on 'Educational informatics', which provides more in-depth coverage of learning theories in the specific context of e-learning and different learning technologies. Practical exercises enable students to experiment with and evaluate technology applications for learning through the use of virtual environments, such as WebCT/Blackboard, Wimba, Second Life and wikis. Assessment tasks include working in small groups on the development of learning materials and evaluation of tools. Students can also take a seminar-based elective on 'Information literacy research', which considers research problems in information literacy and methods of investigating them. Seminars are led by members of the Centre for Information Literacy Research and researchers from other institutions (including academics and practitioner-researchers).

Generalist versus Specialist Programmes and Pathways

Middleton and Hallam (2001) note the tradition in LIS to offer generic education as preparation for both generalist and subject-specialist roles in library and information work, though they observe that the desirability of specialist provision has been debated among law librarians; it has also been discussed in the health sector (Petrinic and Urquhart 2007). While Middleton and Hallam (2001) see continuing value in broadly-based professional curricula, they recognise the need

for some specialised education, but report that in Australia the amalgamation of library schools with other subjects has reduced the opportunity for offering modules on library specialties. They suggest specialist education could be delivered through collaborative provision (e.g. a module developed by one institution being offered to students at another via distance learning) or pursued later as continuing professional development (CPD). Petrinic and Urquhart (2007, p. 174–5) similarly highlight the importance of structured CPD for health librarians, acknowledging that it is not realistic to expect all LIS departments to provide a health information module (though several do so), but suggest that curricula:

> should encourage students to appreciate the need for domain knowledge in their future career, and provide opportunities for developing some specialist subject knowledge, and relevant skills, in the dissertation, at least.

Sector-specific modules on academic libraries are common in the US, where student numbers are more likely to support specialised provision, but relatively rare in the UK and other countries. Recent research by Bailey (2010) revealed that three-quarters of ALA-accredited schools in the US offered courses in academic librarianship, but evidence from UK websites indicates that only Sheffield and the University of the West of England currently offer academic library electives. However, examination of the US syllabi showed that such courses typically include a mix of specialist subjects directly related to university libraries (such as the higher education sector, scholarly communication and academic library standards) and other topics of general relevance to librarians (such as collection management, budgeting/finance and human resources), presumably presented in an academic library context. In addition, Bailey (2010) notes that several topics identified as essential or important by academic librarians (e.g. information literacy, instruction/teaching and technology/Web 2.0) are more likely to be covered by other courses in their programmes, so even where specialist academic library courses exist, aspiring university librarians and their advisers need to look beyond these classes when assessing whether programmes will meet their particular needs.

Bailey (2010, p. 41) consequently argues that 'A single course in academic librarianship … cannot be expected to develop pedagogical or technological competency' and suggests that schools could improve the advice on course selection (module choice) offered to students aspiring to work in academic libraries, and 'Perhaps … should create an academic track with prescribed courses'. However, the increasingly specialist nature of professional work in university libraries arguably requires identification of not just one, but several different specialised academic library tracks or potential pathways through generalist programmes, to help students select the most suitable configuration of units from the wide range of electives now offered by many schools, particularly those within the more broadly-based iSchools community, whose portfolios typically include modules designed for information managers and information systems professionals that may appeal to more technically-oriented university librarians. In the UK, the

iSchool at Sheffield has recently defined specialised pathways through its MA Librarianship programme for aspiring information literacy educators and digital library managers.

Table 4.2 shows how students at Sheffield can opt for either a generalist academic library education, by combining the academic libraries module with a varied mix of materials-based, subject-specific or technology-related electives, or a specialised academic library pathway, by selecting from designated clusters of modules. Students wanting to specialise in information literacy education can choose two electives from 'Information literacy research', 'Educational informatics' and 'Information storage and retrieval research' to build on the introductions to these subjects provided in their core modules (which must also include one sector-specific module, covering services in academic libraries, in public libraries or to young people). Similarly, students wanting to specialise in digital library management can select their two optional modules from two other clusters, offering different blends of content related to information, systems and technology.

The emergence of whole programmes for new entrants or established practitioners wanting a specialised education in these and other areas is one of the significant developments of the past decade. Specialist offerings of potential interest to university librarians include programmes based solely in information schools or equivalents, such as University College London's MA in Electronic Communication and Publishing, and Sheffield's MA in Information Literacy and MSc in Electronic and Digital Library Management, in addition to degrees offered jointly with other departments, such as Sheffield's MSc in Health Informatics (in partnership with the School of Health and Related Research), MSc in Information Systems Management (with the Management School) and MSc in Information Systems (with the Department of Computer Science) and City University London's MSc in Electronic Publishing (a partnership between the Department of Information Science and Department of Journalism) and MSc in Information, Communication and Society (a partnership between the Department of Sociology and Department of Information Science). Dual degrees with business and law schools are a common example of this phenomenon in North America (Owens and Leonhardt 2009).

Educating Professionals for Digital Library Environments

Technological impacts on collections, services, roles and skills dominate the top ten trends in academic libraries identified by the Association of College and Research Libraries (ACRL 2010). Technology has similarly pervaded LIS curricula. Traditional topics such as collection development and reference services are now taught in the context of electronic resources and digital delivery. At Sheffield, the module on information retrieval taken by Librarianship and Information Management students now has the sub-title 'Search engines and

Table 4.2 Generalist and specialist academic library pathways

Core modules (semesters 1 and 2)	**Optional activities (semesters 1 and 2)**
• Libraries, information and society 1 • Information resources and information literacy • Information retrieval: search engines and digital libraries • Libraries, information and society 2: Academic and research libraries • Management for library and information services (double-length module) • Research methods • Dissertation	• Library visits: □ Research-led university library □ Teaching-led university library • Information literacy practitioners seminar • UKSG serials roadshow • CILIP student conference • Essential professional skills • Essential computing skills

Academic Librarian Generalist Programme (semester 2: two electives from any area)				
• Business intelligence • E-business and e-commerce • Legal information resource management • Independent study	• Archives and records management • E-government information • Healthcare information • Independent study	• Information literacy research • Educational informatics • Information storage and retrieval research	• Digital multimedia libraries • Educational informatics • Information storage and retrieval research	• Content management systems • Database design • Human computer interaction and user interface design
		Information Literacy Educator	Digital Library Manager	
		Academic Librarian Specialised Pathways (two electives from selected specialty)		

digital libraries', showing how digital environments have given new meanings to the term 'library', which extend beyond traditional settings. Managing information systems and technology now occupies two sessions of the core management module in Sheffield's MA Librarianship programme and several new technology-based electives have also been offered to librarianship students in recent years (e.g. Content Management Systems, Digital Multimedia Libraries and Educational Informatics). Many librarianship students are choosing technology-related topics for their dissertations; recent examples at Sheffield include virtual reference services, next-generation library catalogues, institutional repositories, RFID technology, digital video archives and image retrieval. Owens and Leonhardt (2009) comment on new clusters of courses related to the Internet and the Web emerging in the past decade, and Ray (2009, p. 358) notes that 'Many LIS schools have or are developing tracks in digital libraries, archives, digital curation, and museum informatics' to meet the need for 'digitally savvy information professionals'.

However, commentators have criticised the treatment of digital library topics in LIS programmes. Varalakshmi (2009) analysed digital library course content of master-degree programmes in India, reporting that all the departments studied included basic aspects of digital libraries, both theoretical and practical, in the core curriculum, but the course components were rudimentary in nature, needing further expansion to gain the required depth of knowledge and skills in the particular areas of specialisation. He concludes with a detailed specification of recommended elements for both core and advanced elective units to give graduates the competence and confidence to handle the digital environments of the new millennium. Dahlström and Doracic (2009) discuss provision of digitisation education in Scandinavian programmes, noting limited coverage, mainly as elective modules, with many courses covering digitisation as part of a larger topic (e.g. electronic publishing) and more emphasis on theory than hands-on practice. Sheffield's innovative module on Digital Multimedia Libraries has been designed to meet the identified need for practical experiential learning; it is a core unit for the specialist MSc in Electronic and Digital Library Management, but is also offered as an elective for the MA in Librarianship and available as a standalone one-week CPD course. Other writers, such as Choi and Rasmussen (2006), argue that professional education for digital librarians should place more emphasis on management (especially project management) and interpersonal skills (particularly teamwork and communication) in preparing students for digital library roles.

There is a continuing debate on the specialist requirements of digital library environments, including the question of whether a library or computer/IT background is better preparation for jobs in libraries with a systems/technology focus, in addition to the issue of coverage in core and elective modules of LIS curricula. In the UK, provision has generally developed incrementally, with new topics and modules introduced into existing portfolios as needs and opportunities arise, but with a few new programmes also emerging through such a process. In the US, national funding has facilitated the development of specialist courses to meet emerging needs. The National Science Foundation supported the development of

model curricula related to digital libraries through a collaborative project involving two institutions, and the Institute of Museum and Library Studies has funded projects to develop new courses and programmes in digital curation at several universities (Ray 2009). Thus, the University of Illinois at Urbana-Champaign[3] has developed a new Data Curation Education Program (DCEP) as a specialisation (a formal pathway) within its existing LIS Master of Science that offers:

> a focus on data collection and management, knowledge representation, digital preservation and archiving, data standards, and policy, providing the theory and skills necessary to work directly with academic and industry researchers who need data curation expertise.

DCEP includes specialist core units on 'Foundations of data curation' and 'Digital preservation', alongside existing units with an information systems/technology focus designated as core and elective courses. It is also available as an online distance learning programme and additional units are planned, including courses on humanities data curation. In addition, the University of North Carolina at Chapel Hill has revised one existing module and developed two new units to offer a postgraduate Certificate of Digital Curation that can be awarded in conjunction with its existing Masters in Library or Information Science on completion of additional credits for three digital curation-related courses (to be available from 2010–11).

Roles and Preparation for Data Management

US educational innovation for the digital environment has taken place alongside significant service development in US university libraries, evidenced by Gold's (2007) discussion of the current state of data librarianship and Walters' (2009) reference to several US academic libraries that 'have taken entrepreneurial steps to extend beyond their traditional digital assets and include managing scientific and scholarly research data' to become 'digital information management centers'. A need for more specialist education in data curation has also been identified in Australia and the UK, where the role of university libraries in managing research data has been debated in relation to e-research developments (Henty 2008; Lewis 2010; Swan and Brown 2008), although there are fewer current examples of data librarianship at present. Provision in UK LIS curricula is similarly limited, but Loughborough's MA/MSc in Information and Library Management includes an elective on digital curation and the University of Glasgow[4] offers a specialised programme in MSc in Information Management and Preservation (Digital) that

3 http://cirss.lis.illinois.edu/CollMeta/dcep/imlsSci.htm.
4 http://www.hatii.arts.gla.ac.uk/imp/page5.htm.

aims to equip students 'to work as archivists, records managers, and digital curators'.

Most commentators recognise that libraries have a role in facilitating access to data sets as an important part of the research knowledge base, but there is less certainty about exactly what it should be. Hey and Hey (2006, p. 526) note that many scientific fields have national repositories for research data, but suggest that university libraries may need to assist in managing smaller datasets generated by research groups or individuals, concluding that 'the e-Science revolution will put libraries and repositories center stage in the development of the next generation research infrastructure'. Swan and Brown (2008) agree that e-research offers strategic opportunities for university libraries, suggesting potential roles in raising data awareness among researchers, providing data archiving and preservation services through institutional repositories and developing data librarianship as a new strand of professional practice. However, Gold (2007) offers a counter-argument, highlighting the issue that domain expertise is sometimes seen as 'essential' for effective working with researchers and also important in providing 'credible expert help with data management problems or tools'. She notes the argument that

> it makes much more sense to train domain experts in data management and curation skills than it does to try to teach nonscientist librarians to understand the infrastructure and service needs of a domain.

The literature identifies several distinct but overlapping roles in the research data arena, with different and inconsistent labels, for example: data creators/authors, data scientists/specialists, data curators/custodians/managers/stewards, data librarians/archivists and data users/re-users. These roles can be undertaken by practitioners from various backgrounds, including researchers, computer scientists, information technologists, information scientists and librarians (Swan and Brown 2008). Lewis (2010) notes that the field of research data management suffers from the terminological problems that often beset an emerging area of practice. The many continual, sequential and occasional action stages identified in the Digital Curation Centre's Curation Lifecycle Model (Higgins 2008; Lewis 2010) illustrate the pluralism and complexity of the field. Yakel (2007) discusses and dissects the concept of digital curation, noting different treatments of the concept in seminal reports and the different aspects emphasised in published definitions, highlighting their dual focus on active intervention and future usage. She concludes that digital curation has become an umbrella term for several related concepts, namely digital preservation, data curation, electronic records and digital asset management.

Writing from a UK perspective, Lewis (2010) discusses the need to resolve what exactly should be done locally, nationally and internationally to manage research data, but suggests nine strategic and operational areas where libraries should get involved, mostly working in partnership with other campus agencies, such as IT services and research offices. His pyramid of responsibilities includes:

raising awareness of data management issues among both the library workforce and research community, providing advice, training and education on data matters for researchers, postgraduates and undergraduates, developing both technical capacity (e.g. storage facilities) and professional capability (i.e. library competence) in data curation, and formulating or shaping policy at local (university) and national levels. In the US, practitioners who have gained experience in this area acknowledge the specialist technical skills needed, but also comment on the relevance and applicability of traditional library competence in areas such as metadata, collections, liaison, reference and instruction (Gabridge 2009; Witt 2008). Choudhury (2008, p. 217, 218) suggests that 'new roles of "data scientist" or "data humanist" … may represent the future of subject librarianship', while arguing that 'Scientific datasets may be thought of as the "special collections" of the digital age'.

While some sources suggest the need for a new category of digital data management or data curation professionals as a defined career path, others, including many of those working in the field, see the required roles as an extension of traditional curatorial work and argue that the need instead is to train and educate professionals at different career stages and from various backgrounds to work in digital or data curation (Yakel 2007; Hank and Davidson 2009). Reports from the US, UK and Australia all point to significant skills gaps and shortages in the field (Yakel 2007; Swan and Brown 2008; Henty 2008). Most sources emphasise the importance of specialist technical skills and sufficient disciplinary knowledge, but many also highlight non-technical skills and personal qualities as equally critical, in addition to LIS expertise, including knowledge of copyright and intellectual property issues, as well as traditional activities such as selection and the reference interview, re-purposed as a 'data interview' (Henty 2008; Gabridge 2009; Garritano and Carlson 2009; Witt and Carlson 2007). Gabridge (2009, p. 18–19) summarises the multi-faceted skillset needed for the new role of 'data liaison':

> The highly self-motivated liaisons who want to work in this realm will need to have very strong analytical, project management, and problem solving skills, as well as the ability to work independently at the intersection of digital data, technology, and metadata. These core skills are the base on which training in digital preservation concepts, data modeling, data standards, policy, and data collection and management can be added to round out a data liaison's preparation.

Experience from the field thus suggests that library competencies provide a good foundation for data management, but they need to be combined with additional technical competencies.

Despite the numerous reports and case studies published recently, there is no consensus on the preferred strategy to close the data skills and knowledge gaps identified. Progress has been hindered by the range of different players potentially needing training and education, shortage of funding in the UK for curriculum

development and programme participation, and uncertainty about who should take the lead in moving things forward. However, there are parallels here with information literacy, which similarly required multi-faceted provision for diverse audiences, including general education for undergraduates, advanced training for postgraduates, specialised curricula for LIS students (including differentiated pathways for mainstream and specialist career tracks) and professional development for experienced practitioners (including different lengths, levels and modes of programmes for different roles and backgrounds). A mixed economy of CPD via short courses, summer schools and extended programmes, combined with specialist credit-bearing modules offered individually and as designated pathways or programmes, complemented with the extension of information literacy education to cover data literacy could be the way forward, with LIS schools collaborating rather than competing with each other and the wider community.

Conclusion

Professional education for library work has generally moved away from vocational programmes on librarianship or library science to degrees including information in their title, provided by schools with broader portfolios covering information technology and/or business. Both educators and practitioners have raised concerns about the position of library education in large schools and the implications for curriculum development, but collocation with information systems and/or management education offers opportunities to extend module choice for library students, particularly in relation to the technical skills and understanding needed for digital library environments. Some practitioners have criticised reduced coverage of traditional topics such as cataloguing, reference work and collection management, while others want more provision for contemporary concerns such as information literacy, teaching and digital curation. Specialised courses in academic librarianship are common in the US, but offered by only a few schools in the UK, though subjects related to academic libraries may be covered in other modules. Many schools have introduced new electives on technology-related topics and a few have introduced whole programmes with a digital library focus, but commentators continue to debate the need to improve professional education in librarianship for the digital world, especially in digital libraries and data curation, which has been facilitated in the US by national funding.

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